HOW DO HOSTS SPEAK ON THE INTERNET

EVERYTHING HOSTS DO TO SPEAK ON THE INTERENT

Different scenarios of hosts connecting to each other

- Hosts connected directly to each other:

- Host connected through a Router:

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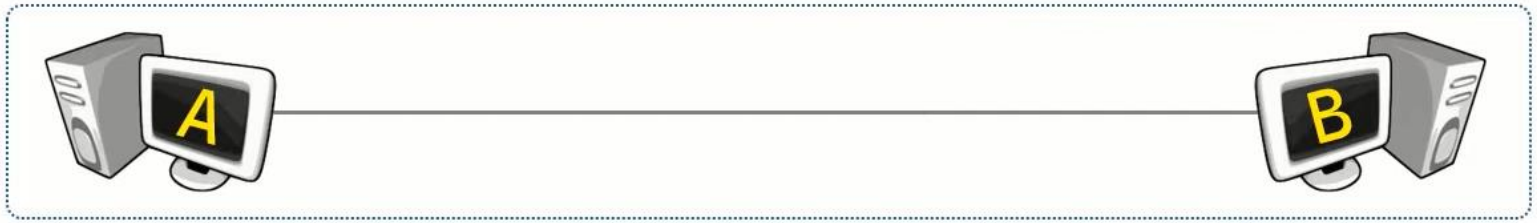

Hosts communicating to another host in the **same** network

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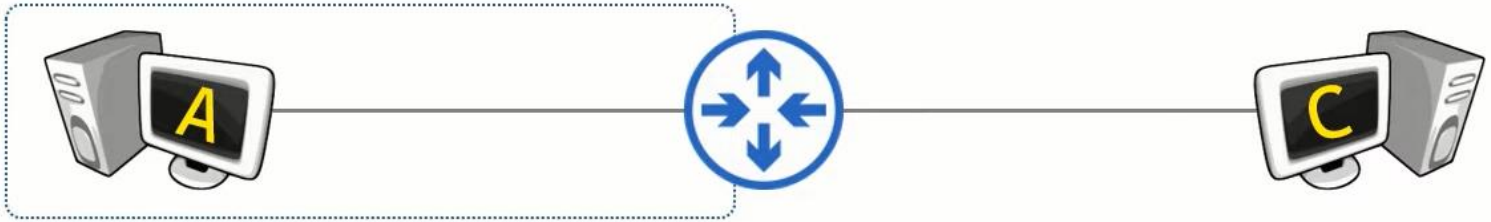

Hosts communicating to another host in a **foreign** network

SCENARIO 1

SCENARIO 1

- Hosts connected directly to each other:

*Hosts communicating to another host in the **same** network*

Everything Hosts do to speak on the Internet

- Host A and B are directly connected
  - Both hosts have a NIC, and therefore a MAC address
  - Both hosts are configured with an IP address and a Subnet Mask

Everything Hosts do to speak on the Internet

- Host A has some Data to send to Host B
  - Networking doesn't care what this data is – it's just `1` and `0`

Everything Hosts do to speak on the Internet

- Host A has some Data to send to Host B
- Host A knows the IP address of Host B
  - Maybe user typed: **`ping 10.1.1.33`**
  - Maybe IP address was acquired from DNS

Everything Hosts do to speak on the Internet

- Host A has some Data to send to Host B
- Host A knows the IP address of Host B
  - Maybe user typed: **`ping 10.1.1.33`**
  - Maybe IP address was acquired from DNS
    - DNS converts Domain Name into an IP address
  - Eg: www.abc.com IP Address – 192.245.123.33
  - Host A knows **`10.1.1.33`** is in its own IP Network

Everything Hosts do to speak on the Internet

- Host A has some Data to send to Host B
- Host A knows the IP address of Host B
- Host A can create the L3 header to attach to the Data
  - Layer 3 – End to End

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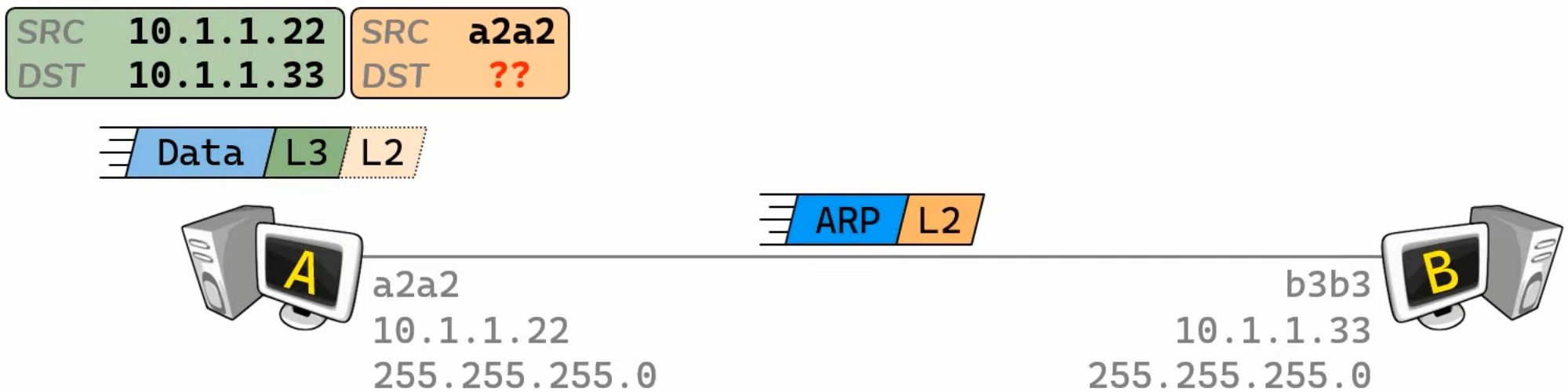
- Host A does not know Host B's MAC address

Everything Hosts do to speak on the Internet

- Host A has some Data to send to Host B
- Host A knows the IP address of Host B
- Host A can create the L3 header to attach to the Data
- Host A does not know Host B's MAC address
  - Host A must use **Address Resolution Protocol** (**ARP**)

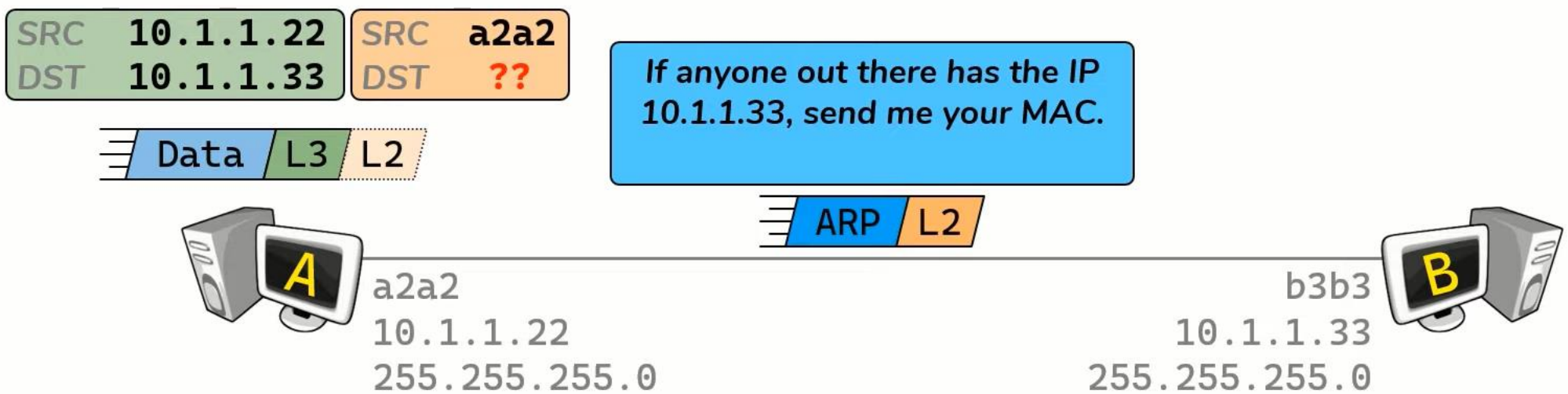
Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address



