



# Router

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# Routers

## Lesson 1

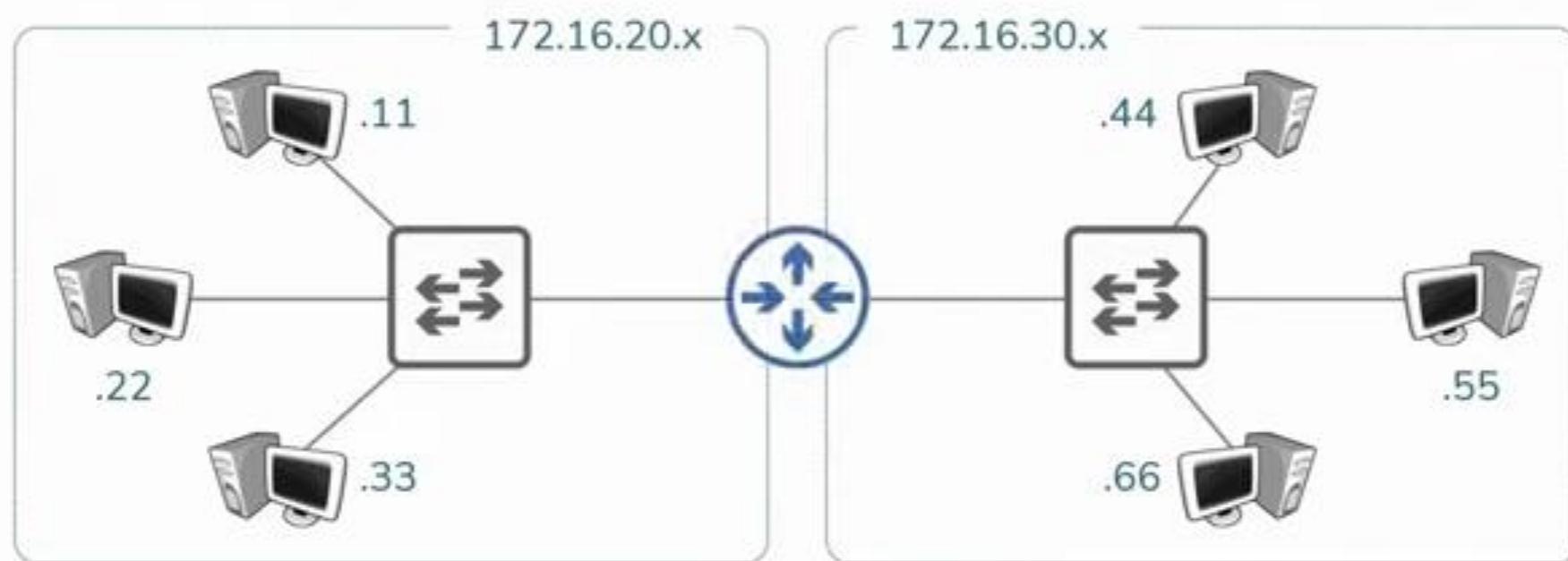
- **Network** – logical grouping of hosts



# Routers

## Lesson 1

- **Network** – logical grouping of hosts
- **Routing** is the process of **moving data between networks**
  - A **Router** is a device whose primary purpose is Routing



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Lesson 2

- **OSI Model** and interaction between L2 and L3



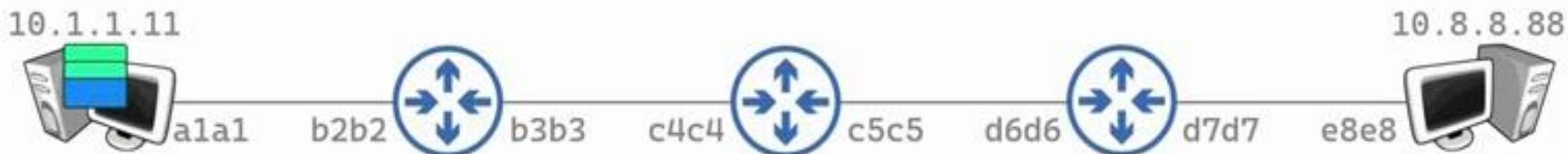
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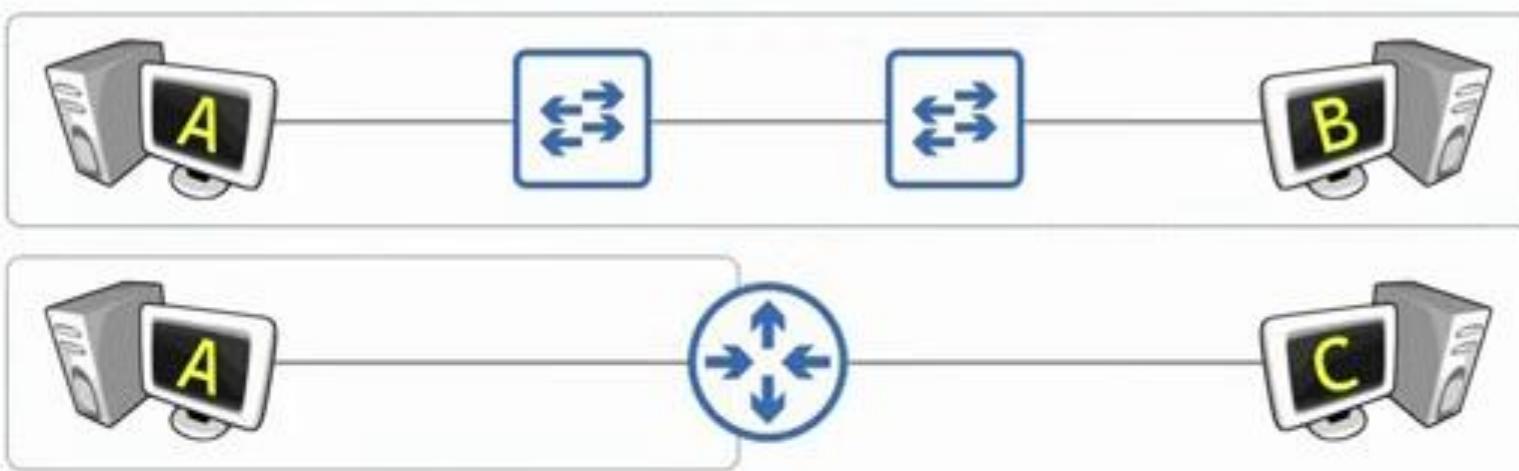
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- **Everything Hosts do** when speaking to other hosts



Hosts communicating  
to another host  
in the *same* network

Hosts communicating  
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- **Everything Hosts do** when speaking to other hosts
- **ARP** – Address Resolution Protocol

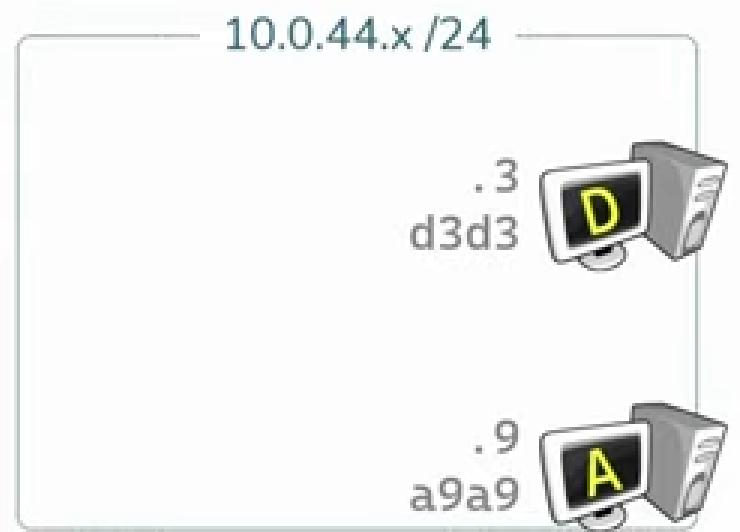


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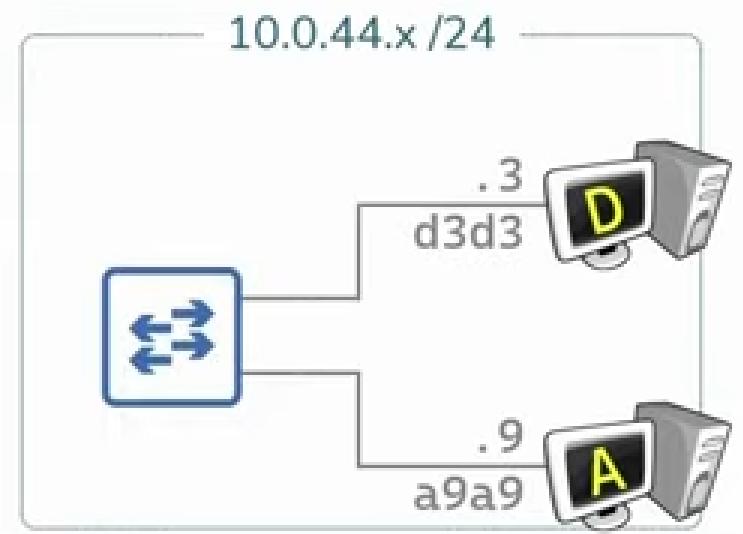


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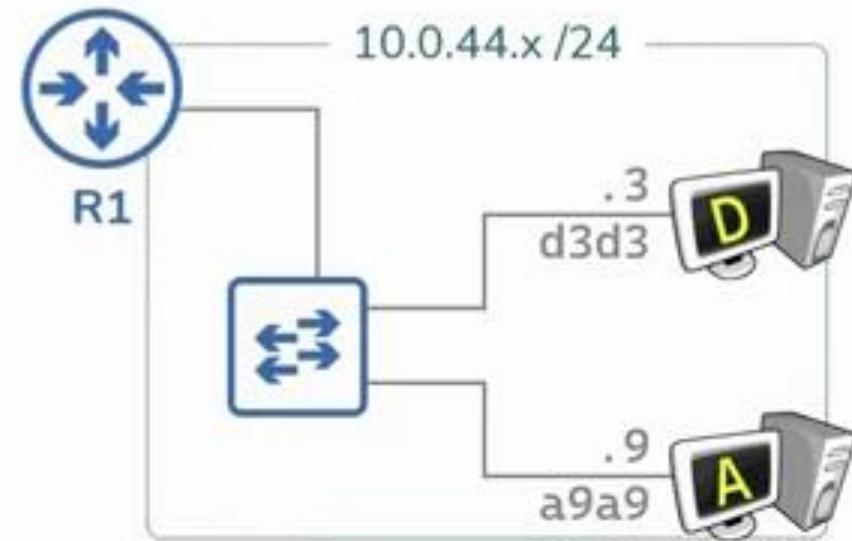


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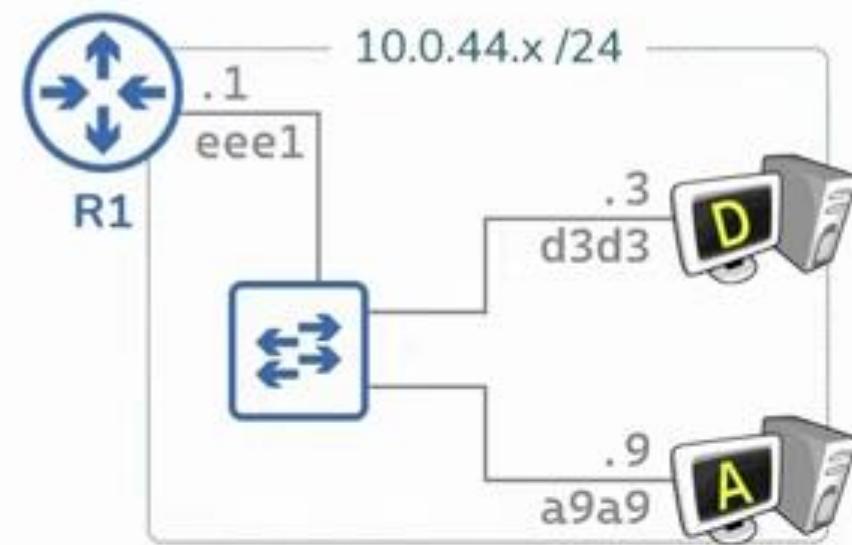
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- Routers are connected to a network



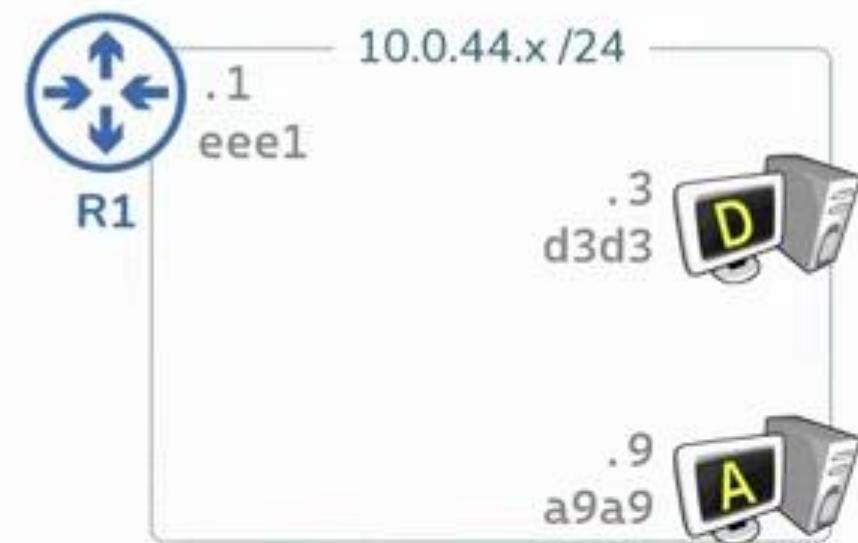
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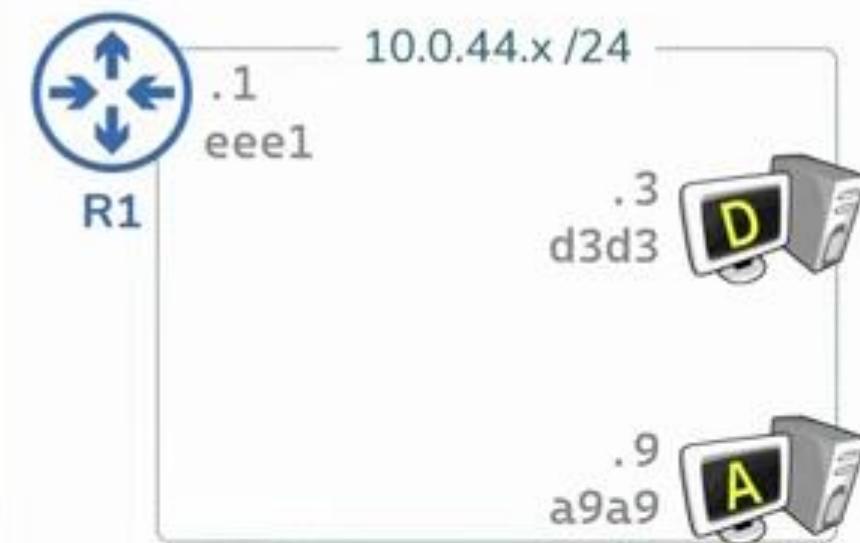


# Routers

- Routers are connected to a network (just like hosts)
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RFC 2460:

Internet Protocol, Version 6 (IPv6)  
Specification



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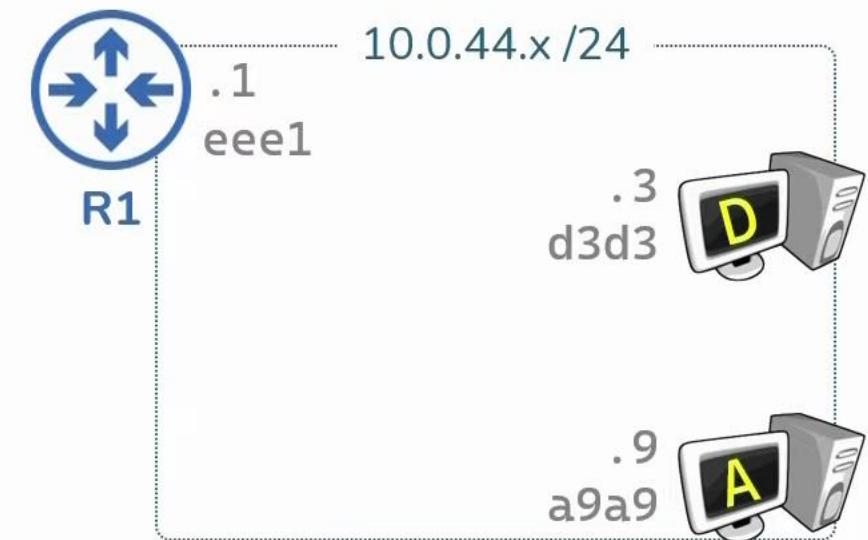
...