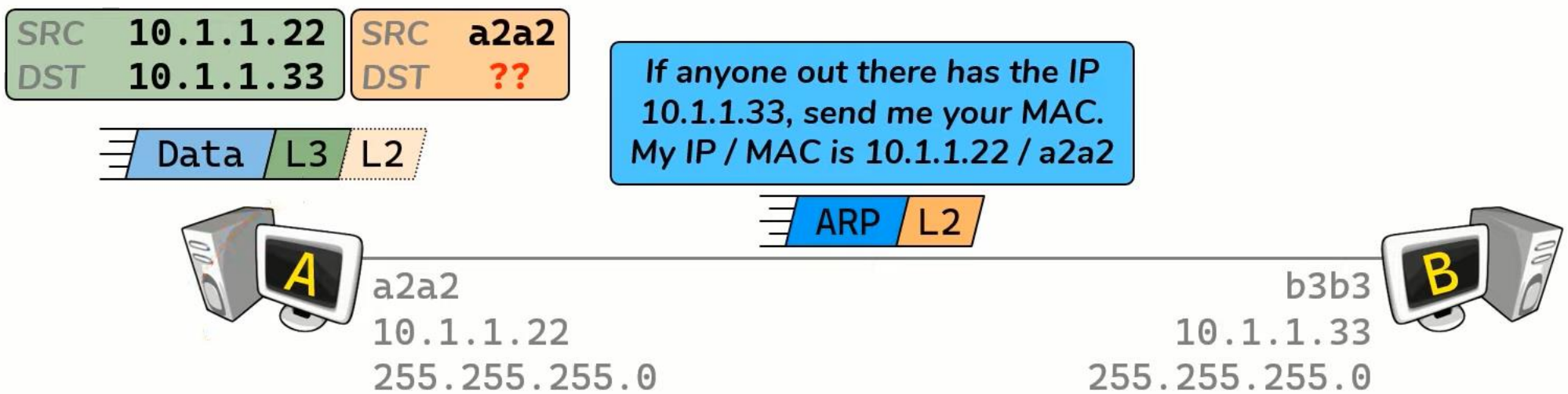
Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address
  - ARP Request asks for the MAC address associated with target IP



Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address
  - ARP Request asks for the MAC address associated with target IP
    - ARP Request includes sender's MAC address



Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address
  - ARP Request asks for the MAC address associated with target IP
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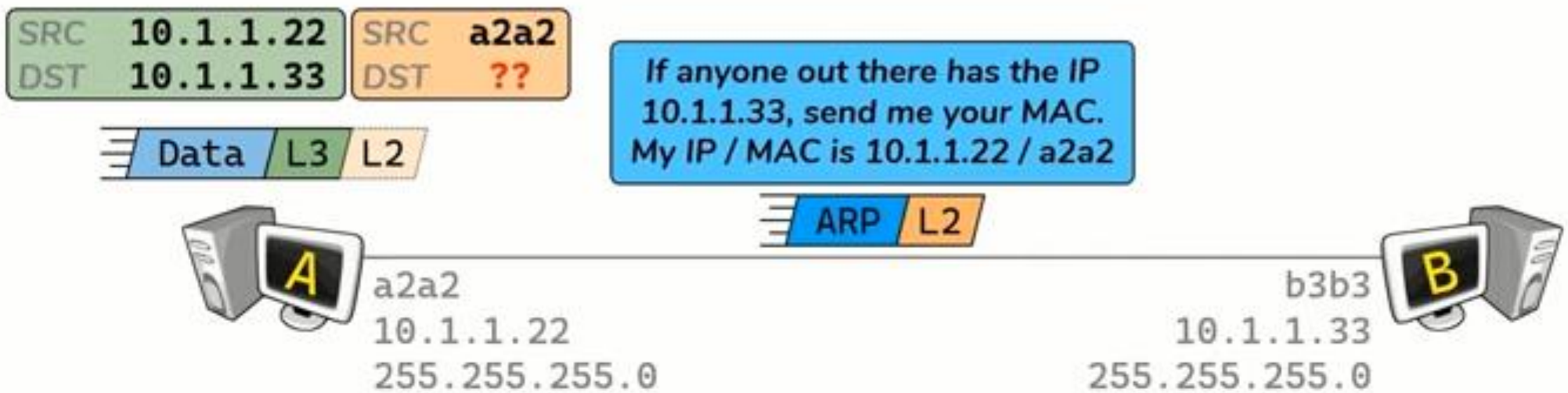
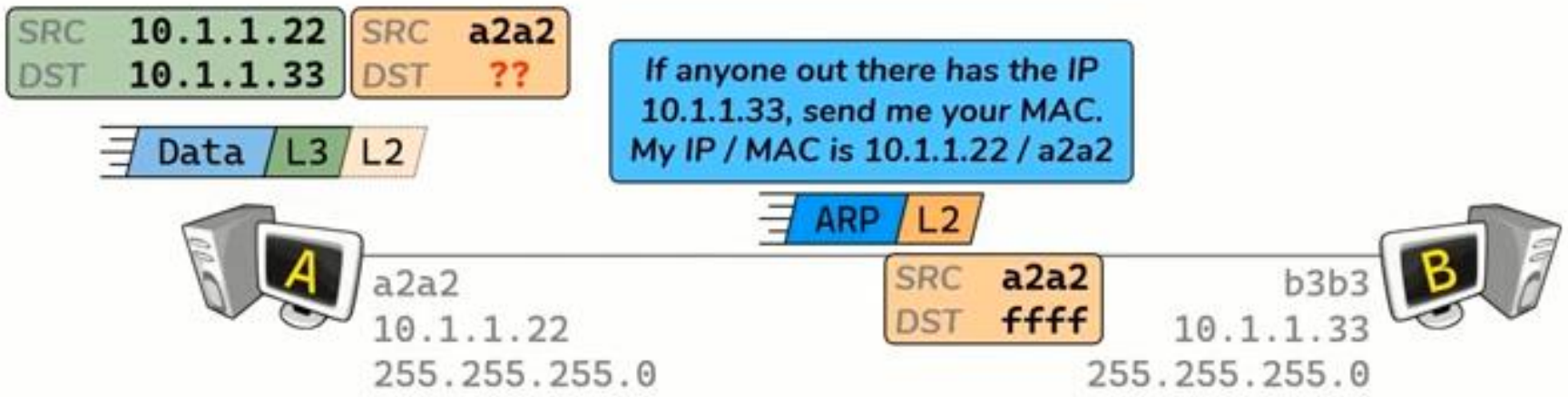
    - ARP Request is a Broadcast – sent to everyone on the network



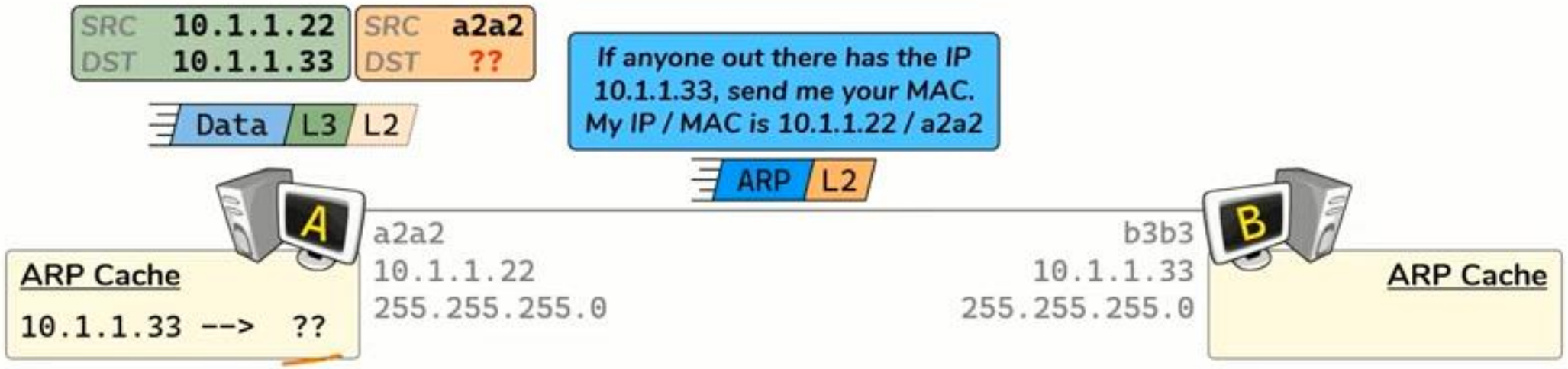
Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address
  - ARP Request asks for the MAC address associated with target IP
    - ARP Request includes sender's MAC address
    - ARP Request is a Broadcast – sent to everyone on the network
      - Destination MAC address: `ffff.ffff.ffff`
      - Reserved MAC address to send a packet to everyone on the local network



Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address
  - ARP Request asks for the MAC address associated with known IP
  - ARP Mappings are stored in an ARP Cache



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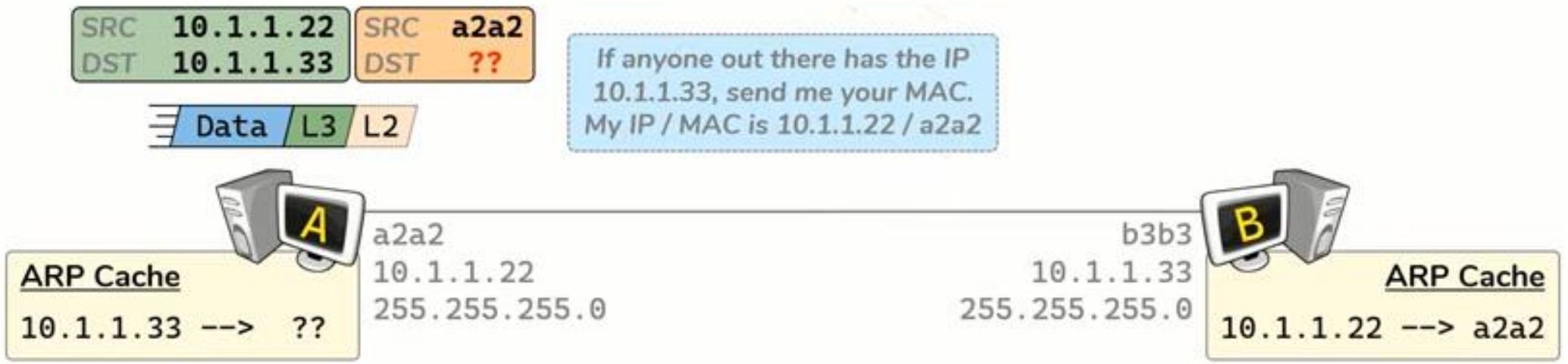

Everything Hosts do to speak on the Internet

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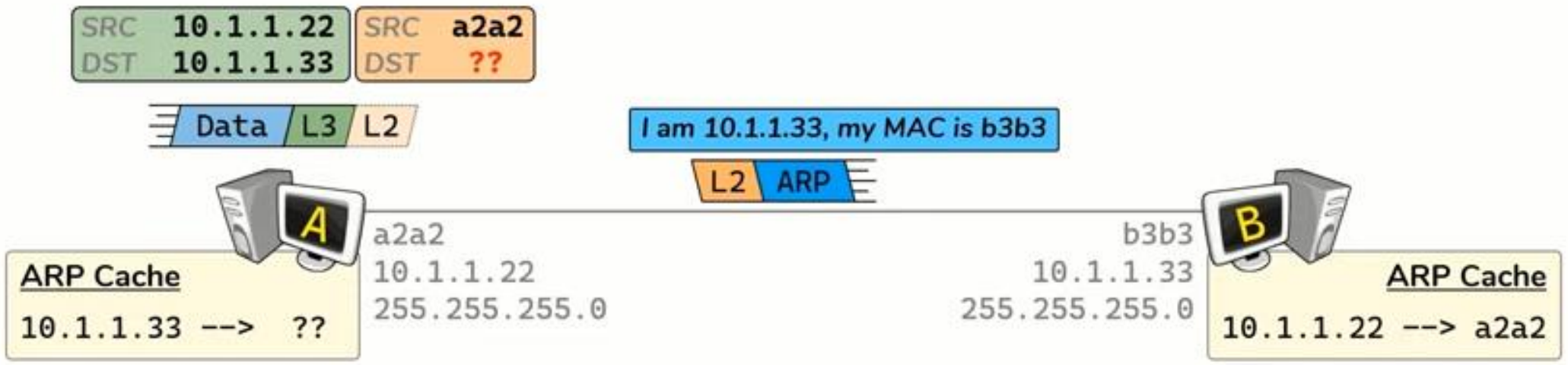
  - Host B responds by sending an ARP Response



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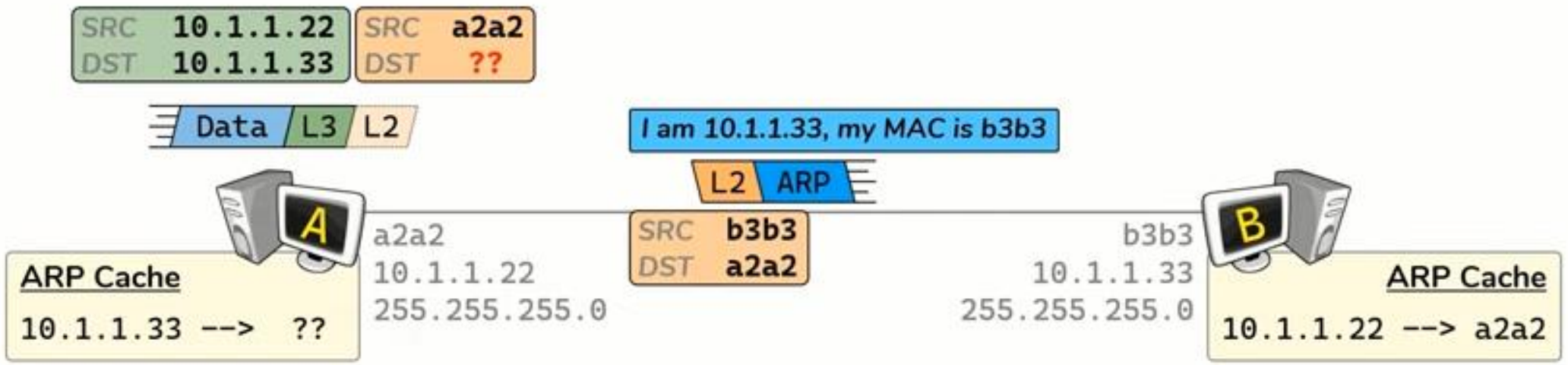