## 2. Terminology

**node** – a device that implements IPv6.

**router** – a node that forwards IPv6 packets  
not explicitly addressed to itself.

**host** – any node that is not a router.



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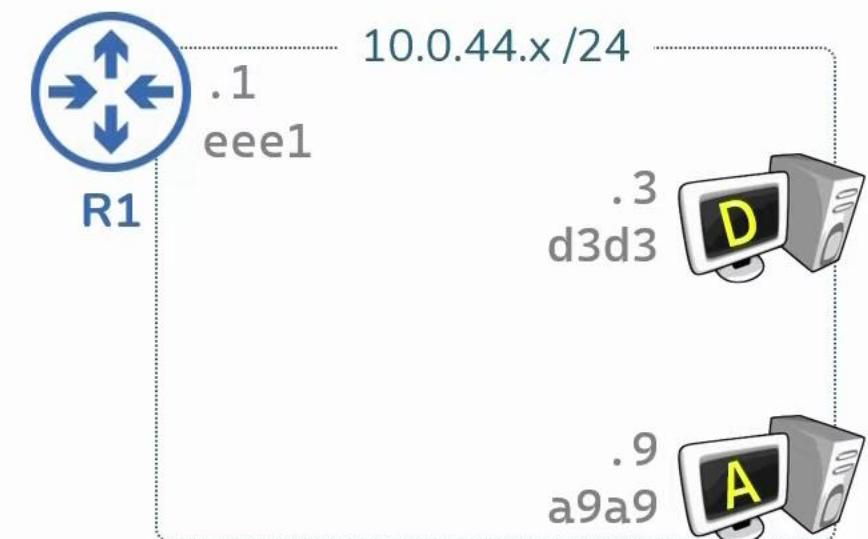
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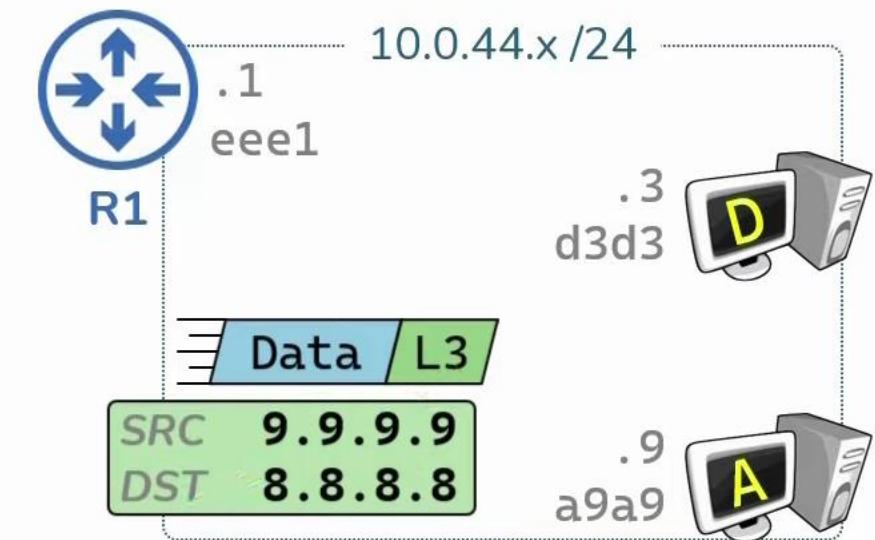
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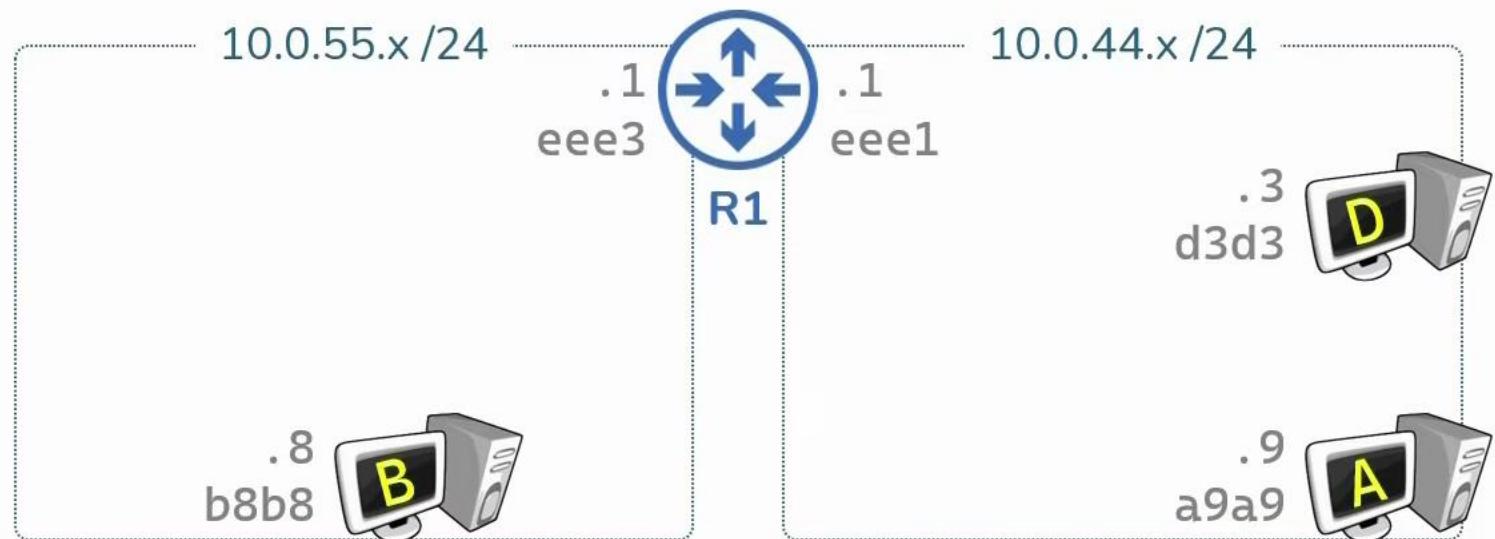
# Routers

- Routers are connected to a network (*just like hosts*)
  - Routers have an IP address and a MAC address **on each Interface**
- Routers forward packets not destined to themselves (*unlike hosts*)
- Routers maintain a map of all the Networks they know about
  - **Routing Table**

## R1 – Routing Table

For destination 10.0.55.x ...  
– Send packet via **Left** interface

For destination 10.0.44.x ...  
– Send packet via **Right** interface



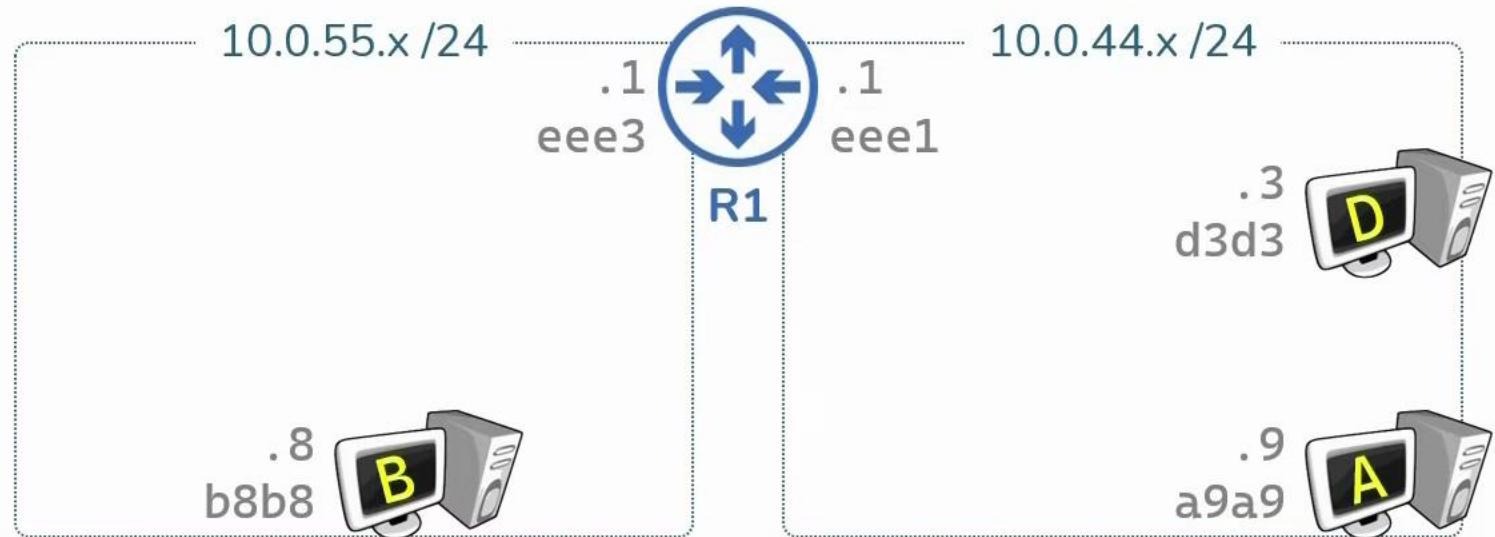
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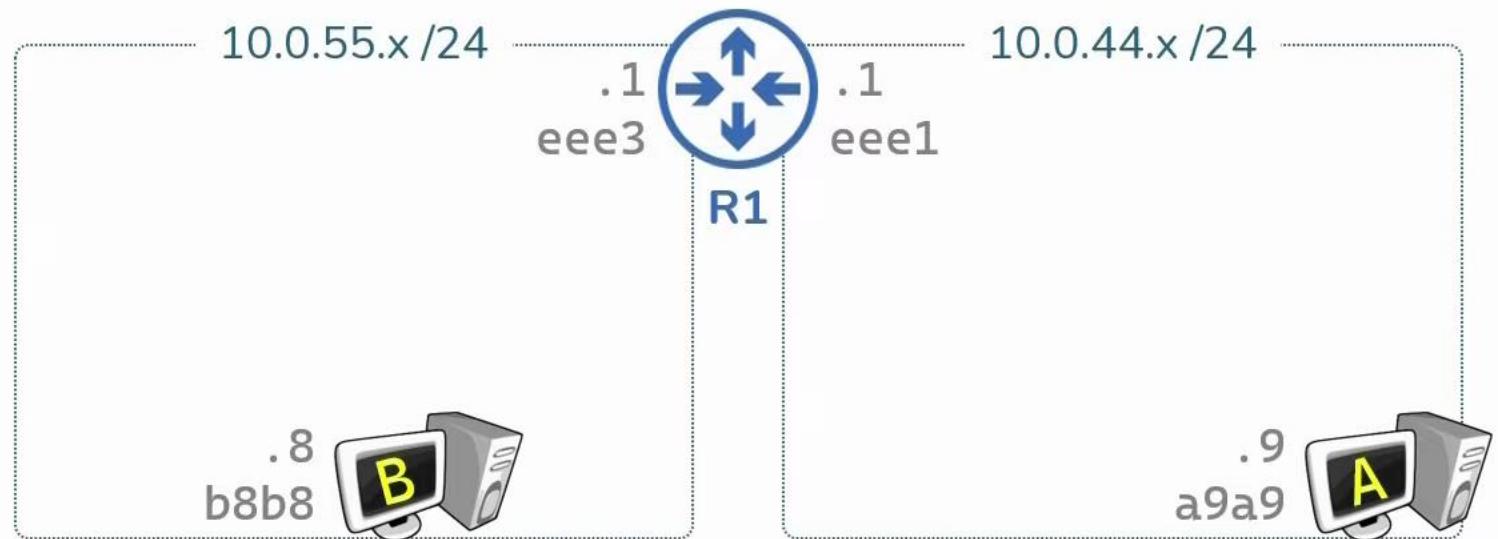
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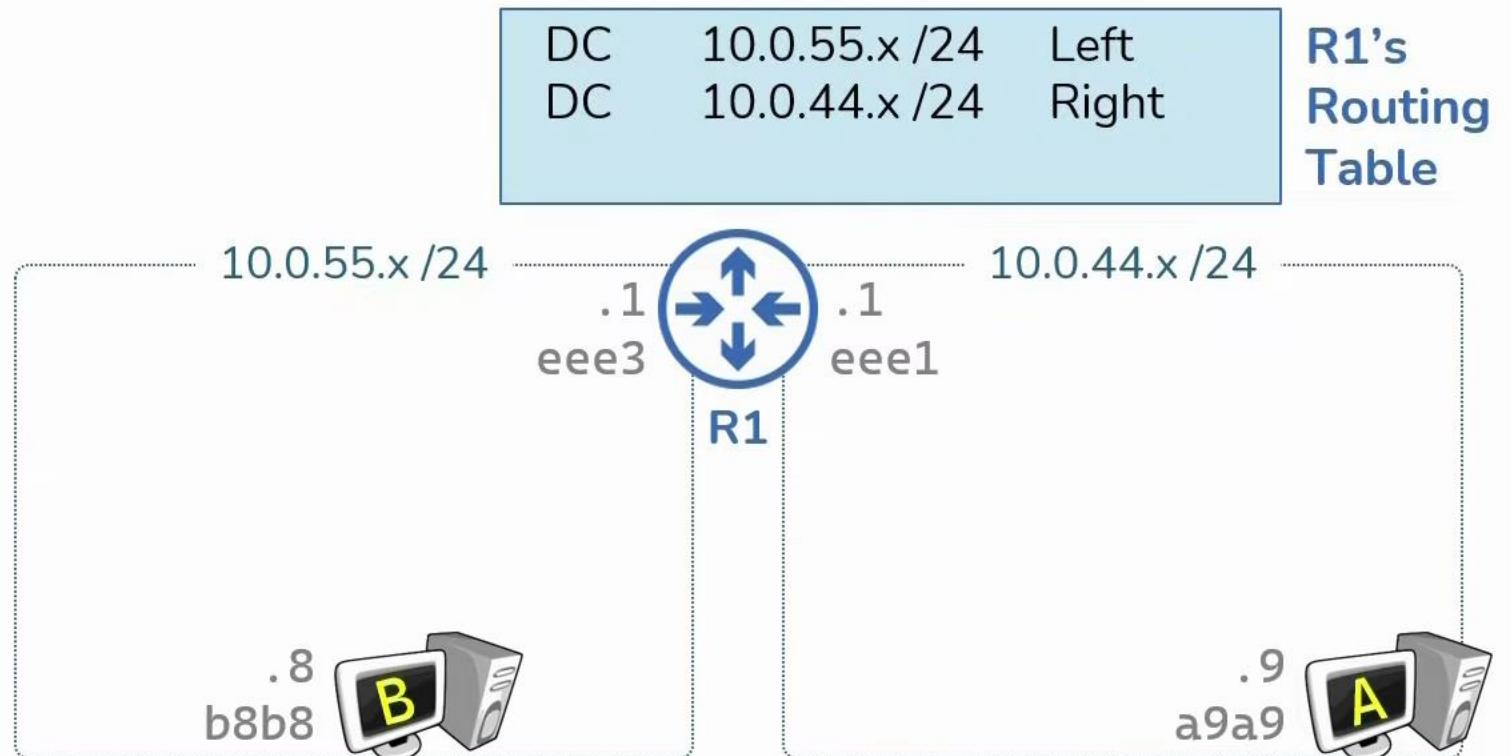
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- Routing Table can be populated via **three** methods:
  - Directly Connected – Routes for the Networks which are attached