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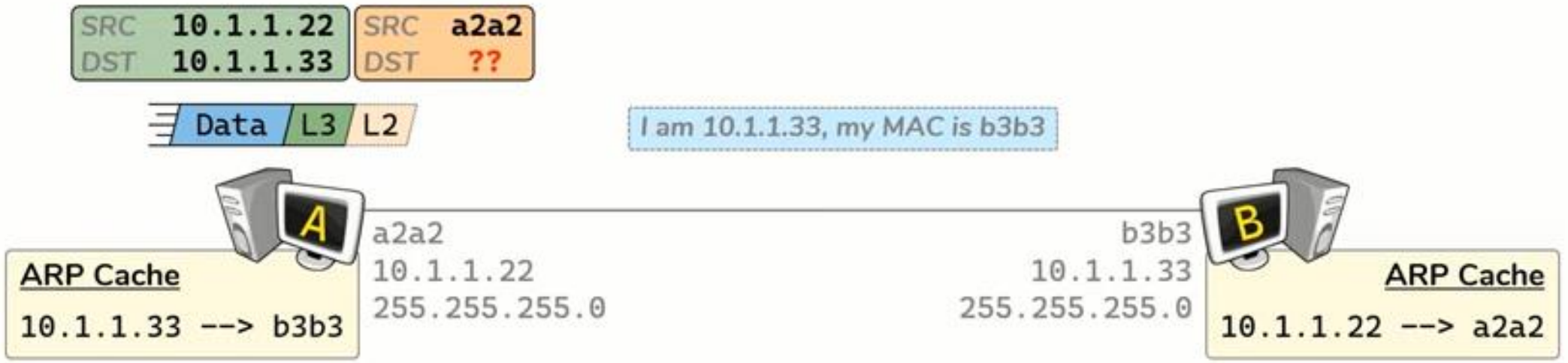
  - ARP Request asks for the MAC address associated with known IP
  - ARP Mappings are stored in an ARP Cache
  - Host B responds by sending an ARP Response
    - Response is sent Unicast (directly to Host A)
  - Host A populates it's ARP cache with Host B's IP/MAC mapping



Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address
- Host A creates L2 header

Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address
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Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address
- Host A creates L2 header
- Data is sent to Host B
  - L2 header is discarded

Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address
- Host A creates L2 header
- Data is sent to Host B
  - L2 header is discarded
  - L3 header is discarded

Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve target's MAC address
- Host A creates L2 header
- Data is sent to Host B
  - L2 header is discarded
  - L3 header is discarded
  - Data is processed by Application

Everything Hosts do to speak on the Internet

- Host B has necessary information to respond

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Everything Hosts do to speak on the Internet

- Host B has necessary information to respond
  - ARP cache is already populated

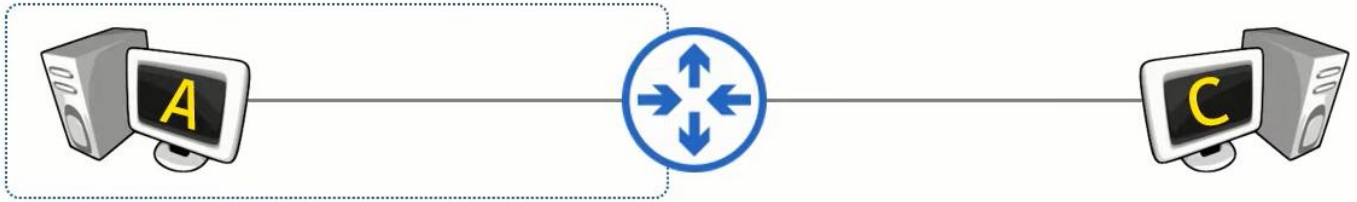
Everything Hosts do to speak on the Internet

- Host B has necessary information to respond
  - ARP cache is already populated
- Further data exchange between hosts is simple
  - Both hosts have what they need to create L3 and L2 headers

SCENARIO 2

SCENARIO 2

- Host connected through a Router:



*Hosts communicating to another host in a **foreign** network*

HOW MANY MAC ADDRESSES DOES A ROUTER HAVE?

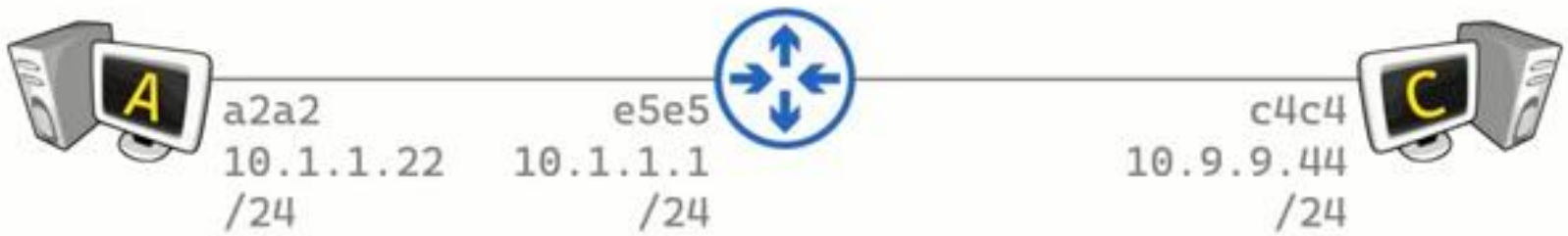
The modern-day router has a minimum of three MAC addresses for its three network interfaces.

- **WAN (Wide Area Network)**: A public network interface that comprises several LANs (Local Area Networks) or the internet.
- **Wired LAN (Ethernet)**: A network interface that connects multiple devices with ethernet cables to set up a LAN.
- **Wireless LAN (Wi-Fi)**: A network interface linking two or more devices through Wi-Fi (wireless communication) to form a LAN.

The more ports your router has, the more MAC addresses it will have—since each port has a NIC and each NIC has a MAC address. The MAC address behind a router is typically the WAN interface's address.

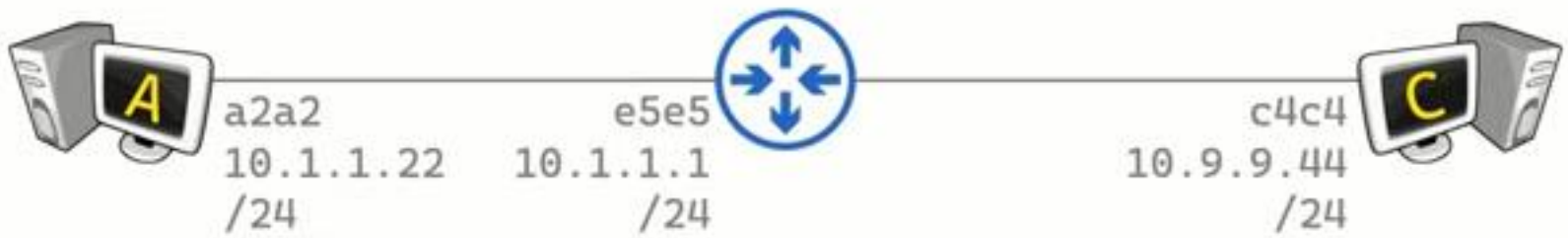
Everything Hosts do to speak on the Internet