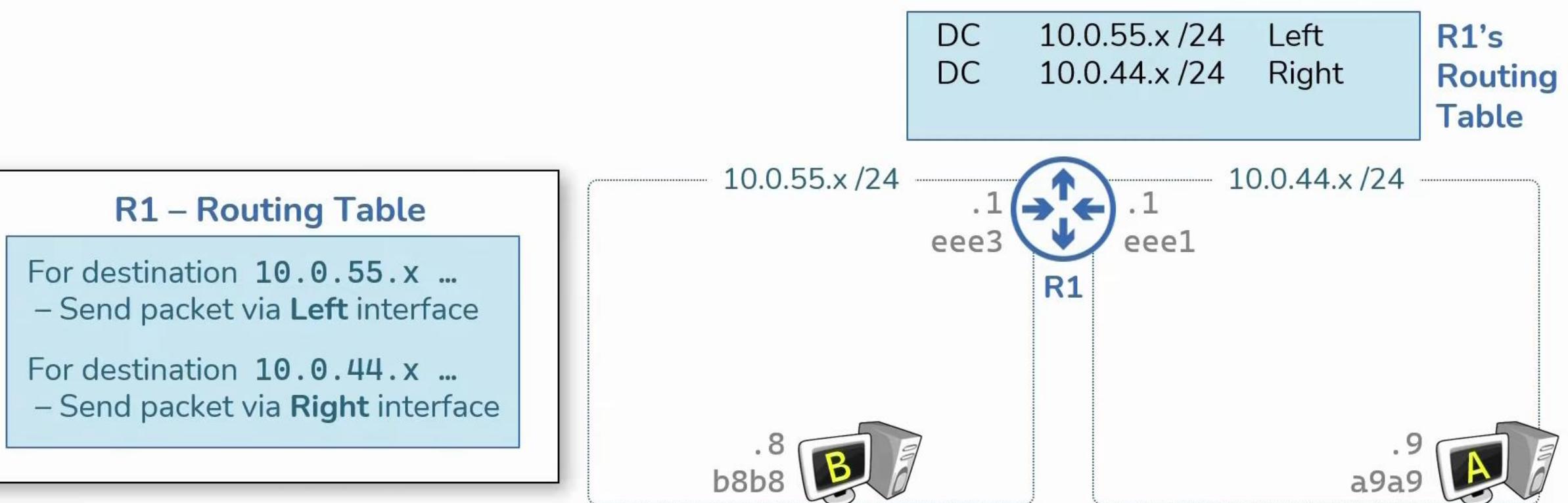
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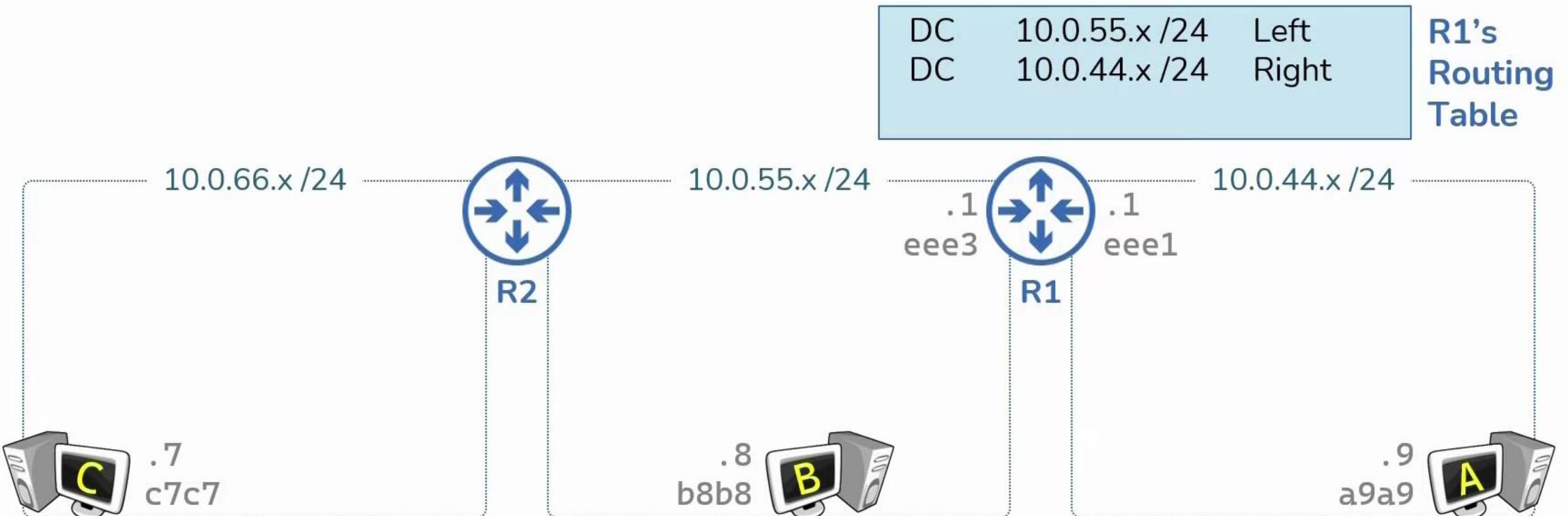
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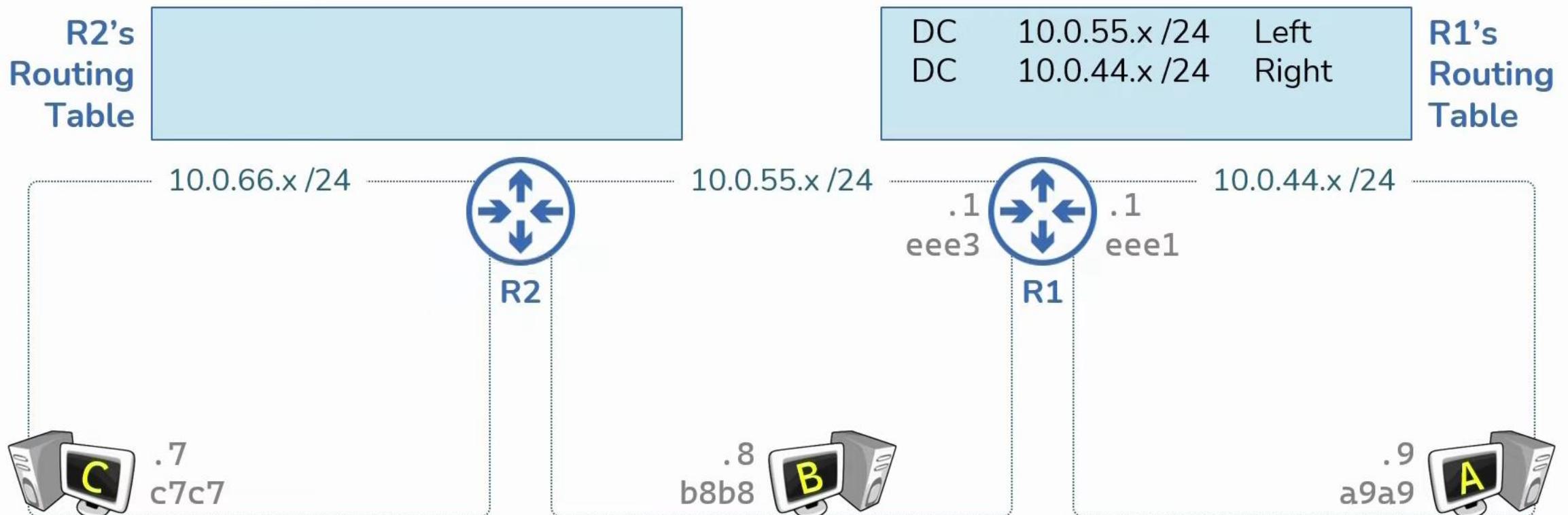
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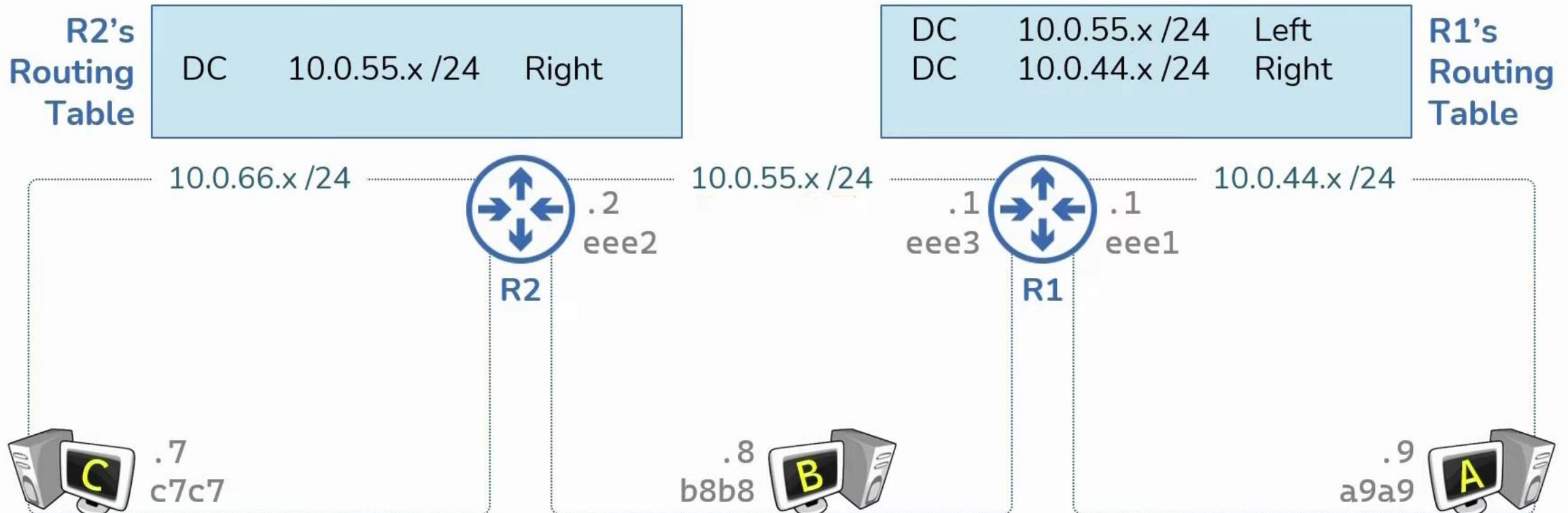
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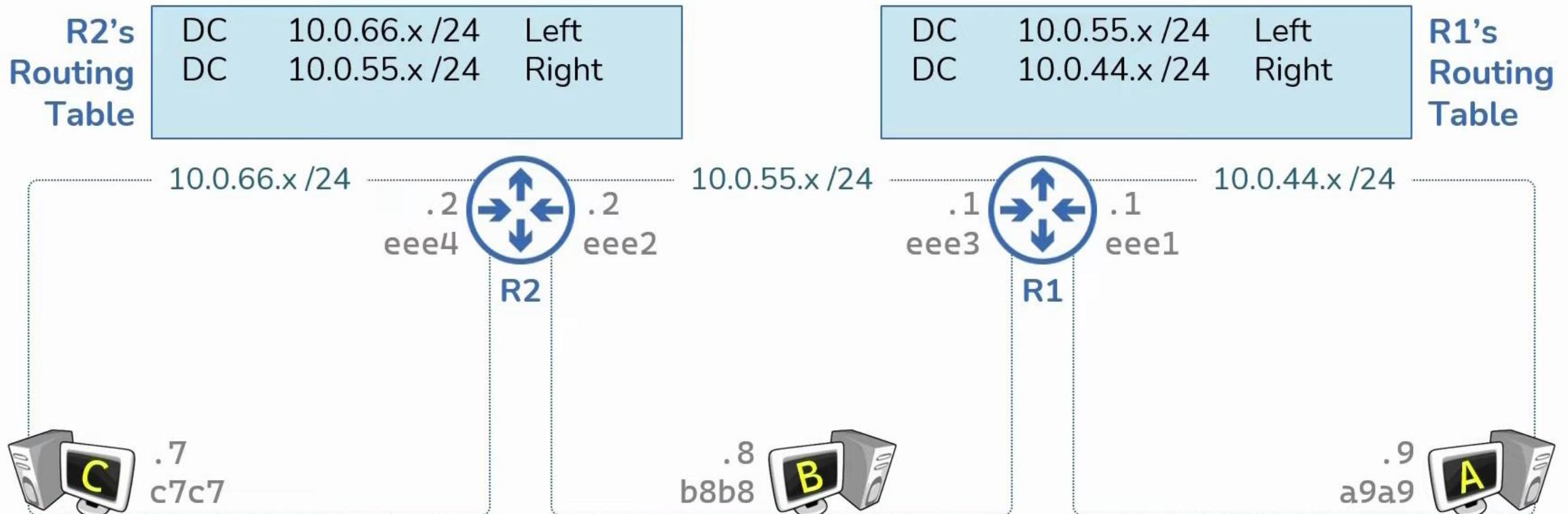
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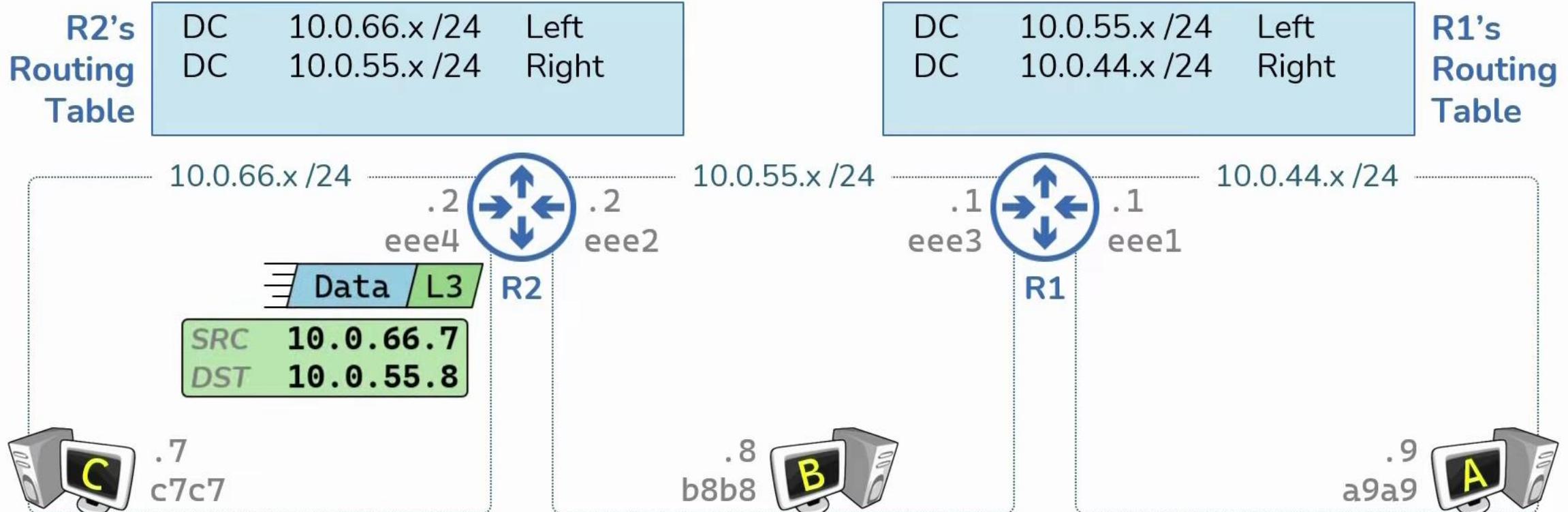
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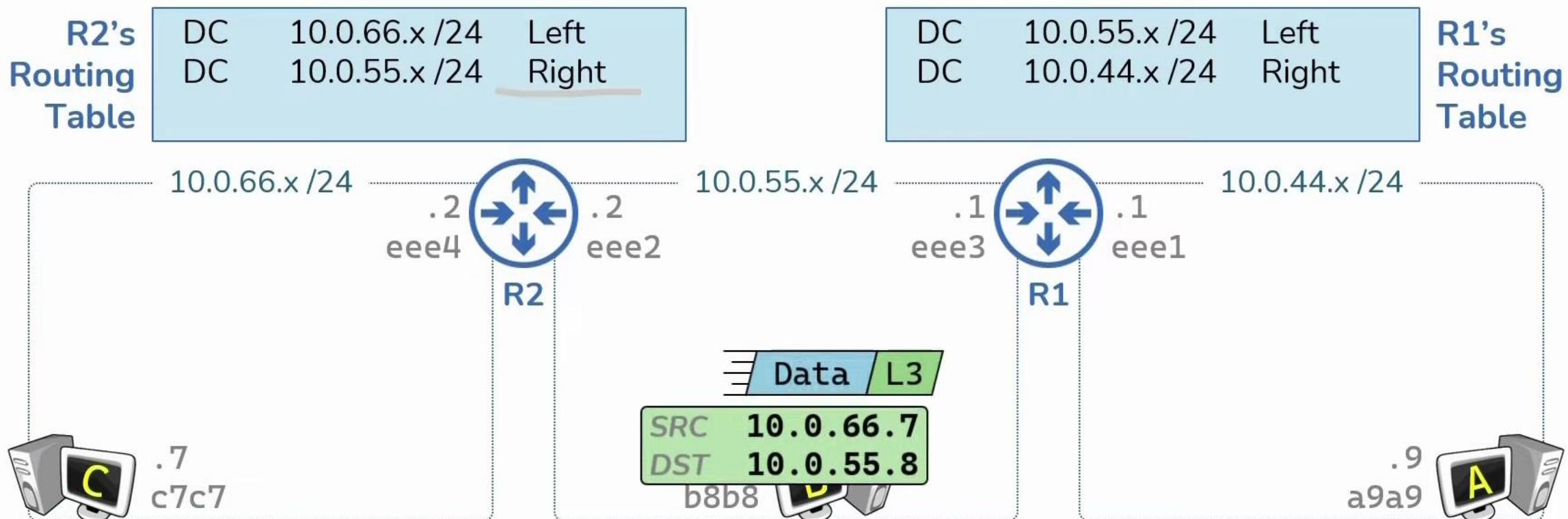
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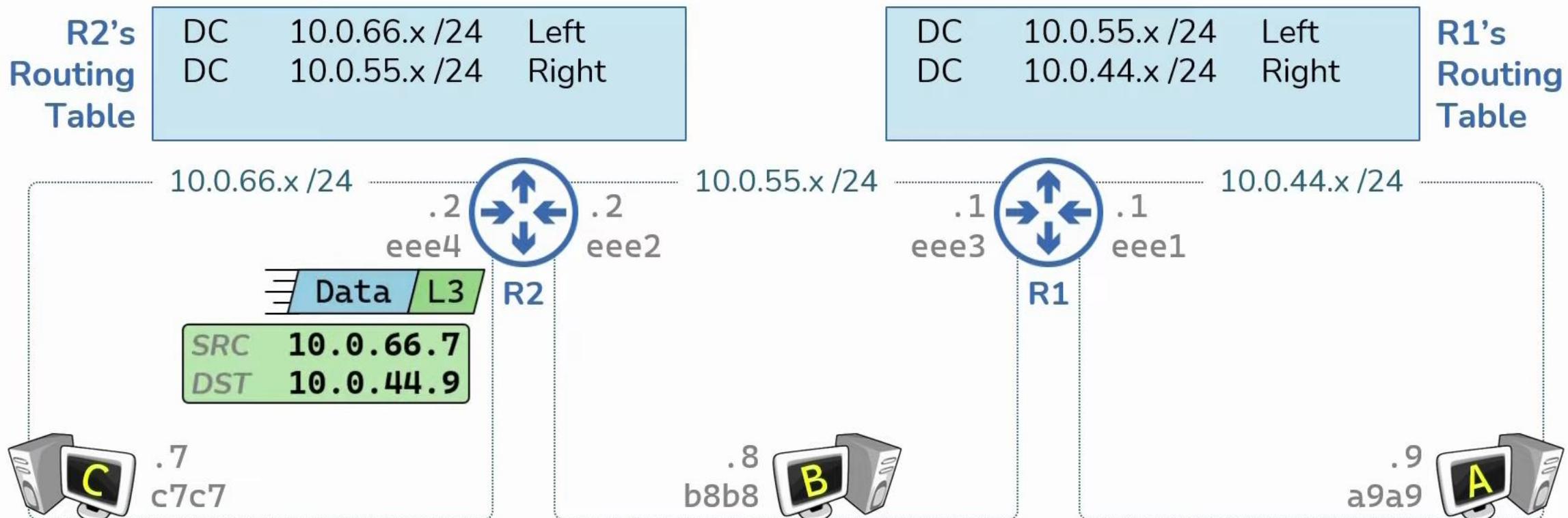
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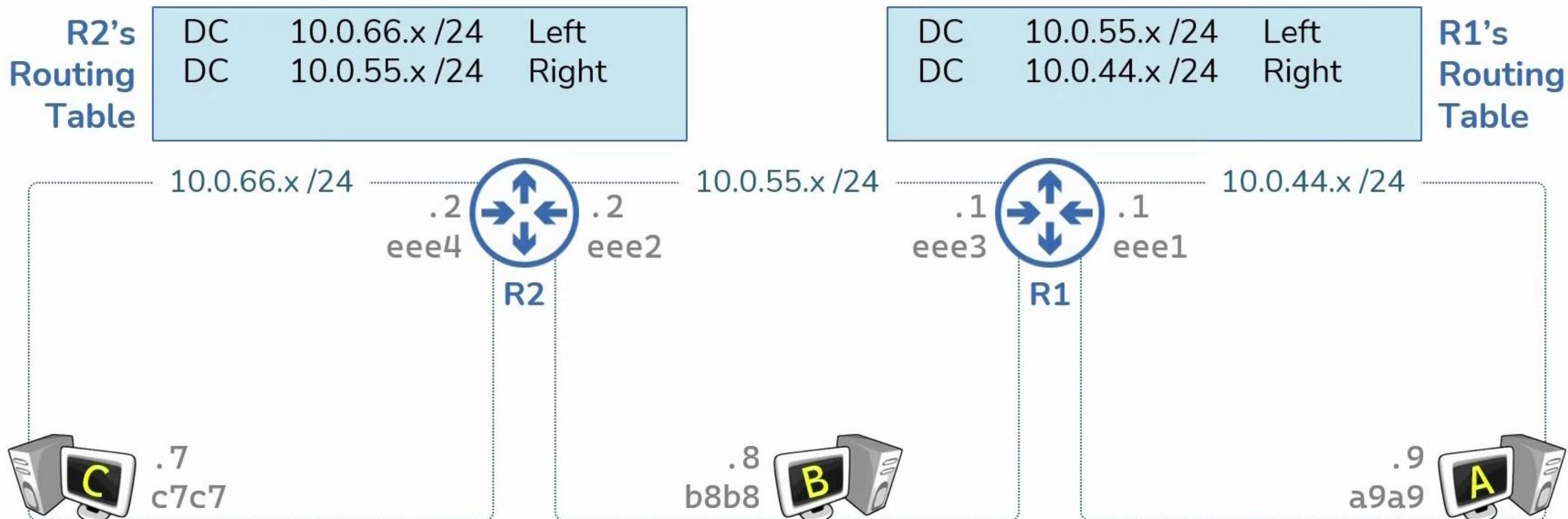
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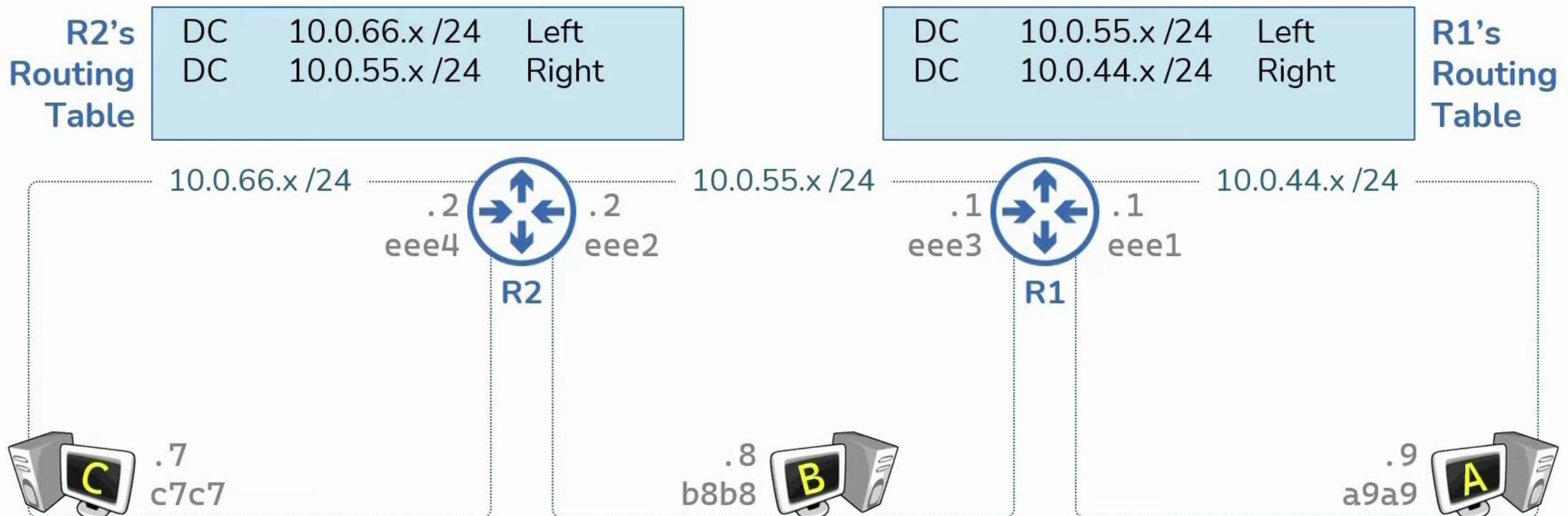
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***When Routers receive packets with an unknown Destination IP, packet is dropped***



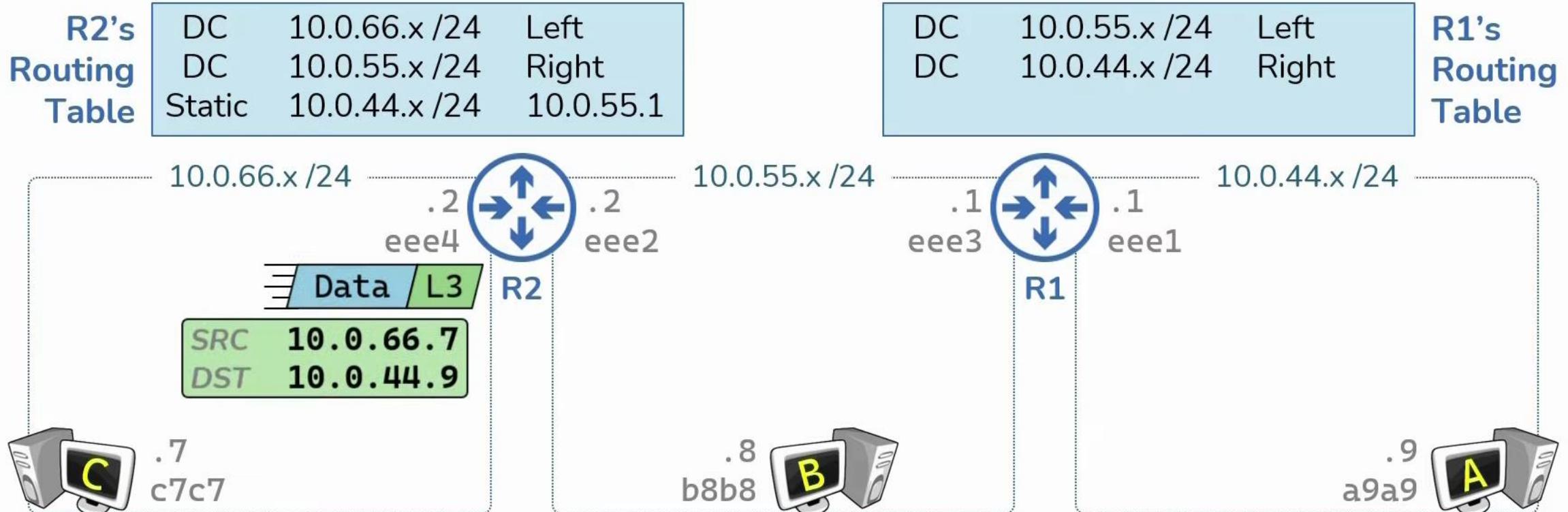
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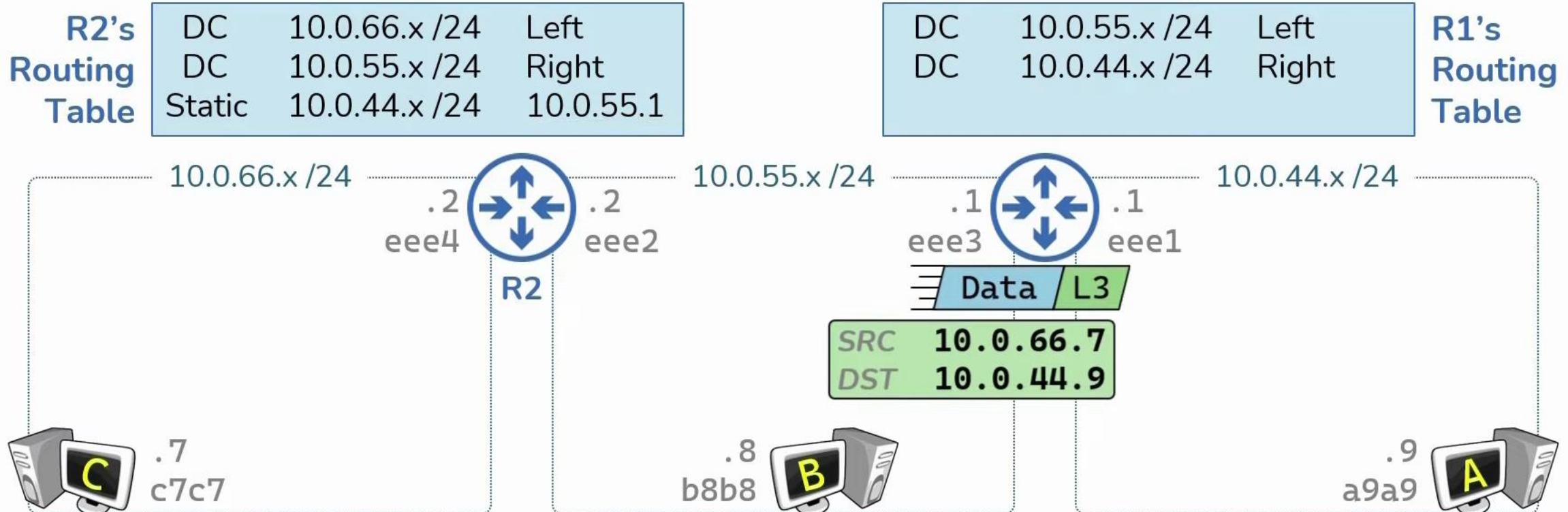
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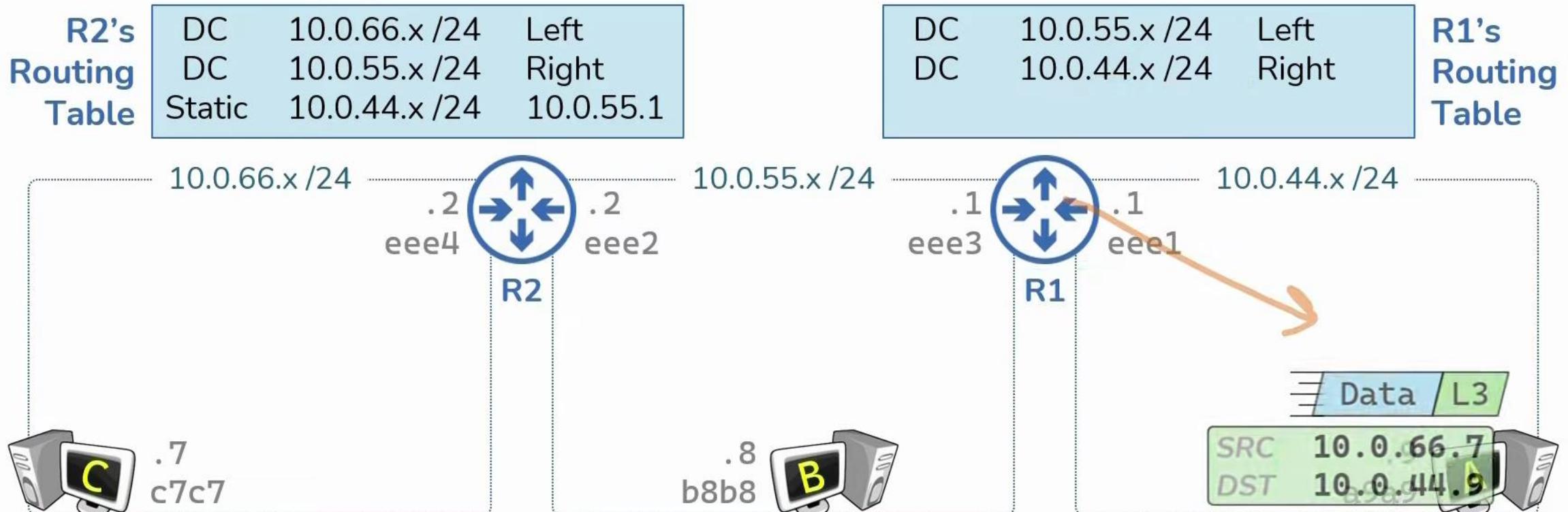
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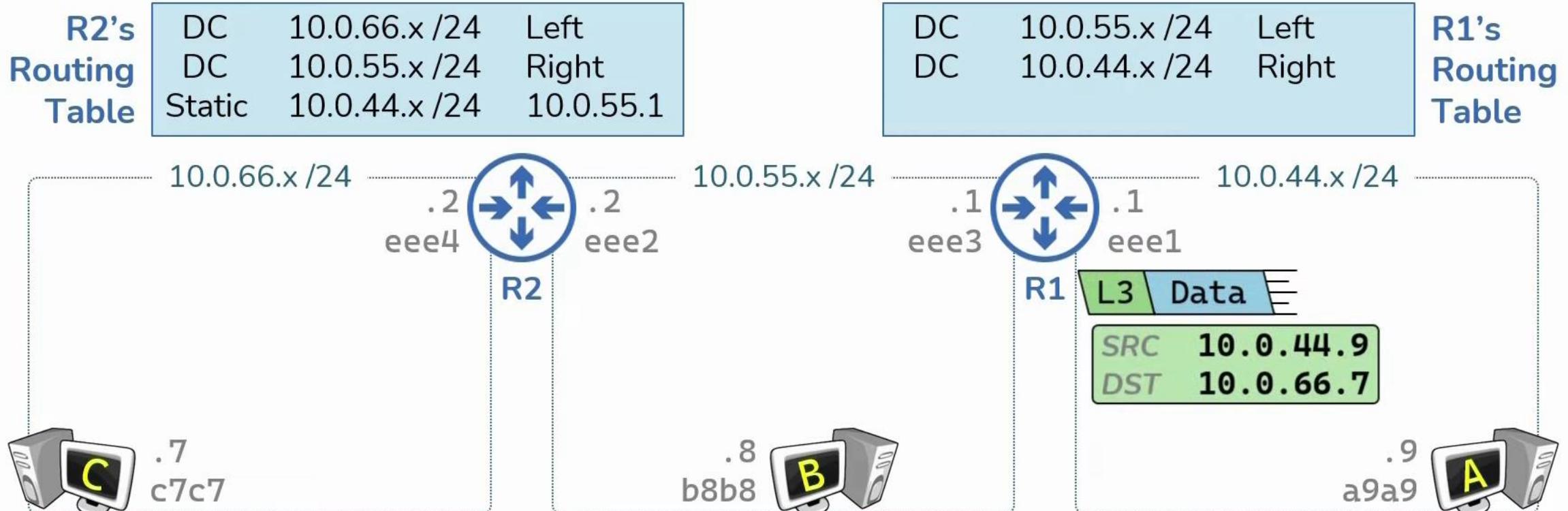
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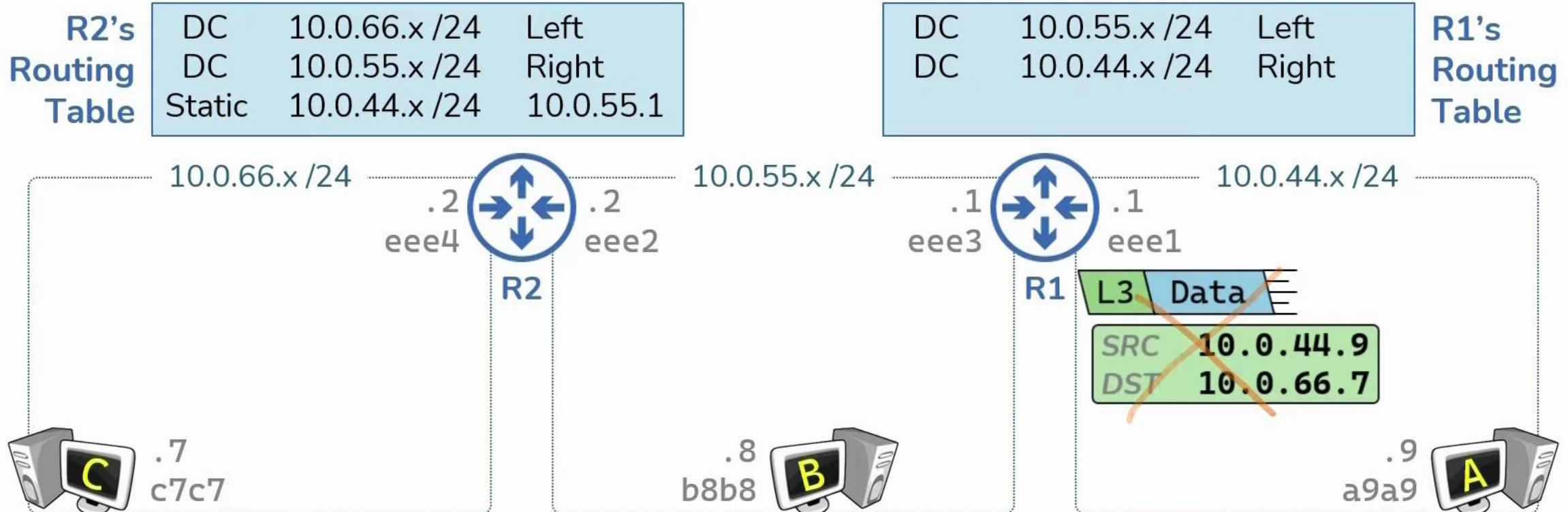
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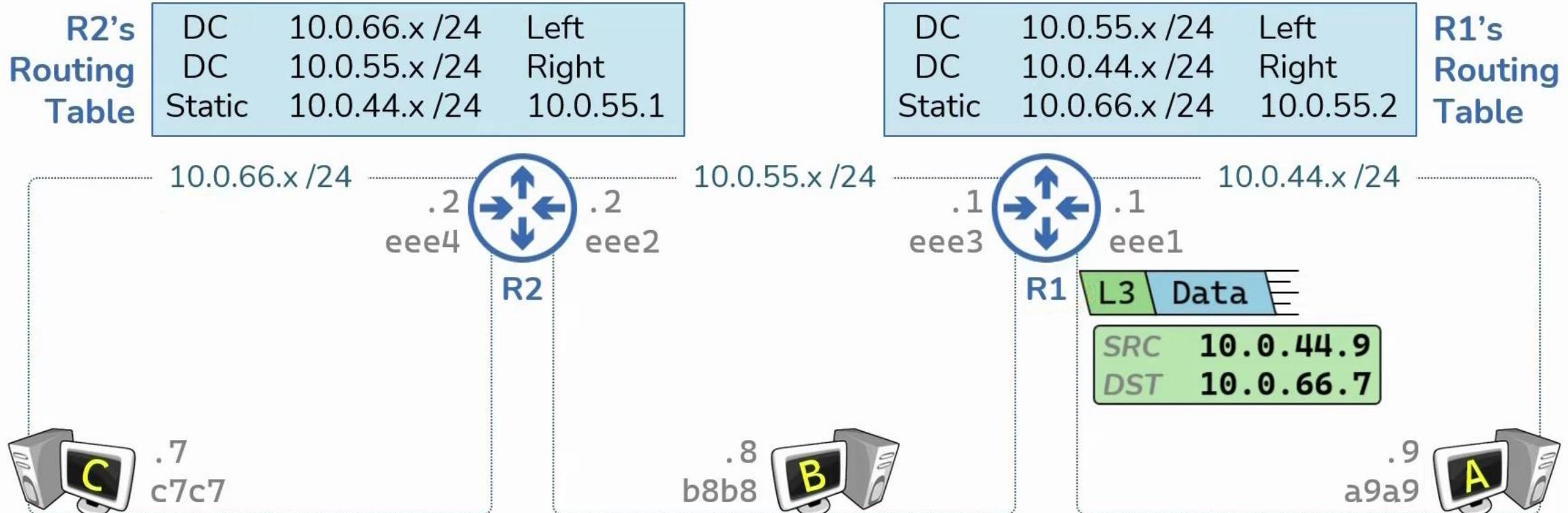
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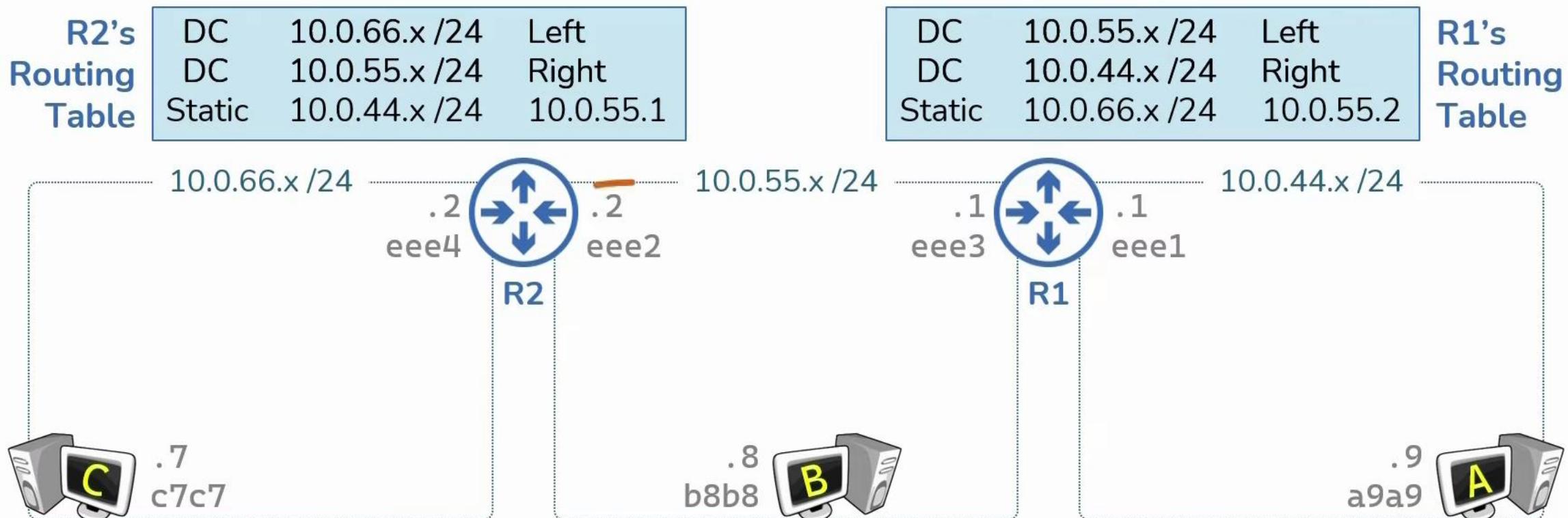
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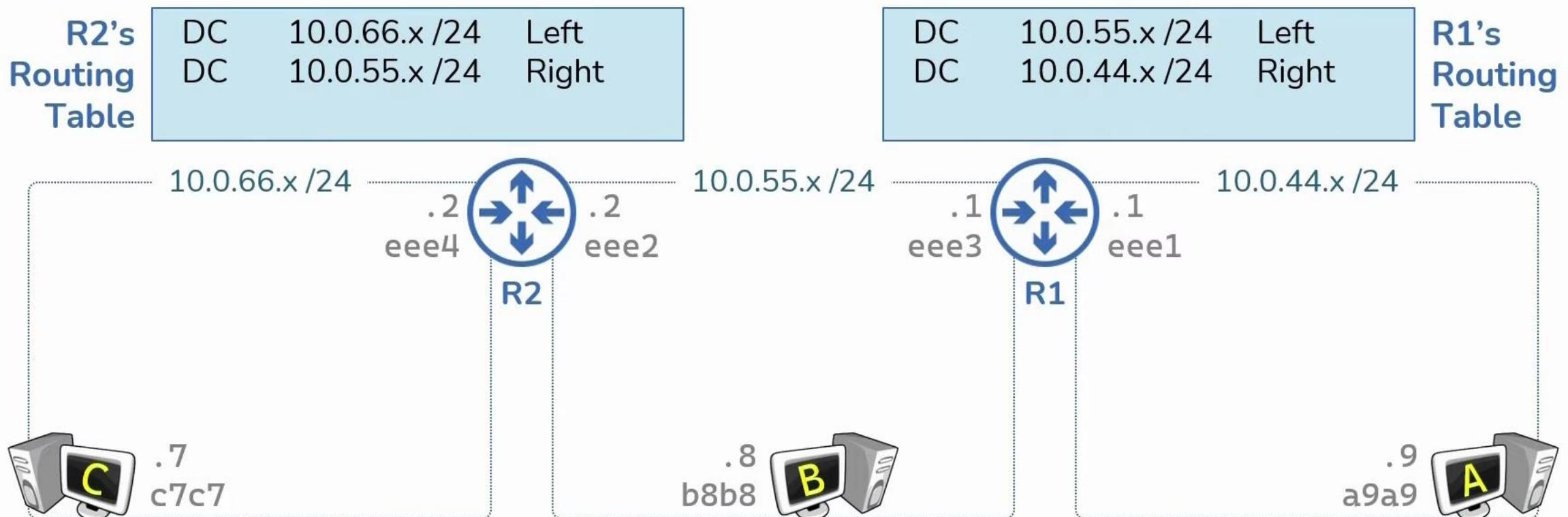
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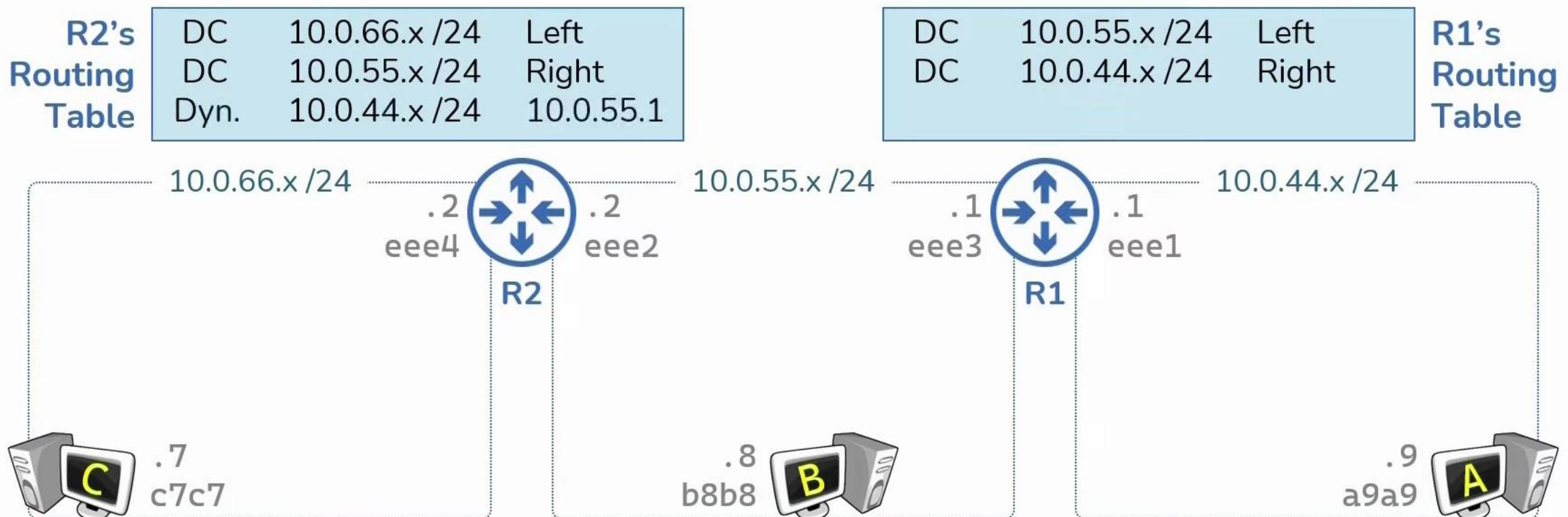
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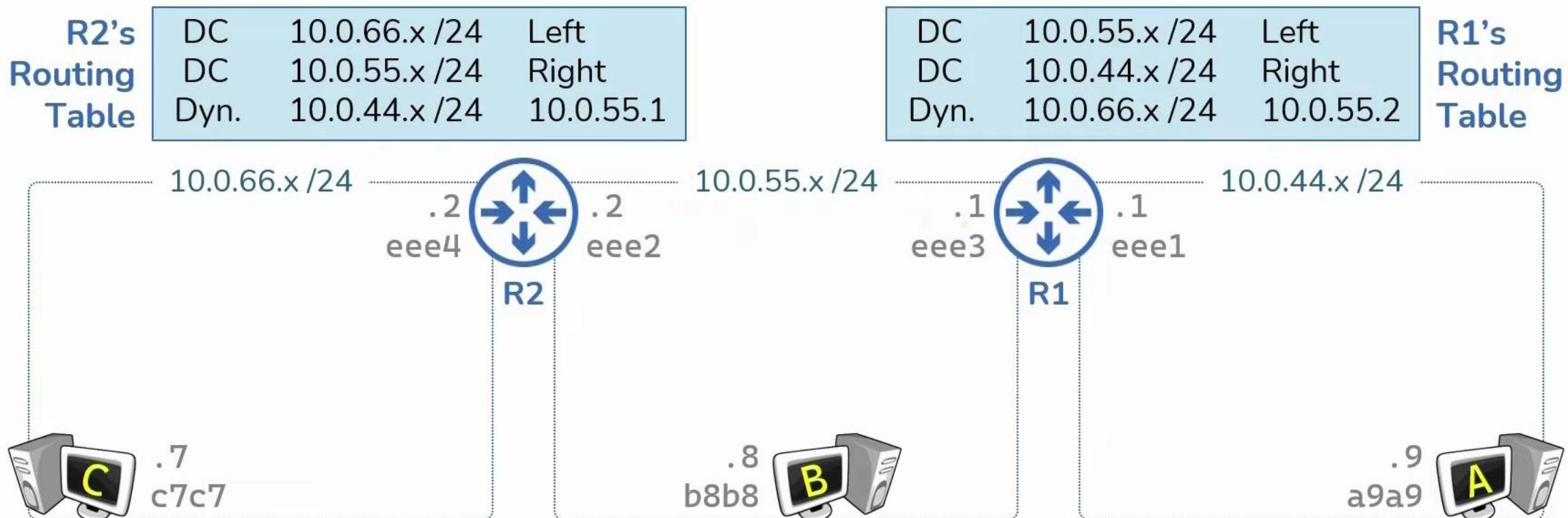
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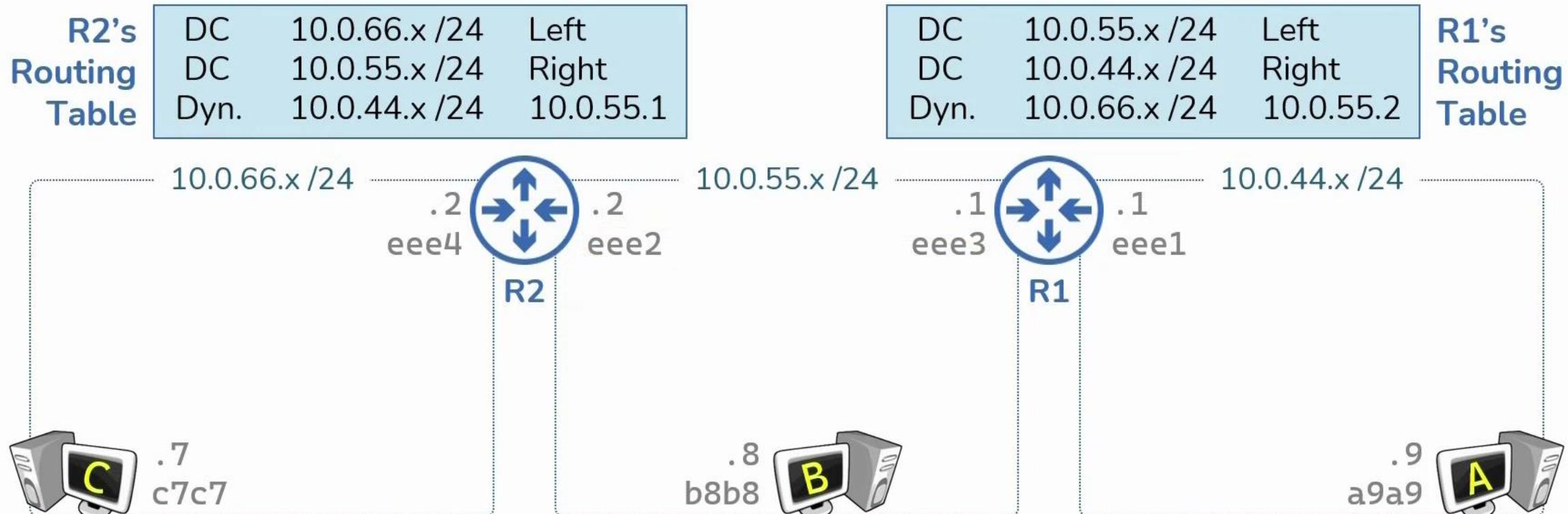
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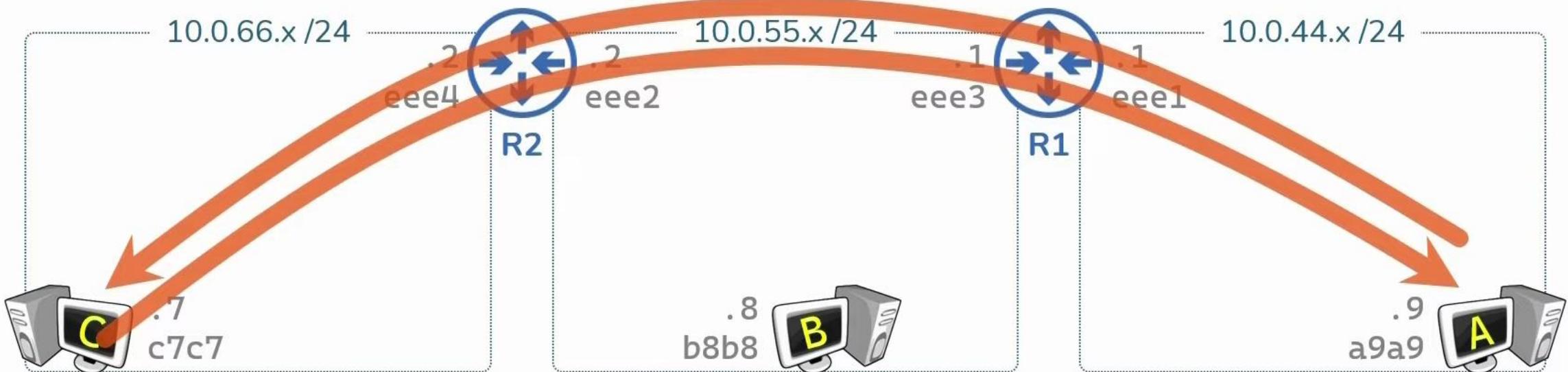
Dynamic Routing Protocols	RIP	OSPF	BGP
	EIGRP	IS-IS	