- Host A, Host C, and the Router have MAC and IP addresses



Everything Hosts do to speak on the Internet

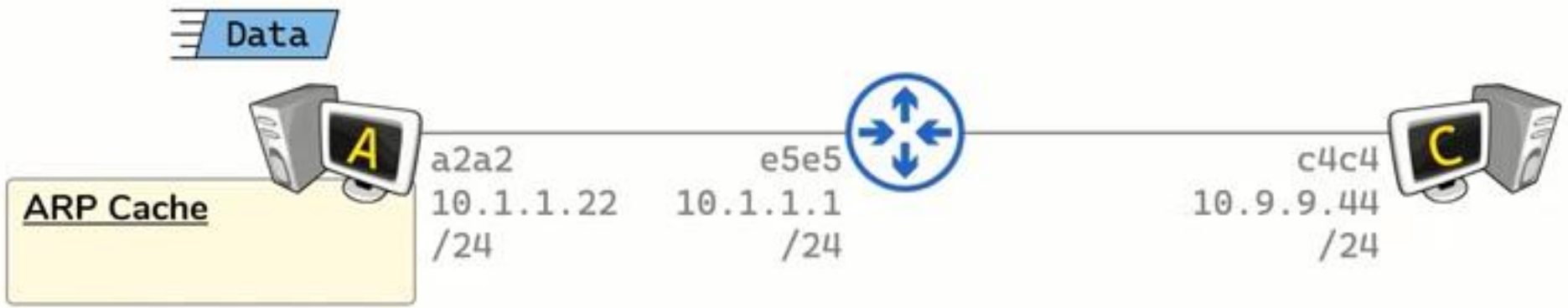
- Host A, Host C, and the Router have MAC and IP addresses
  - `/24` is a Subnet Mask – `255.255.255.0`



Everything Hosts do to speak on the Internet

- Host A, Host C, and the Router have MAC and IP addresses
  - `/24` is a Subnet Mask – `255.255.255.0`

- Host A has some data to send to Host C
  - Host A knows Host C's IP address
    - Provided by the User or the Application
  - Host A knows Host C's IP address is on a **foreign** network



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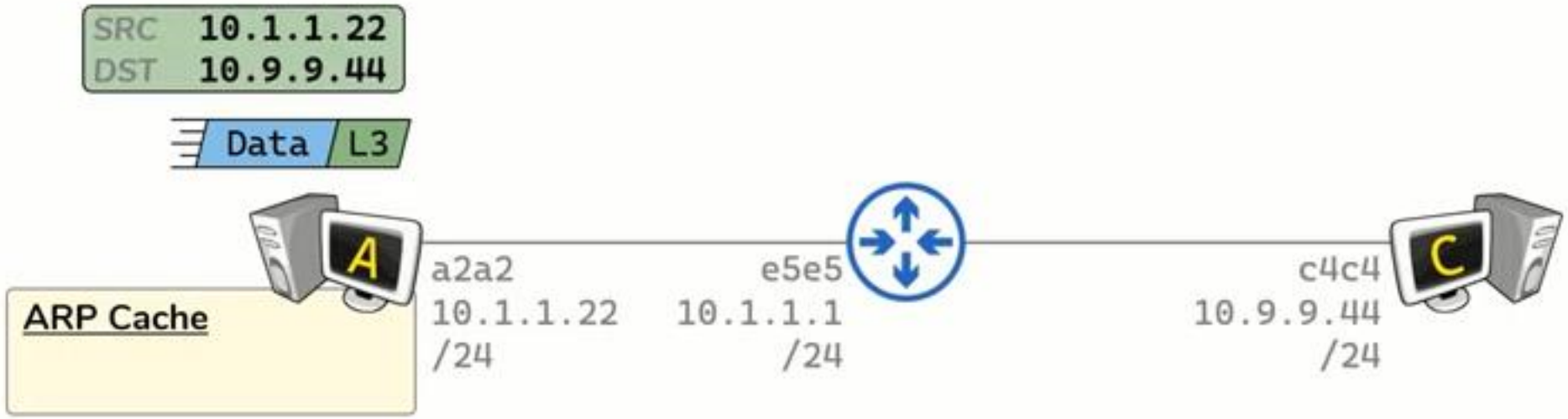

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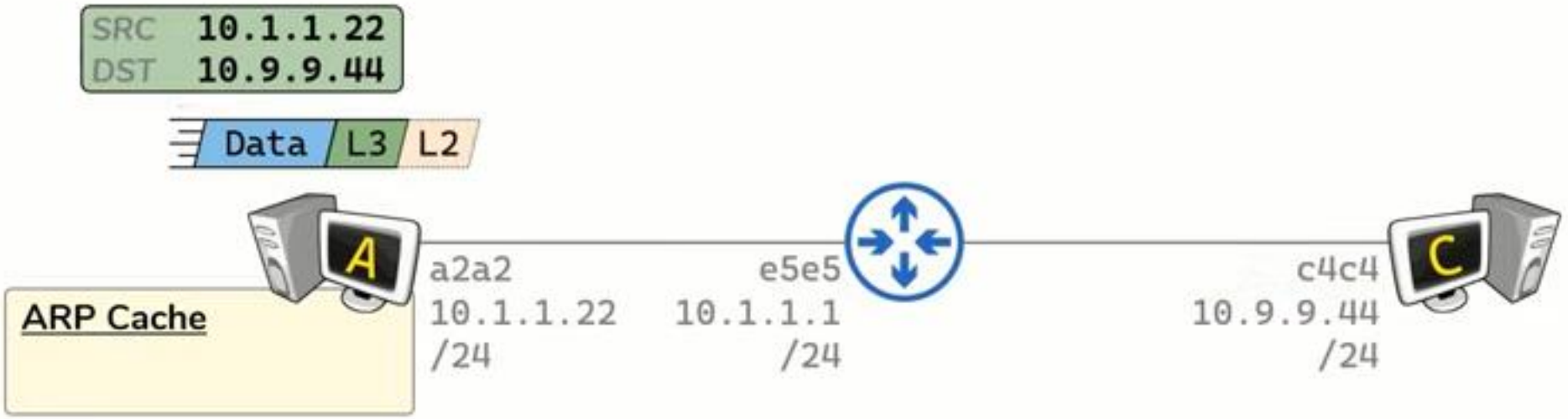

Everything Hosts do to speak on the Internet

- Host A creates a L3 header
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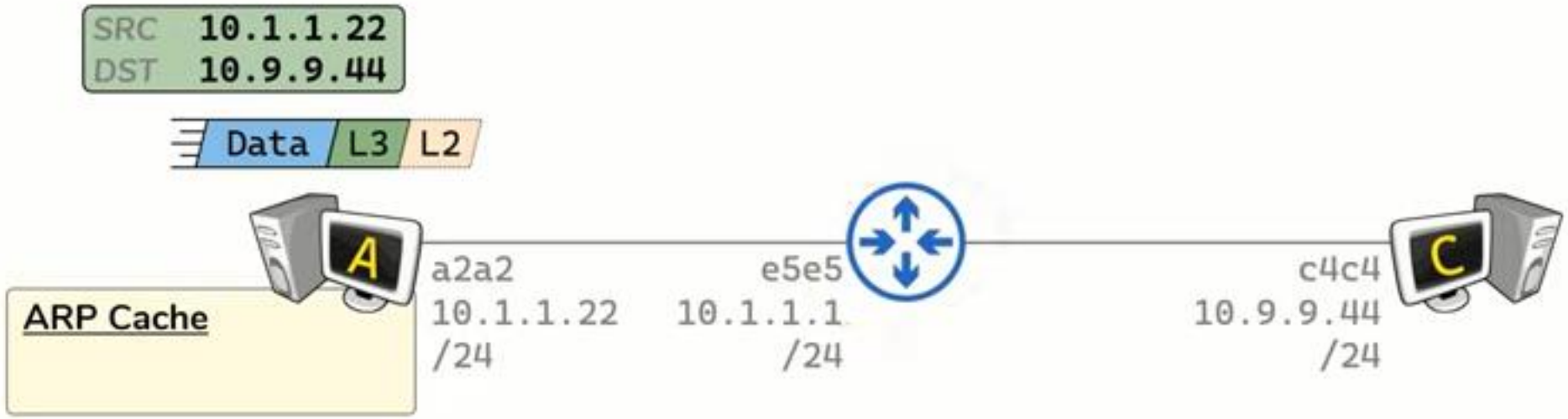
  - Layer 2 – Hop to Hop
  - Next Hop is the Router