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# Routers

- Key Points:
  - Routers have an IP & MAC for each Network they are connected to
  - Routing Table contains all the networks a Router knows
    - Populated via: Directly Connected, Static Routes, Dynamic Routes



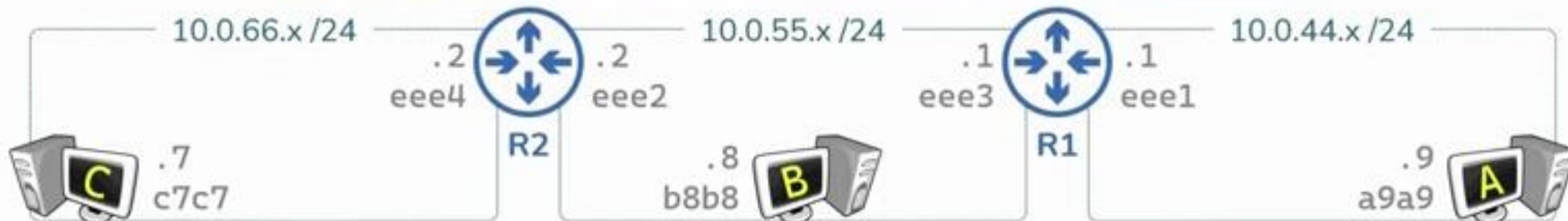
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R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2



- Routers have an **IP & MAC** for each Network they are connected to
- Routers have **Routing Tables** – map of every network
  - Populated with **Directly Connected**, **Static Routes**, **Dynamic Routes**
- Routers also have **ARP Tables** – mapping of **L3** to **L2** address

R2 ARP Table

10.0.55.1 --> eee3
10.0.55.8 --> b8b8
10.0.66.7 --> c7c7

R2 Routing Table

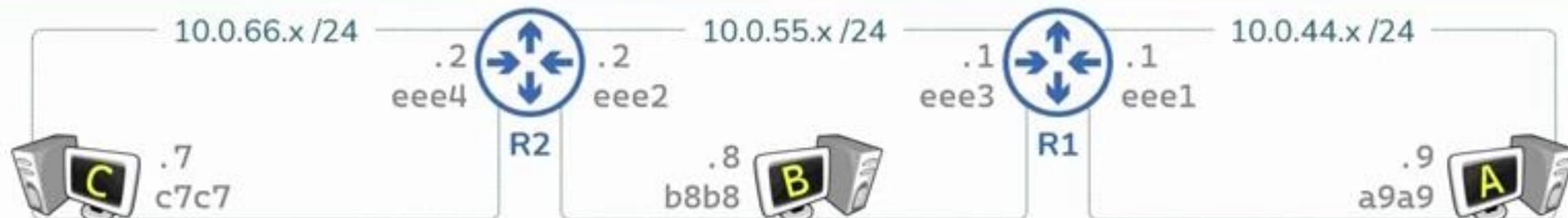
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R1 Routing Table

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DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.8 --> b8b8
10.0.55.2 --> eee2



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- Routers have **Routing Tables** – map of every network
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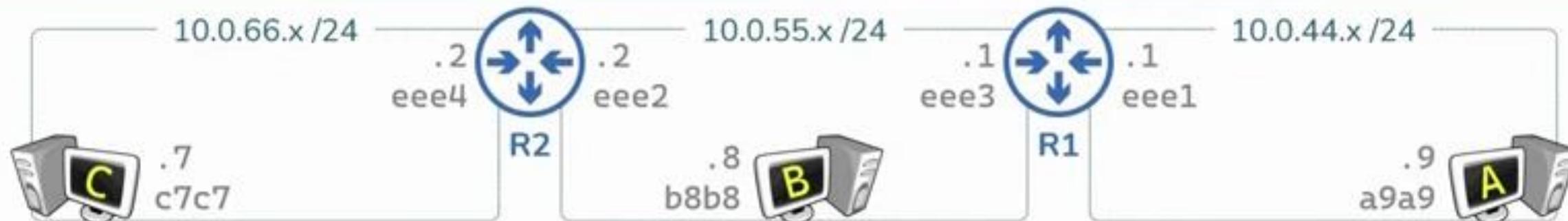
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- Routers also have **ARP Tables** – mapping of **L3** to **L2** address
  - Everything with an IP address has an ARP Table
  - **Start Empty** – populated as needed with network traffic

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table

	DC 10.0.66.x /24 Left DC 10.0.55.x /24 Right Static 10.0.44.x /24 10.0.55.1	DC 10.0.55.x /24 Left DC 10.0.44.x /24 Right Static 10.0.66.x /24 10.0.55.2	
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R2 ARP Table

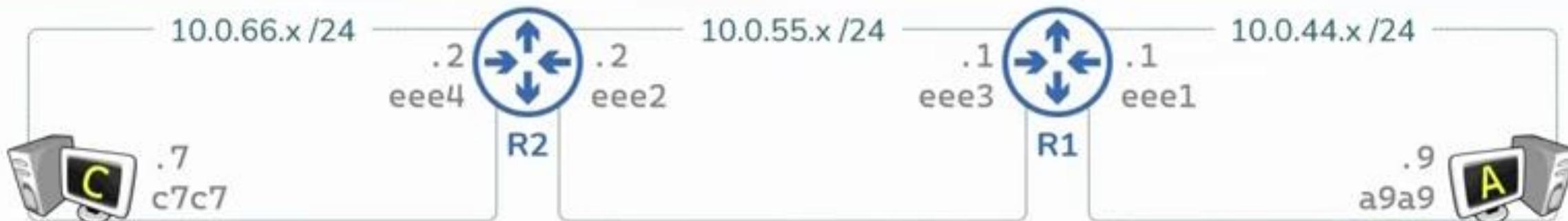
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L3	Data
SRC	10.0.44.9
DST	10.0.66.7

- Host A has data to send to Host C
- Host A constructs the L3 header

R2 ARP Table

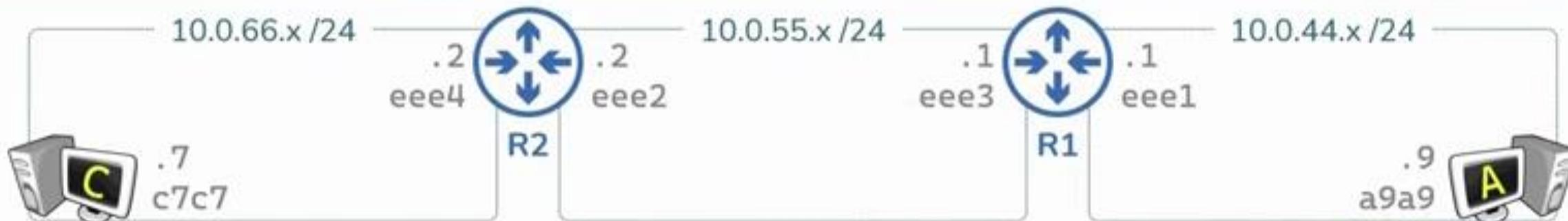
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Static	10.0.66.x /24	10.0.55.2



L3	Data
SRC	10.0.44.9
DST	10.0.66.7

- Host A has data to send to Host C
- Host A constructs the L3 header
- Host A knows packet must be sent to Default Gateway (R1)

R2 ARP Table

R2 Routing Table

R1 Routing Table

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Static	10.0.66.x /24	10.0.55.2



L2	L3	Data
SRC a9a9	SRC 10.0.44.9	
DST ??	DST 10.0.66.7	

HostA ARP Table

- Host A has data to send to Host C
- Host A constructs the L3 header
- Host A knows packet must be sent to Default Gateway (R1)
- Host A cannot construct L2 header
  - No ARP entry for Gateway's IP Address (R1)

R2 ARP Table

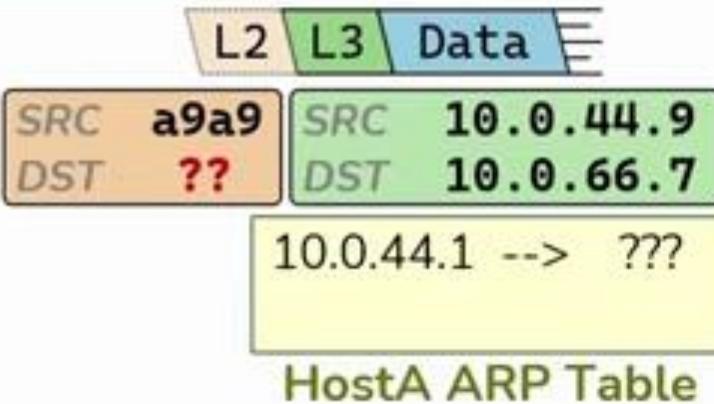
R2 Routing Table

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R1 ARP Table



- Host A sends ARP Request for 10.0.44.1



R2 ARP Table

R2 Routing Table

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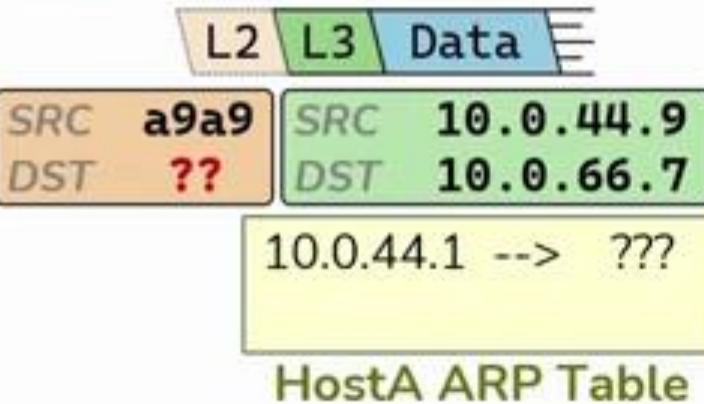
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DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.44.1

10.0.44.9 --&gt; a9a9



- Host A sends ARP Request for 10.0.44.1
- R1 populates its ARP Table with entry for 10.0.44.9

10.0.44.1 --&gt; ???

HostA ARP Table

L2	L3	Data
SRC a9a9	SRC 10.0.44.9	
DST ??	DST 10.0.66.7	

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

10.0.44.9 --&gt; a9a9



- Host A sends ARP Request for 10.0.44.1
- R1 populates its ARP Table with entry for 10.0.44.9
- R1 sends ARP Response

10.0.44.1 --&gt; ???

HostA ARP Table

L2	L3	Data
SRC a9a9	SRC 10.0.44.9	
DST ??	DST 10.0.66.7	

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

10.0.44.9 --&gt; a9a9



- Host A sends ARP Request for 10.0.44.1
- R1 populates its ARP Table with entry for 10.0.44.9
- R1 sends ARP Response

L2	L3	Data
SRC a9a9	SRC 10.0.44.9	
DST ??	DST 10.0.66.7	

10.0.44.1 --&gt; ???

HostA ARP Table

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

10.0.44.9 --&gt; a9a9



- Host A sends ARP Request for 10.0.44.1
- R1 populates its ARP Table with entry for 10.0.44.9
- R1 sends ARP Response
- Host A populates its ARP Table with entry for 10.0.44.1

L2	L3	Data
SRC a9a9	SRC 10.0.44.9	
DST ??	DST 10.0.66.7	

10.0.44.1 --&gt; eee1

HostA ARP Table

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

10.0.44.9 --&gt; a9a9



- Host A constructs L2 header

10.0.44.1 --&gt; eee1

HostA ARP Table

L2	L3	Data
SRC a9a9	SRC 10.0.44.9	
DST eee1	DST 10.0.66.7	

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

10.0.44.9 --&gt; a9a9



- Host A constructs L2 header
- Host A sends packet to R1

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

10.0.44.9 --&gt; a9a9



- R1 receives packet
- R1 discards L2 header

R2 ARP Table

R2 Routing Table

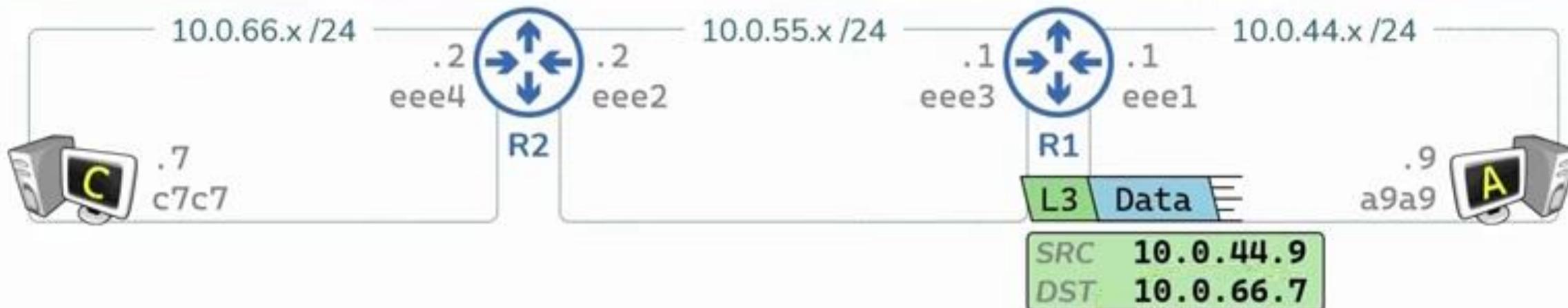
R1 Routing Table

R1 ARP Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

10.0.44.9 --&gt; a9a9



- R1 receives packet
- R1 discards L2 header
- R1 looks up Destination IP in Routing Table

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

10.0.44.9 --> a9a9



- R1 receives packet
- R1 discards L2 header
- R1 looks up Destination IP in Routing Table
  - Packet's next hop is to 10.0.55.2
- R1 cannot construct L2 header
  - No ARP entry for 10.0.55.2

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table

	DC 10.0.66.x /24 Left DC 10.0.55.x /24 Right Static 10.0.44.x /24 10.0.55.1	DC 10.0.55.x /24 Left DC 10.0.44.x /24 Right Static 10.0.66.x /24 10.0.55.2	10.0.44.9 --> a9a9 10.0.55.2 --> ??
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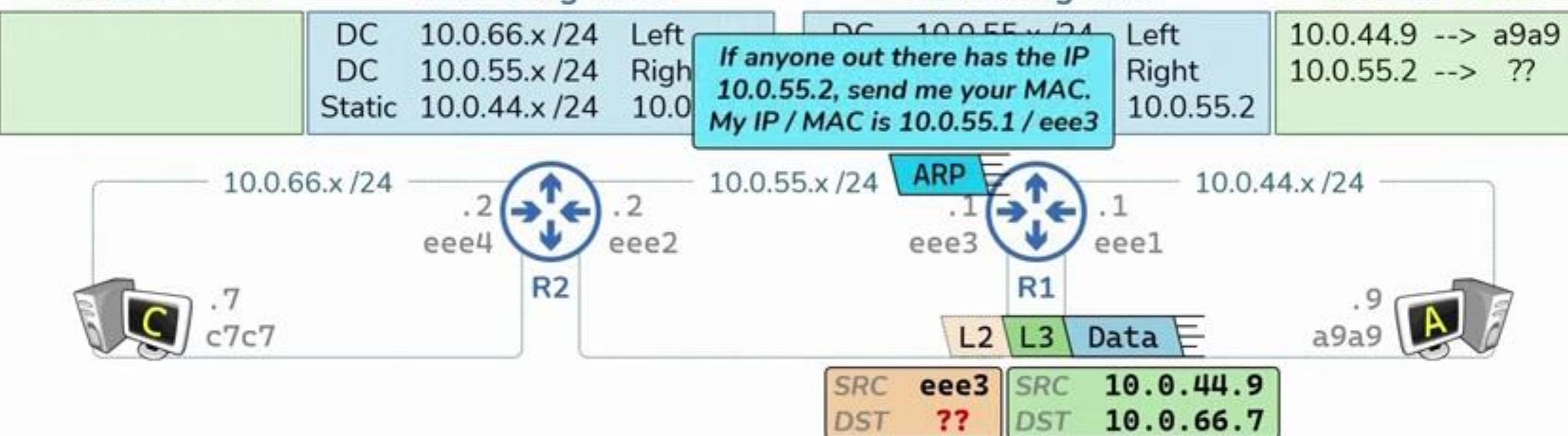
- R1 sends ARP Request for 10.0.55.2

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table



- R1 sends ARP Request for 10.0.55.2

R2 ARP Table

R2 Routing Table

R1 Routing Table

R1 ARP Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

10.0.44.9	-->	a9a9
10.0.55.2	-->	??



- R1 sends ARP Request for 10.0.55.2

R2 ARP Table

10.0.55.1 --&gt; eee3

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 -->	a9a9
10.0.55.2 -->	??



- R1 sends ARP Request for 10.0.55.2
- R2 populates its ARP Table with entry for 10.0.55.1

R2 ARP Table

10.0.55.1 --&gt; eee3

R2 Routing Table

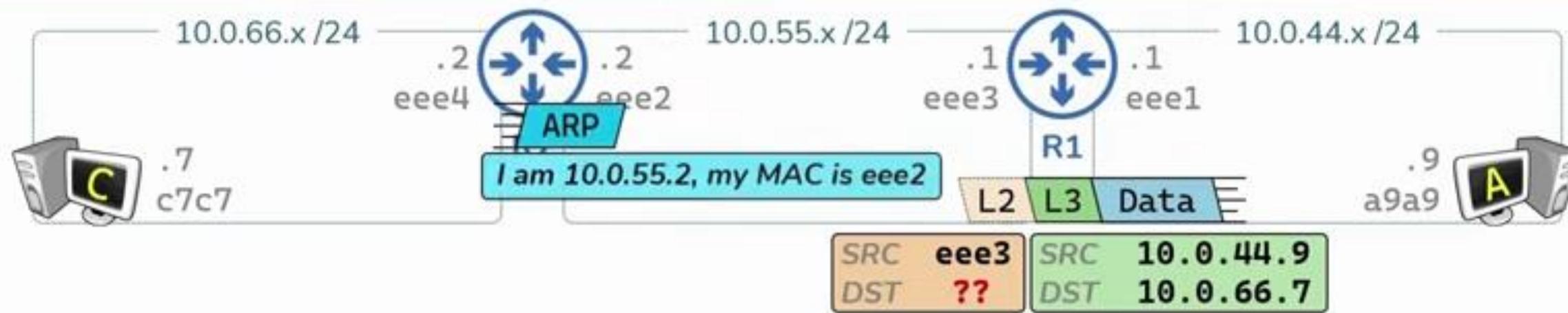
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 -->	a9a9
10.0.55.2 -->	??



- R1 sends ARP Request for 10.0.55.2
- R2 populates its ARP Table with entry for 10.0.55.1
- R2 sends ARP Response

R2 ARP Table

10.0.55.1 --&gt; eee3

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 -->	a9a9
10.0.55.2 -->	??



- R1 sends ARP Request for 10.0.55.2
- R2 populates its ARP Table with entry for 10.0.55.1
- R2 sends ARP Response

R2 ARP Table

10.0.55.1 --&gt; eee3

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R1 sends ARP Request for 10.0.55.2
- R2 populates its ARP Table with entry for 10.0.55.1
- R2 sends ARP Response
- R1 populates its ARP Table with entry for 10.0.55.2

R2 ARP Table

10.0.55.1 --&gt; eee3

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R1 constructs L2 header

R2 ARP Table

10.0.55.1 --&gt; eee3

R2 Routing Table

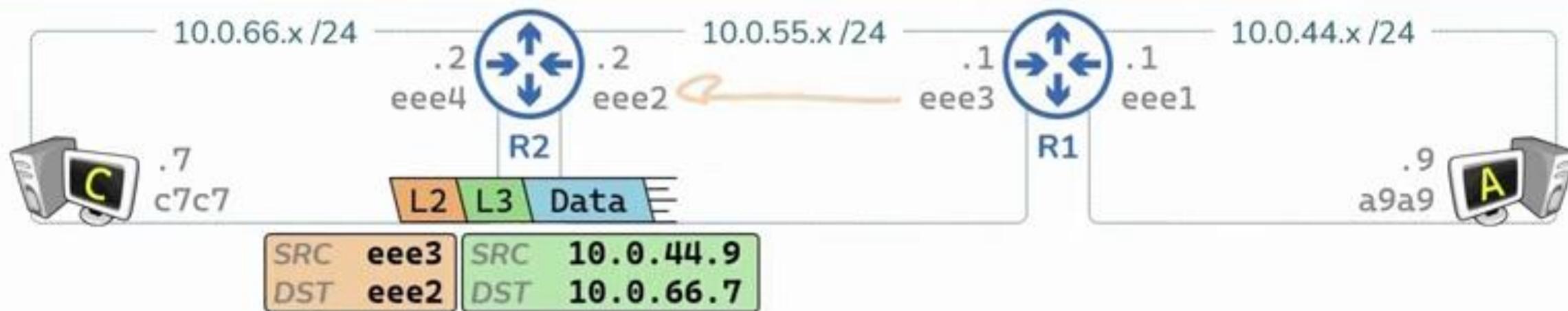
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R1 constructs L2 header
- R1 sends packet to R2

R2 ARP Table

10.0.55.1 --&gt; eee3

R2 Routing Table

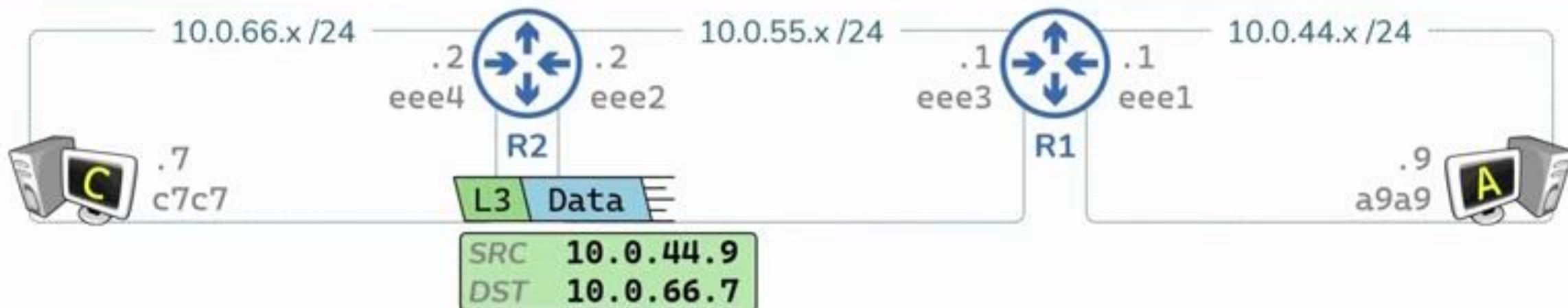
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 receives packet
- R2 discards L2 header

R2 ARP Table

10.0.55.1 --&gt; eee3

R2 Routing Table

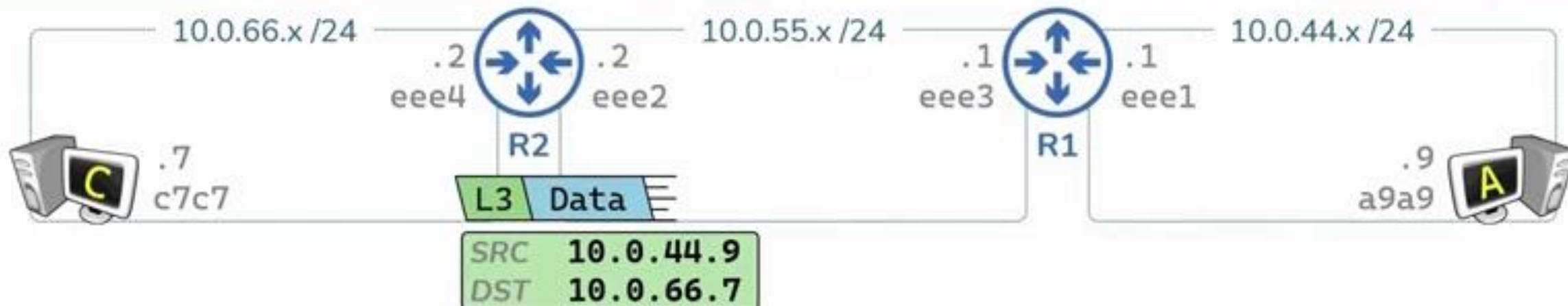
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 -->	a9a9
10.0.55.2 -->	eee2



- R2 receives packet
- R2 discards L2 header
- R2 looks up Destination IP in Routing Table

R2 ARP Table

10.0.55.1 --&gt; eee3

R2 Routing Table

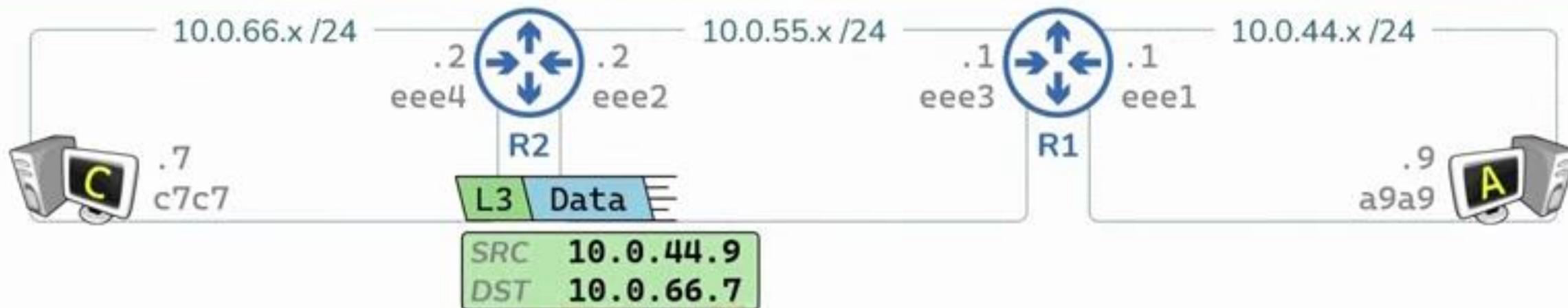
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 -->	a9a9
10.0.55.2 -->	eee2



- R2 receives packet
- R2 discards L2 header
- R2 looks up Destination IP in Routing Table
  - Packet's final hop is to 10.0.66.7

R2 ARP Table

10.0.55.1 --&gt; eee3

R2 Routing Table

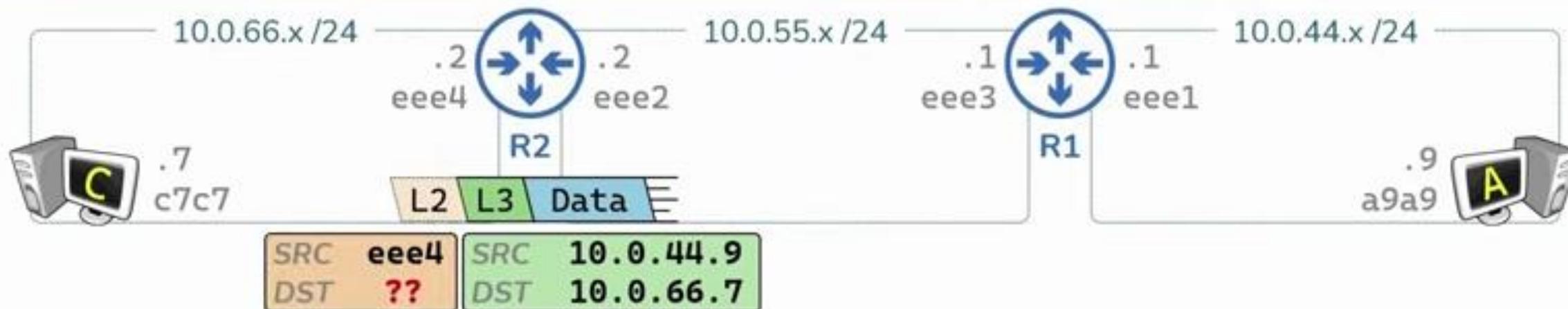
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 receives packet
- R2 discards L2 header
- R2 looks up Destination IP in Routing Table
  - Packet's final hop is to 10.0.66.7
- R2 cannot construct L2 header
  - No ARP entry for 10.0.66.7

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> ??