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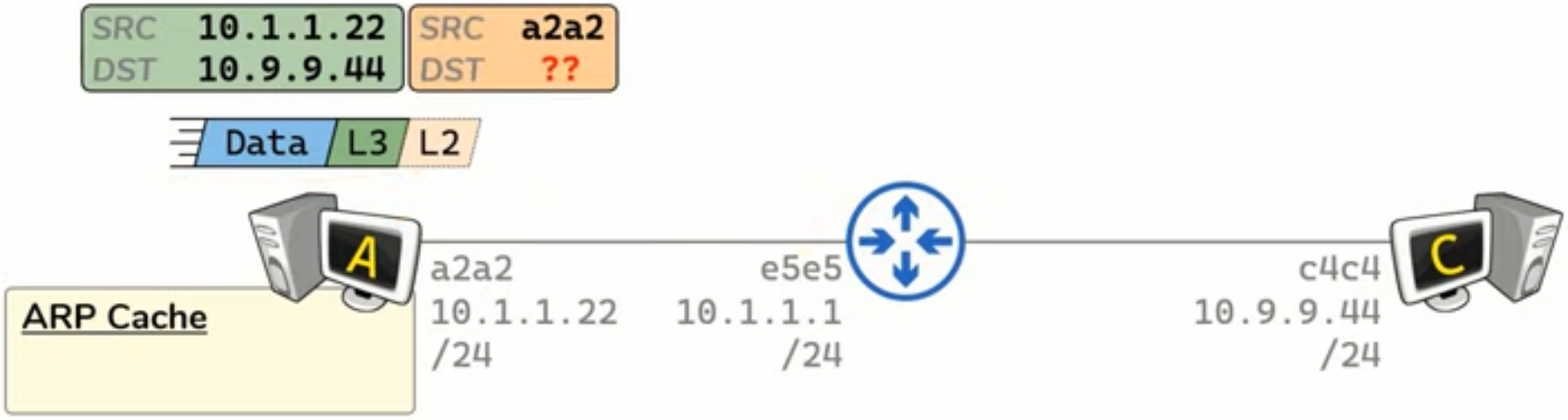

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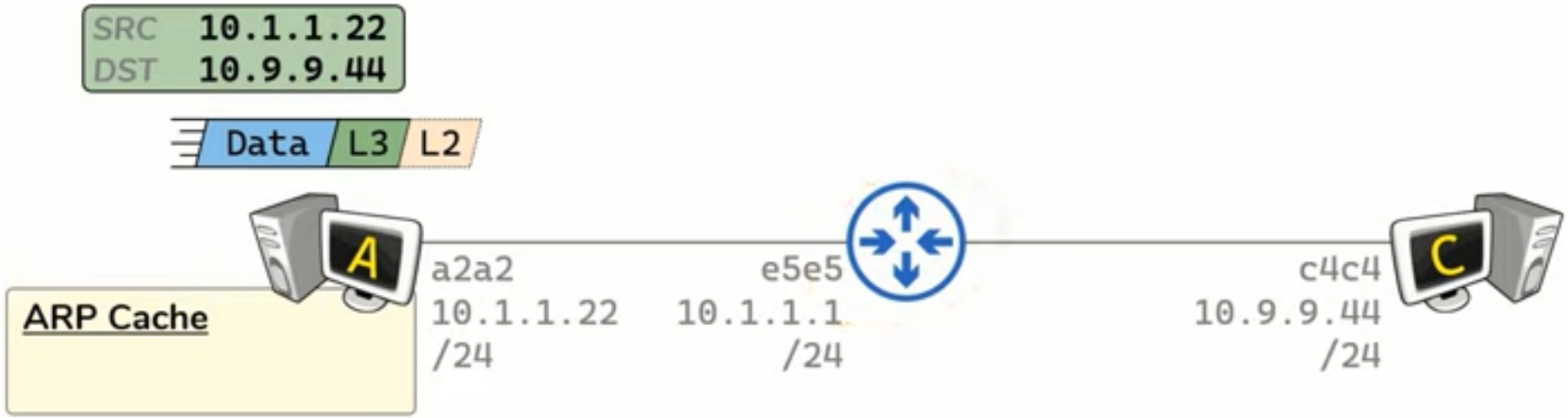
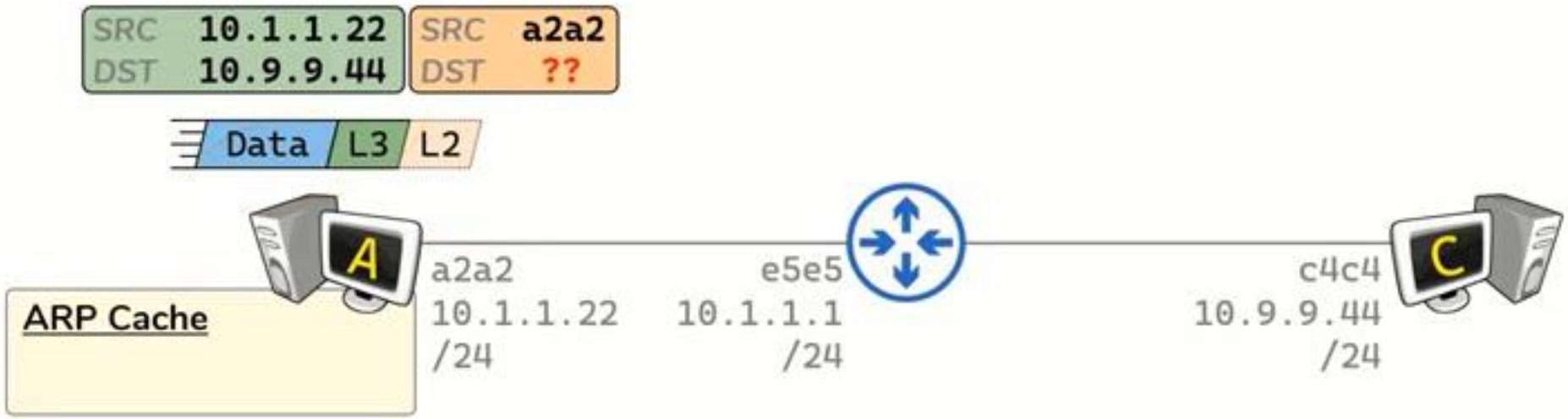


Everything Hosts do to speak on the Internet

- Host A uses ARP to resolve the MAC address of the Router's IP



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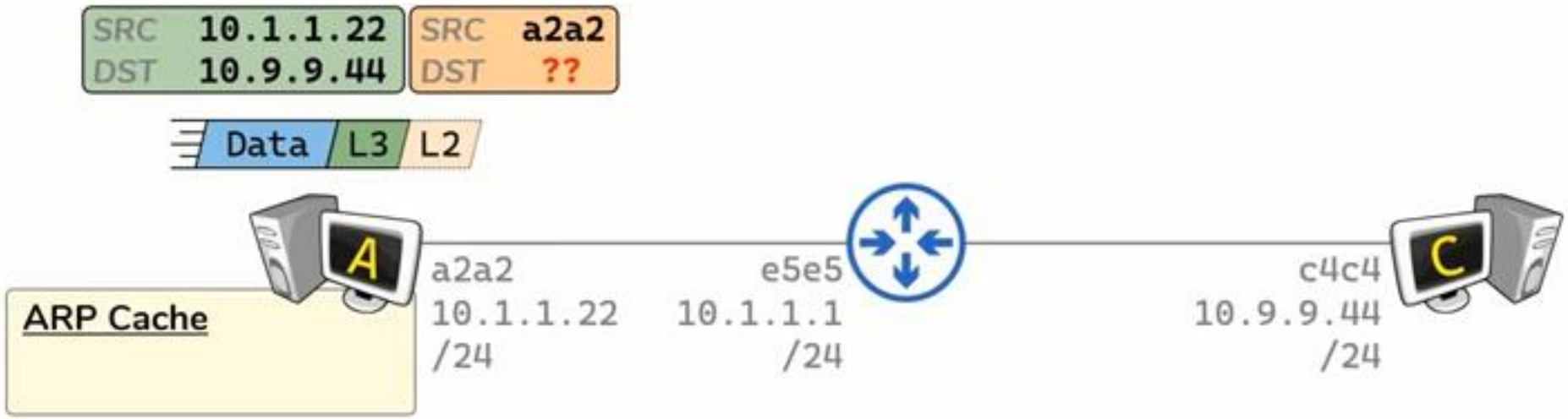
- Host A uses ARP to resolve the MAC address of the Router's IP
  - Router IP address is configured as the **Default Gateway**