R2 Routing Table

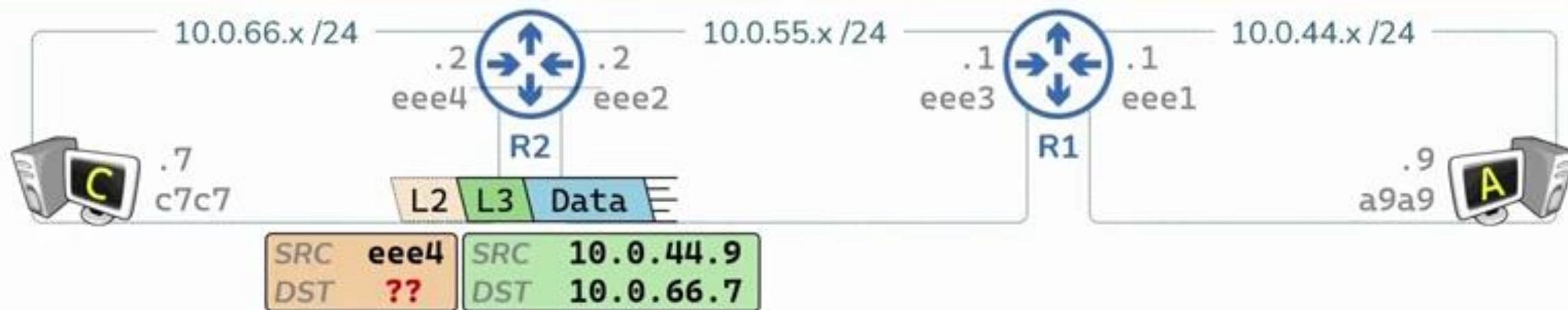
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 sends ARP Request for 10.0.66.7

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> ??

R2 Routing Table

DC	10.0.66.x /24	Left
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If anyone out there has the IP  
10.0.66.7, send me your MAC.  
My IP / MAC is 10.0.66.2 / eee4

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 sends ARP Request for 10.0.66.7

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> ??

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 sends ARP Request for 10.0.66.7

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> ??

R2 Routing Table

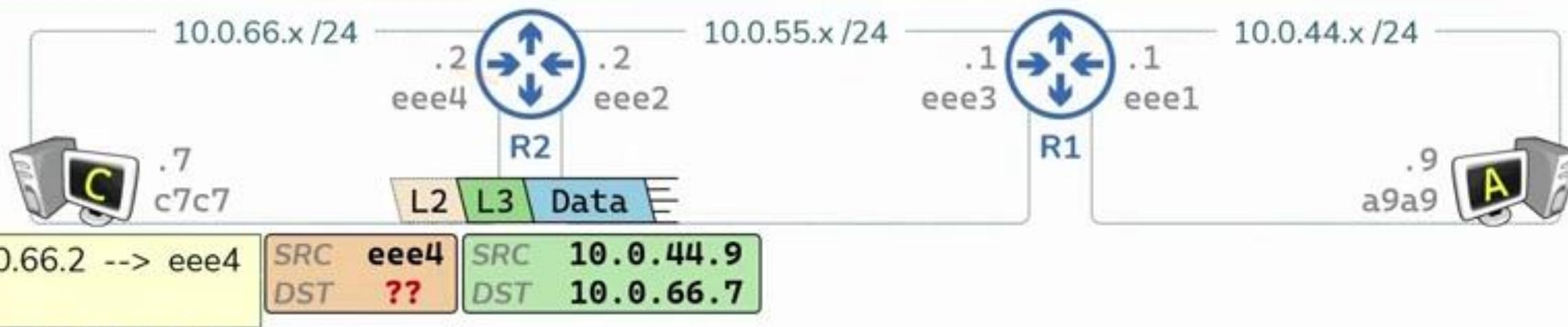
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



HostC ARP Table

- R2 sends ARP Request for 10.0.66.7
- Host C populates its ARP Table with entry for 10.0.66.2

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> ??

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



10.0.66.2 --> eee4

SRC **eee4**  
DST **??**

SRC **10.0.44.9**  
DST **10.0.66.7**

### HostC ARP Table

- R2 sends ARP Request for 10.0.66.7
- Host C populates its ARP Table with entry for 10.0.66.2
- Host C sends ARP Response

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> ??

R2 Routing Table

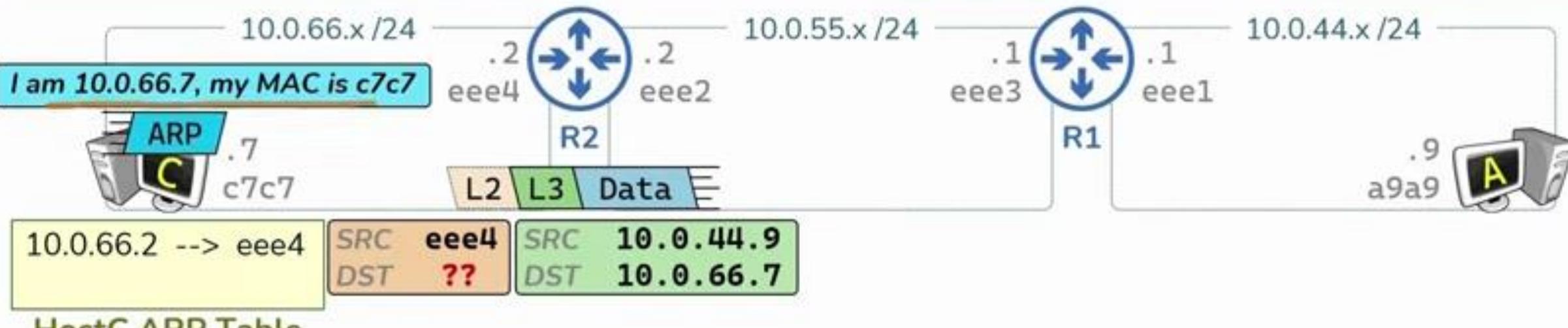
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 sends ARP Request for 10.0.66.7
- Host C populates its ARP Table with entry for 10.0.66.2
- Host C sends ARP Response

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> ??

R2 Routing Table

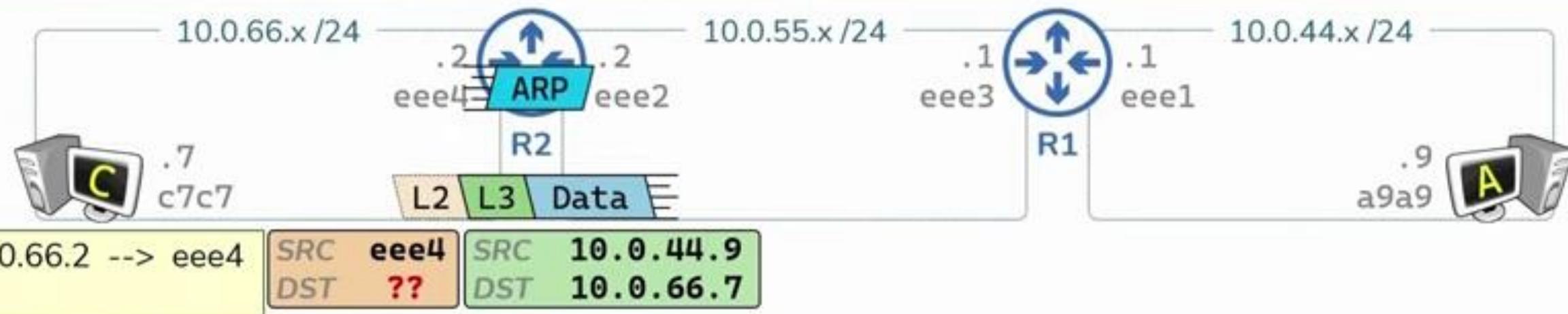
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



HostC ARP Table

- R2 sends ARP Request for 10.0.66.7
- Host C populates its ARP Table with entry for 10.0.66.2
- Host C sends ARP Response

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 sends ARP Request for 10.0.66.7
- Host C populates its ARP Table with entry for 10.0.66.2
- Host C sends ARP Response
- R2 populates its ARP Table with entry for 10.0.66.7

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 constructs L2 header
- R2 sends packet to Host C

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 constructs L2 header
- R2 sends packet to Host C

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

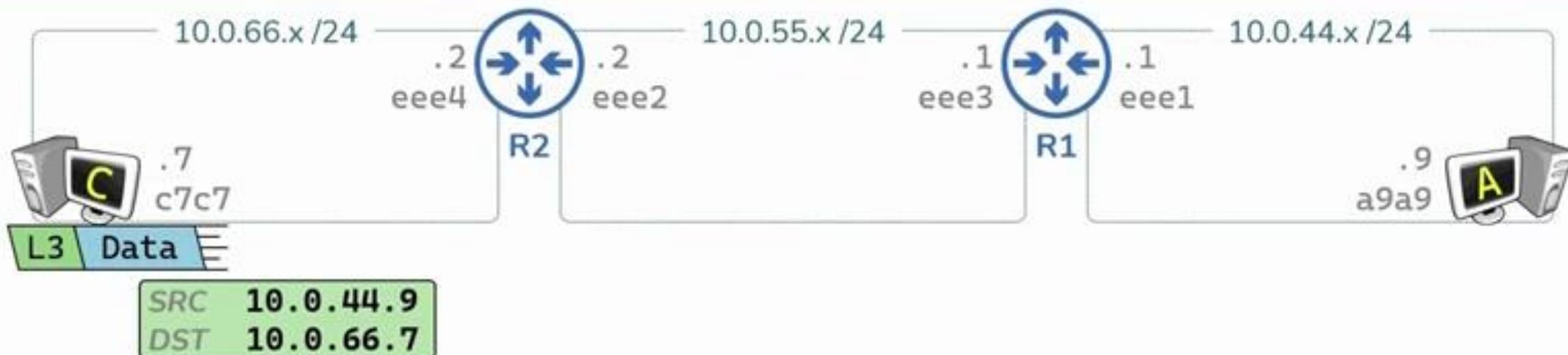
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- Host C receives packet
- Host C discards L2 header

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

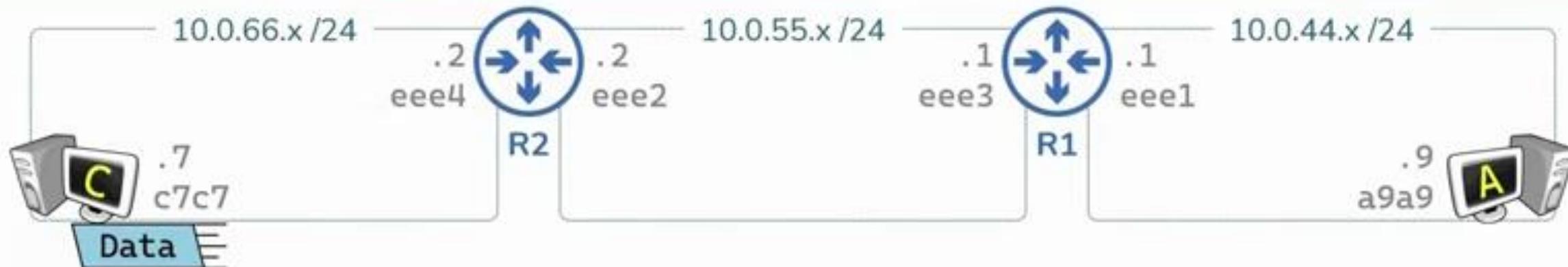
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- Host C receives packet
- Host C discards L2 header
- Host C discards L3 header

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- Host C receives packet
- Host C discards L2 header
- Host C discards L3 header
- Host C processes data

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

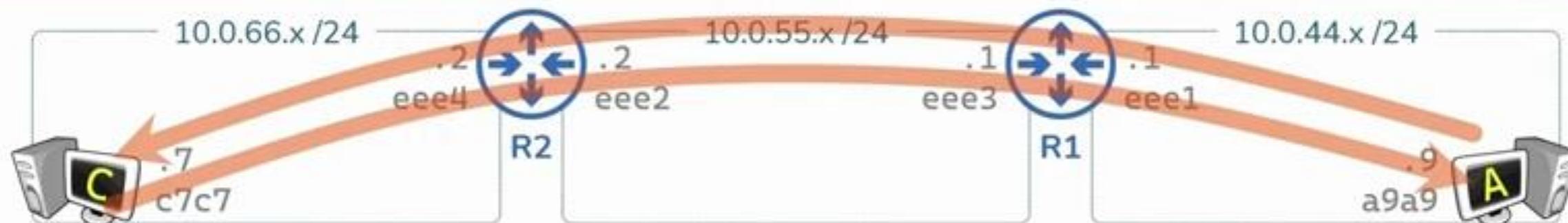
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

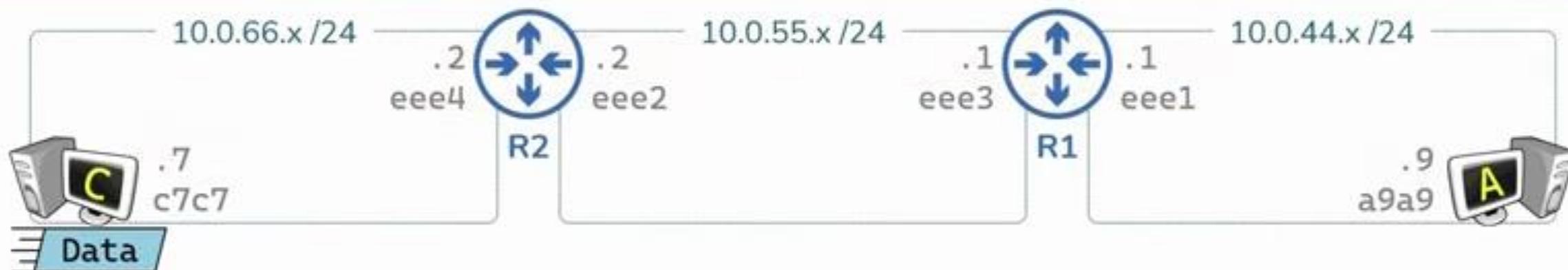
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- Host C has data for Host A

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

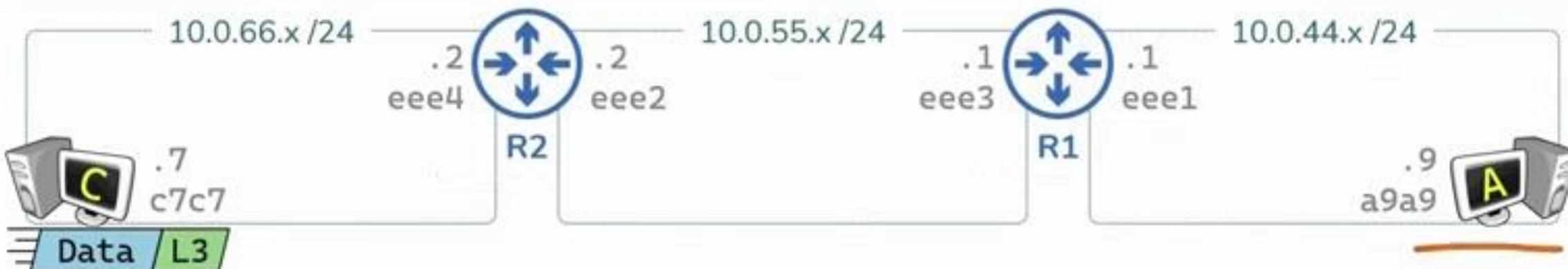
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- Host C has data for Host A
- Host C constructs L3 header

SRC **10.0.66.7**  
DST **10.0.44.9**

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

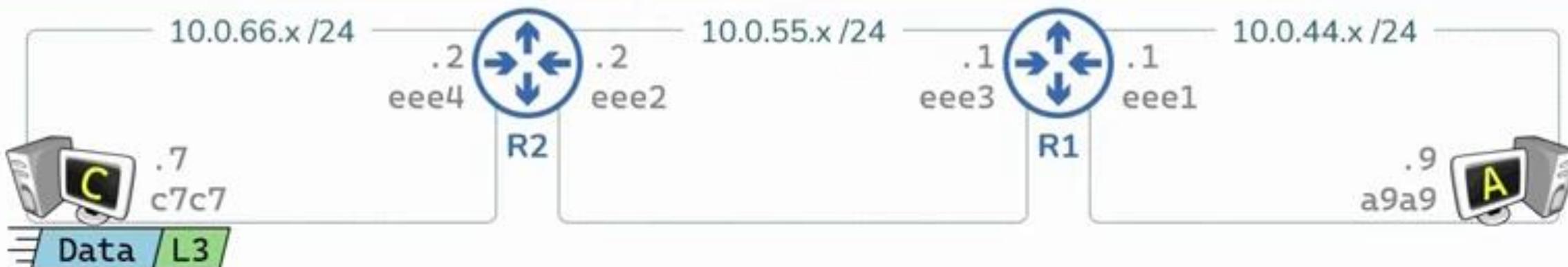
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



Data L3

SRC	10.0.66.7
DST	10.0.44.9

- Host C has data for Host A
- Host C constructs L3 header
- Host C knows packet must be sent to Default Gateway (R2)

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

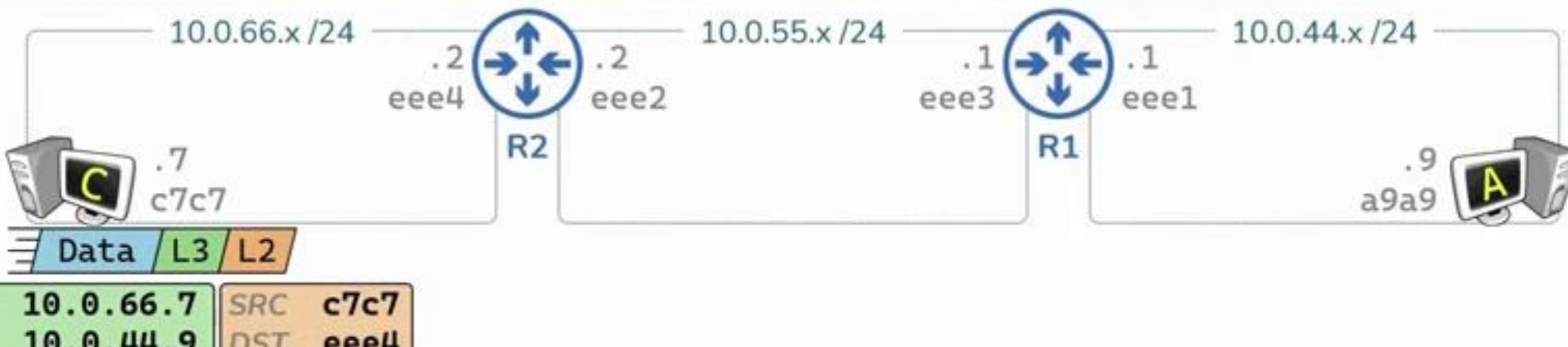
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- Host C has data for Host A
- Host C constructs L3 header
- Host C knows packet must be sent to Default Gateway (R2)
  - Host C knows R2's MAC from previous communication
- Host C constructs L2 header