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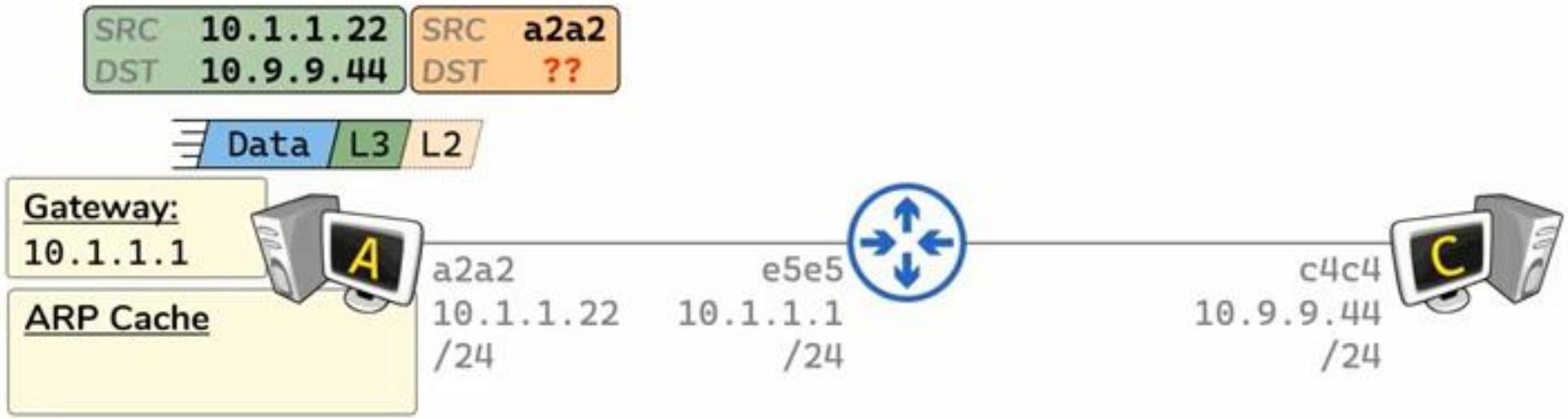
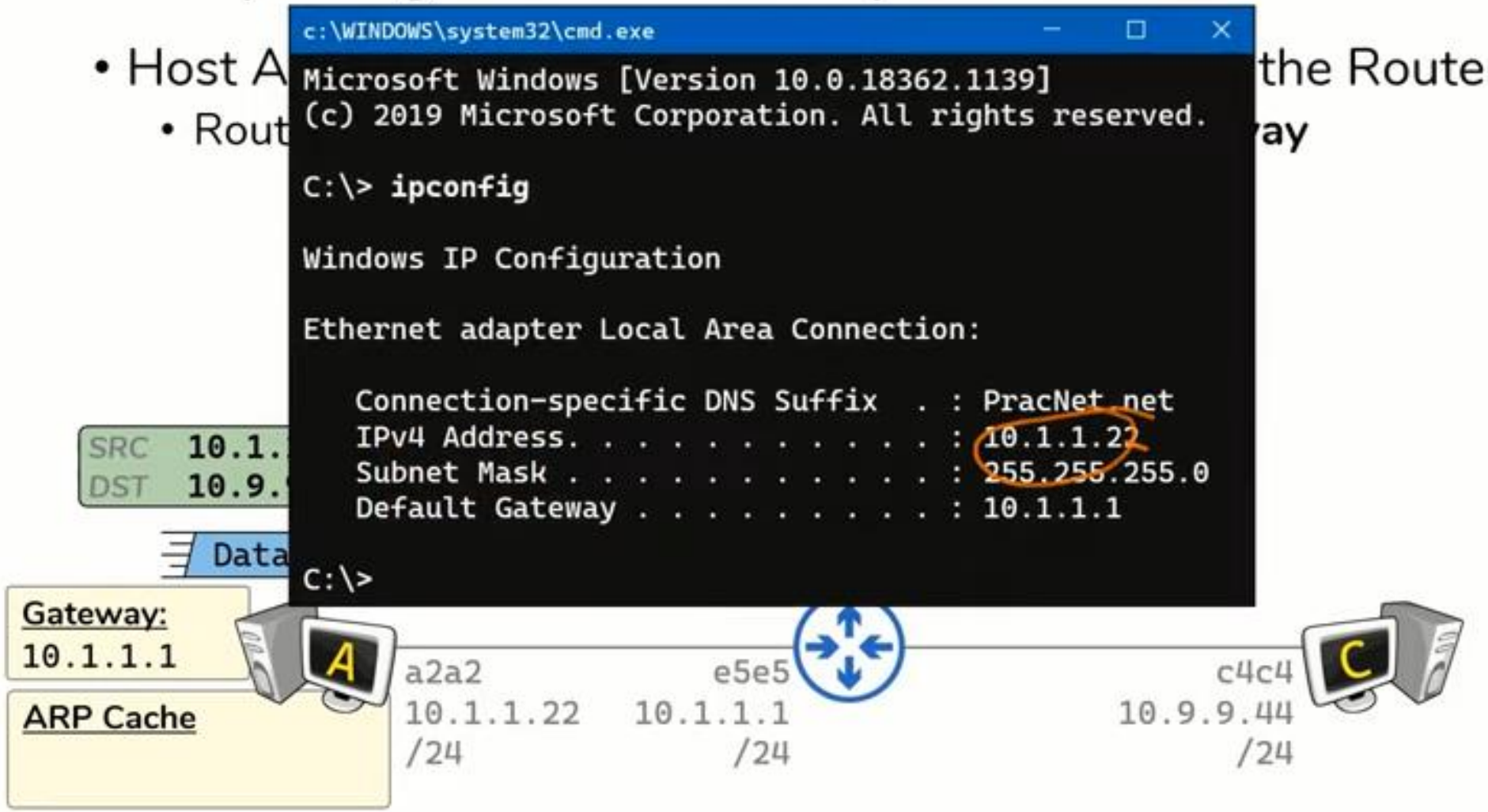