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

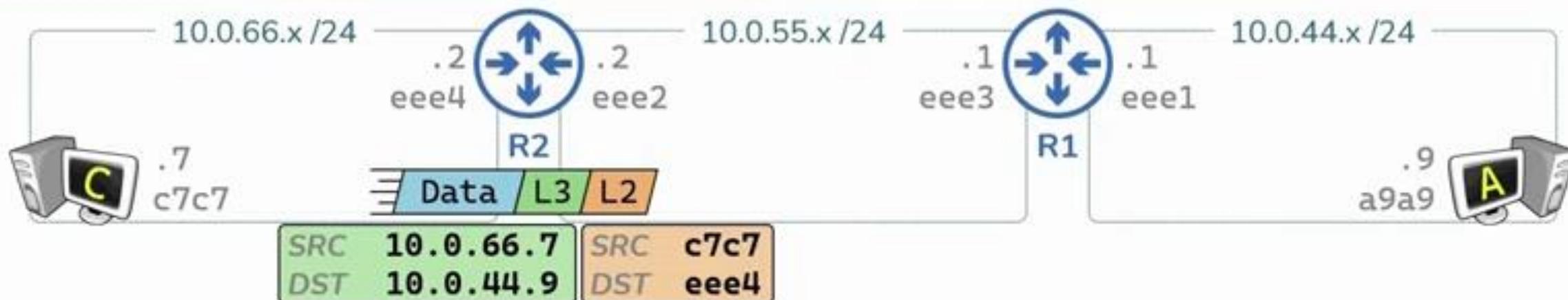
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 receives packet

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 receives packet
- R2 discards L2 header

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 receives packet
- R2 discards L2 header
- R2 looks up Destination IP in Routing Table
  - Packet's next hop is to 10.0.55.1

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

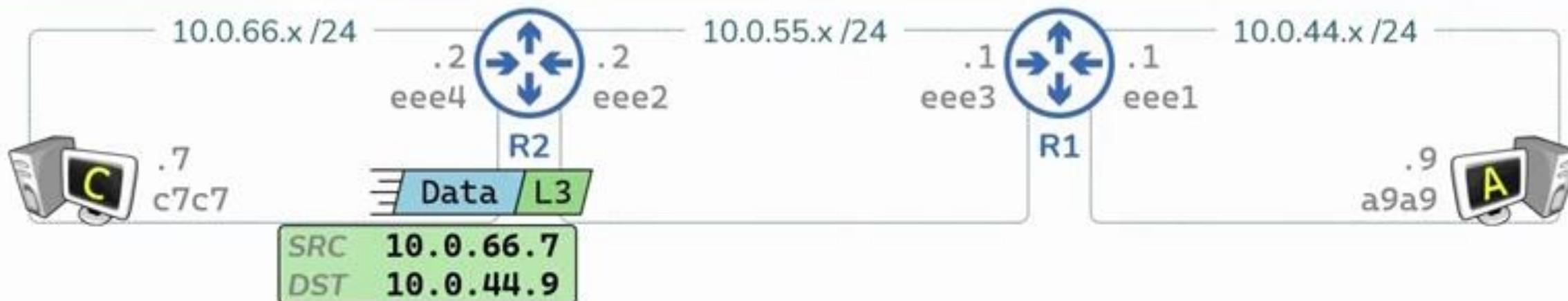
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 receives packet
- R2 discards L2 header
- R2 looks up Destination IP in Routing Table
  - Packet's next hop is to 10.0.55.1
  - R2 knows R1's MAC from previous communication

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

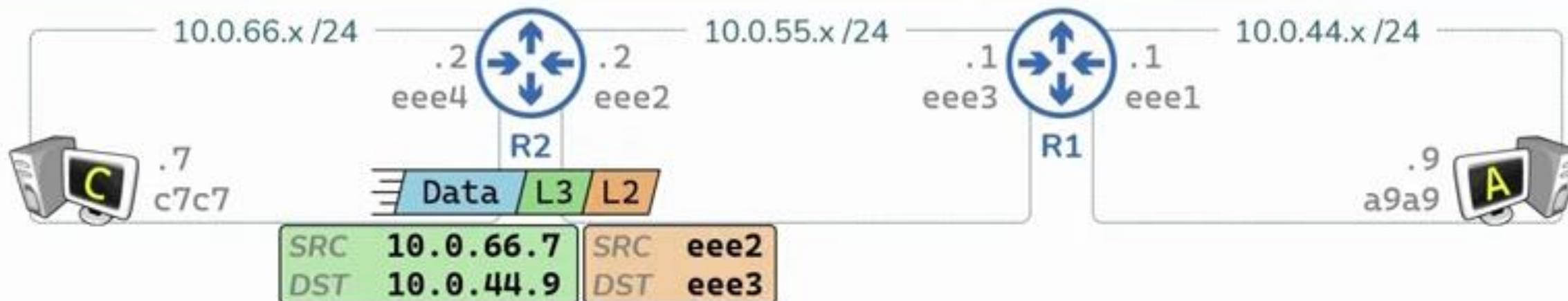
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R2 receives packet
- R2 discards L2 header
- R2 looks up Destination IP in Routing Table
  - Packet's next hop is to 10.0.55.1
  - R2 knows R1's MAC from previous communication
- R2 constructs new L2 header

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

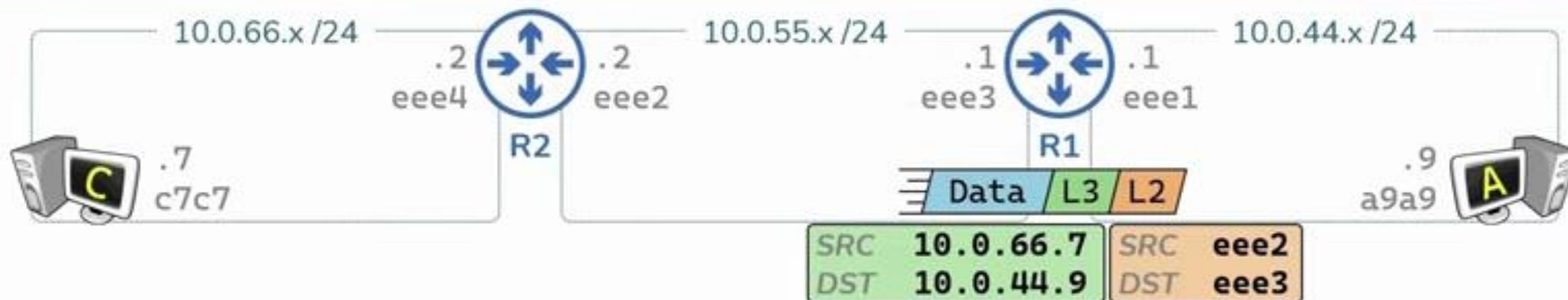
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R1 receives packet

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

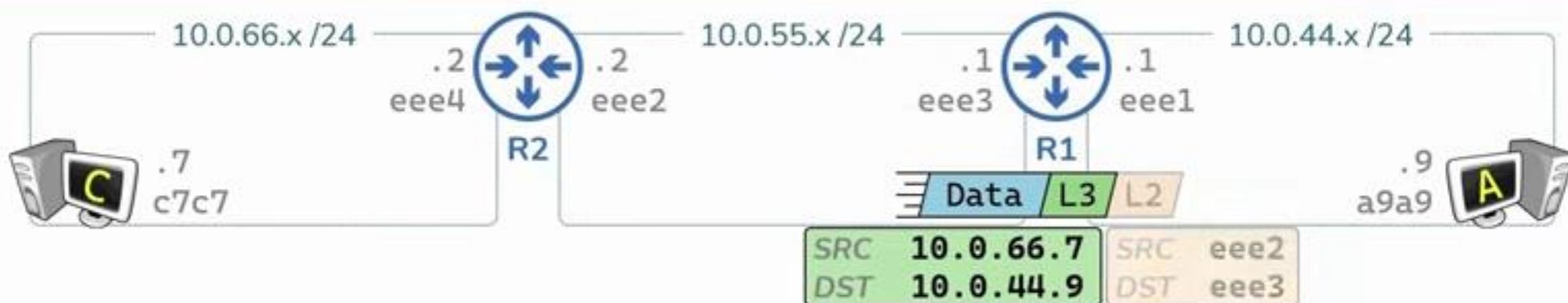
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R1 receives packet
- R1 discards L2 header

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R1 receives packet
- R1 discards L2 header
- R1 looks up Destination IP in Routing Table
  - Packet's final hop is to 10.0.44.9

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- R1 receives packet
- R1 discards L2 header
- R1 looks up Destination IP in Routing Table
  - Packet's final hop is to 10.0.44.9
  - R1 knows Host A's MAC from previous communication
- R1 constructs new L2 header

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

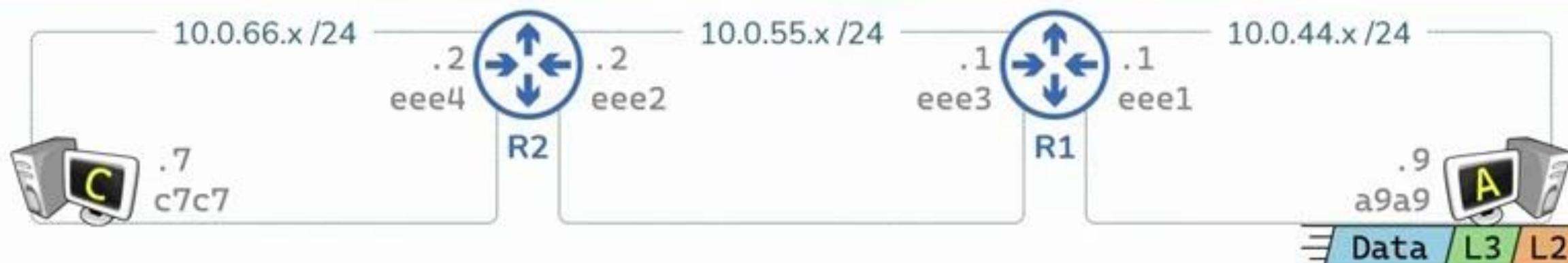
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



Data	L3	L2
	SRC 10.0.66.7	SRC eee1
DST 10.0.44.9	DST a9a9	

- Host A receives packet

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

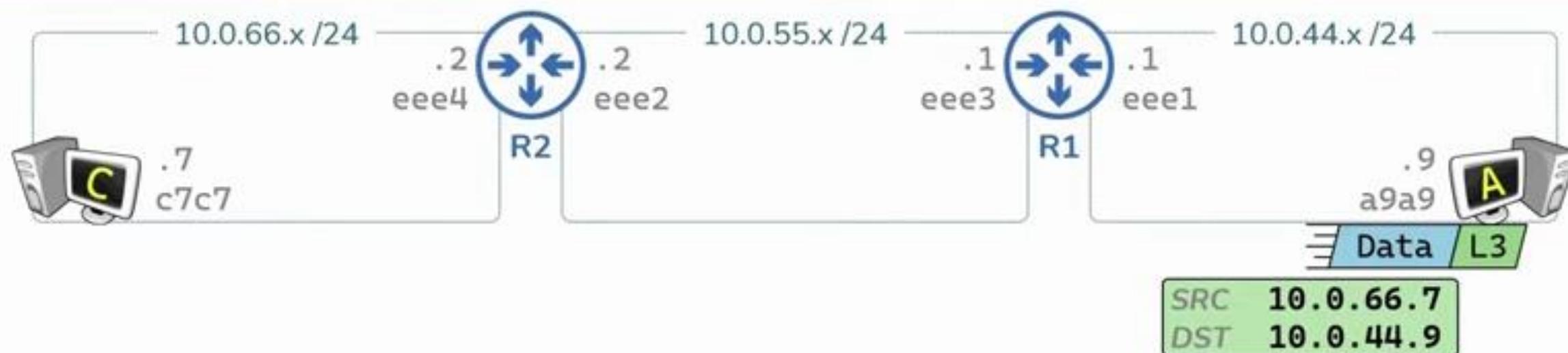
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- Host A receives packet
- Host A discards L2 header

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

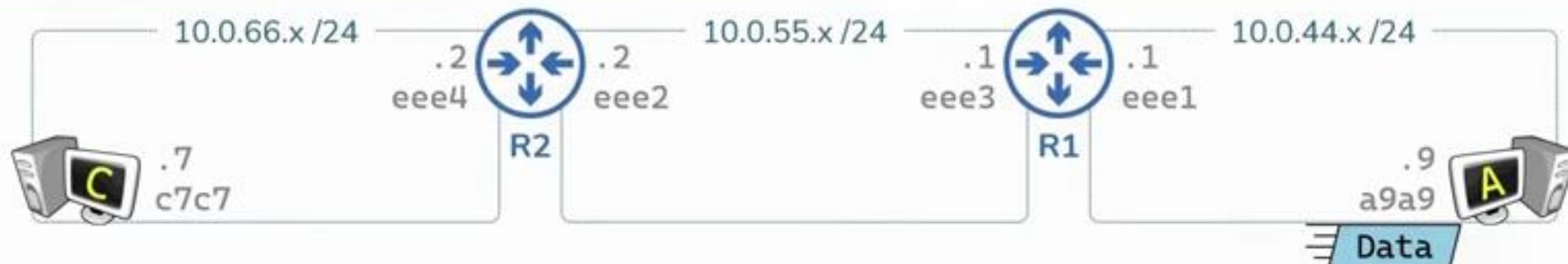
DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- Host A receives packet
- Host A discards L2 header
- Host A discards L3 header

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- Host A receives packet
- Host A discards L2 header
- Host A discards L3 header
- Host A processes data

R2 ARP Table

10.0.55.1 --> eee3
10.0.66.7 --> c7c7

R2 Routing Table

DC	10.0.66.x /24	Left
DC	10.0.55.x /24	Right
Static	10.0.44.x /24	10.0.55.1

R1 Routing Table

DC	10.0.55.x /24	Left
DC	10.0.44.x /24	Right
Static	10.0.66.x /24	10.0.55.2

R1 ARP Table

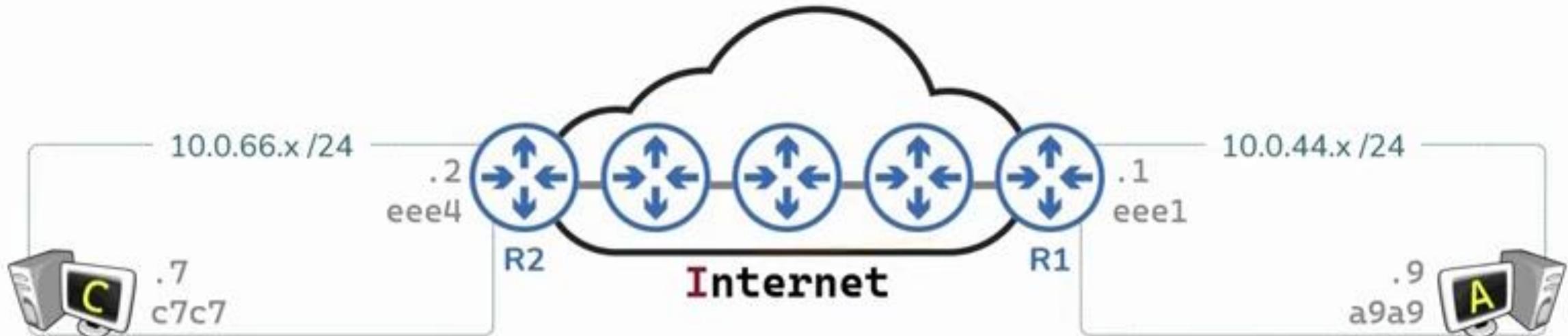
10.0.44.9 --> a9a9
10.0.55.2 --> eee2



- Events between R2 and R1 would repeat for any amount of Routers in the Path
- Each Router:
  - Looks up Destination IP in Routing Table to determine Next-Hop IP
  - Adds a L2 header with Destination MAC next Router's MAC
    - Performs ARP as necessary



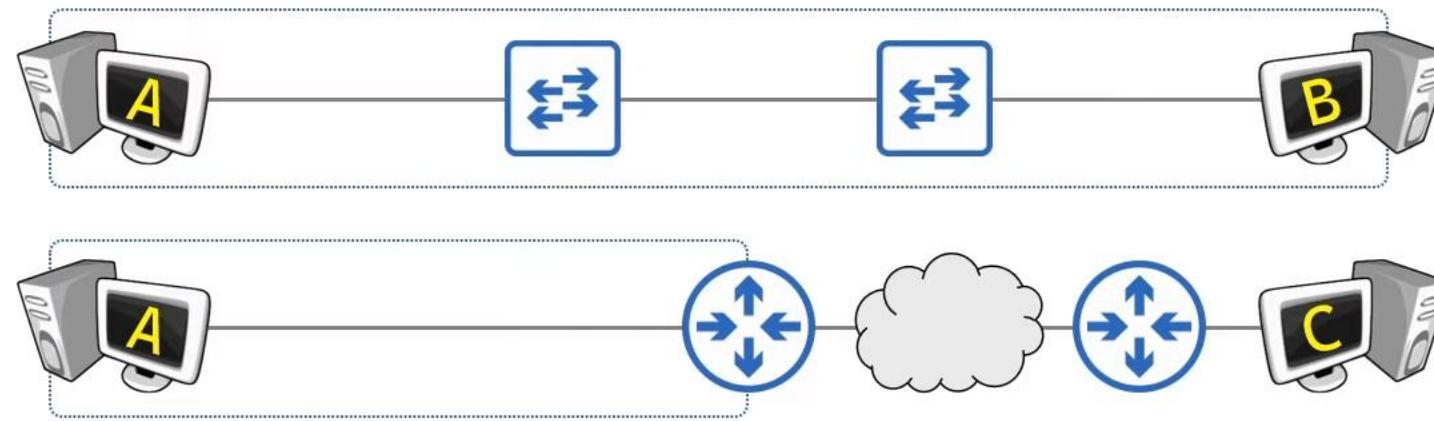
- Events between R2 and R1 would repeat for any amount of Routers in the Path
- Each Router:
  - Looks up Destination IP in Routing Table to determine Next-Hop IP
  - Adds a L2 header with Destination MAC next Router's MAC
    - Performs ARP as necessary



- Events between R2 and R1 would repeat for any amount of Routers in the Path
- Each Router:
  - Looks up Destination IP in Routing Table to determine Next-Hop IP
  - Adds a L2 header with Destination MAC next Router's MAC
    - Performs ARP as necessary

# Packet Traveling

- Summary lesson to Network Fundamentals series
  - *Everything* you need to understand how data flows through a Network



- Data moves through networks based upon three Tables:

**MAC Address Table**

– Mapping of **Switchport** to MAC address

**ARP Table / Cache**

– Mapping of IP Address to MAC address

**Routing Table**

– Mapping of IP Network to Interface or Next Router