Everything Hosts do to speak on the Internet

- Host A … the Router's IP
  - Rout … way



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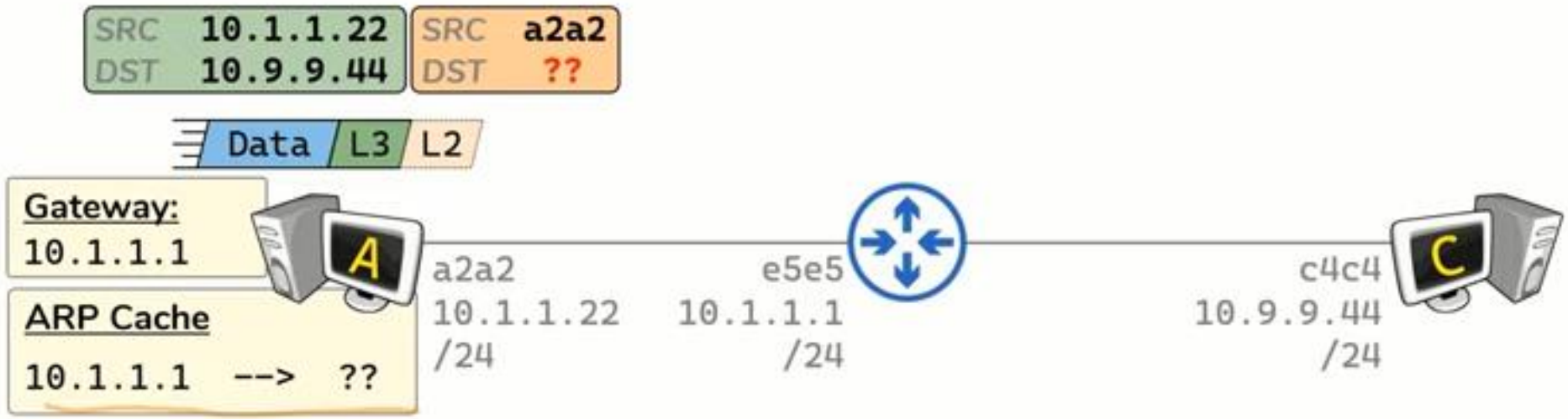

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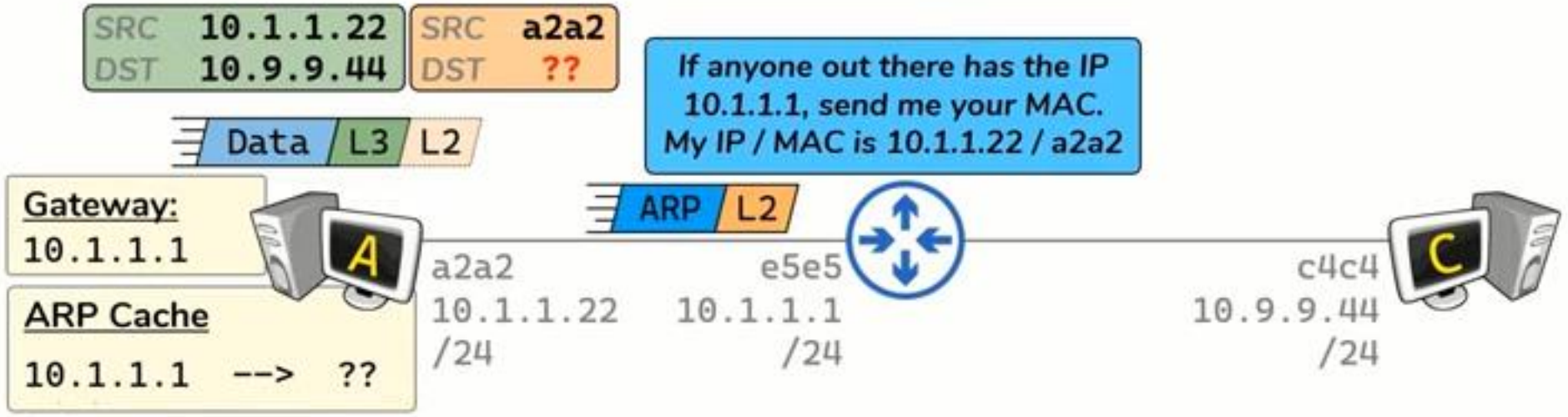

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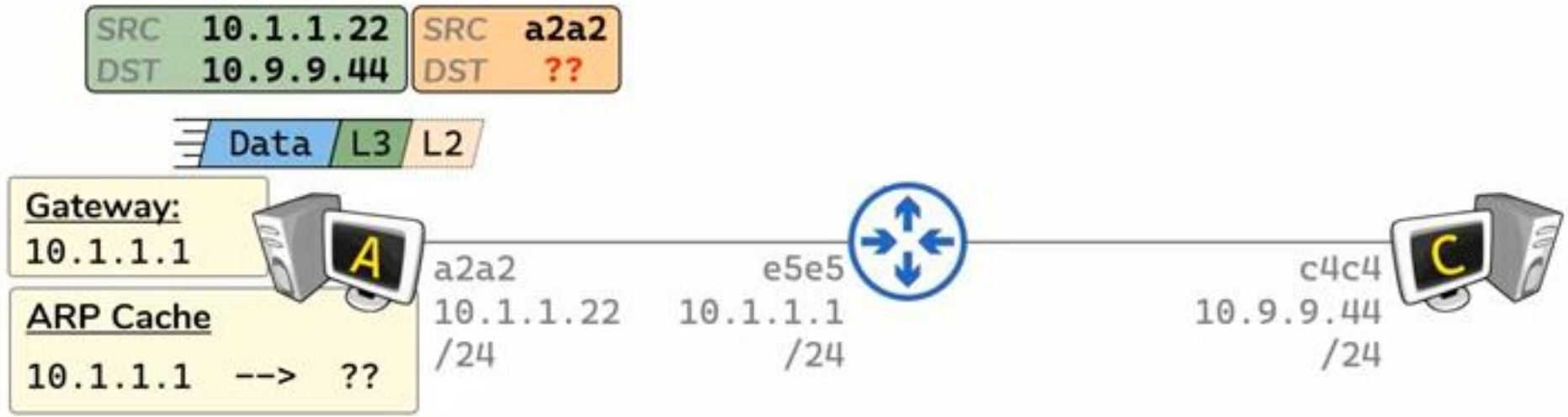

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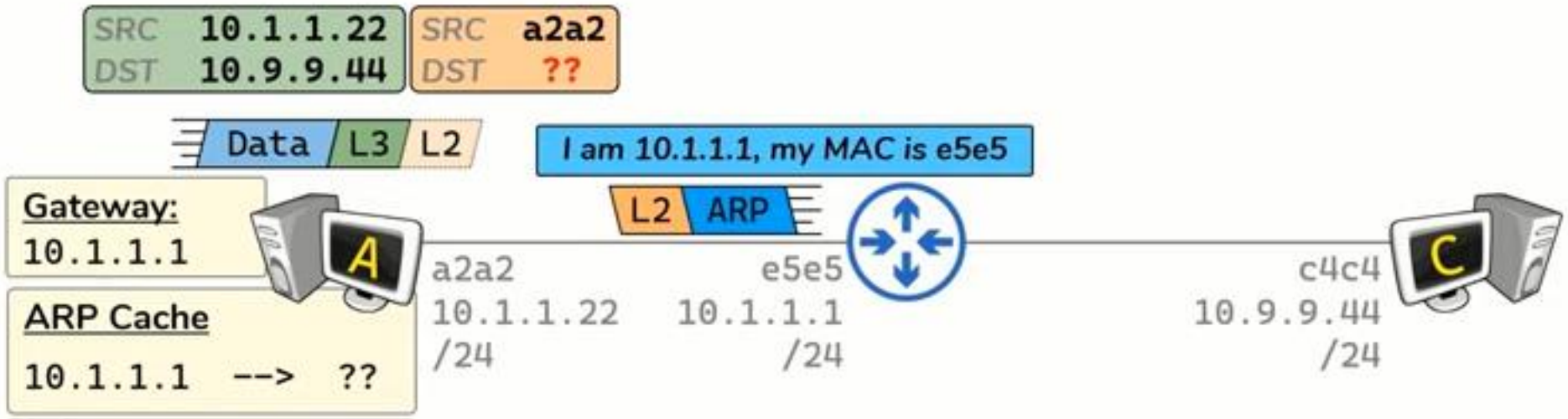

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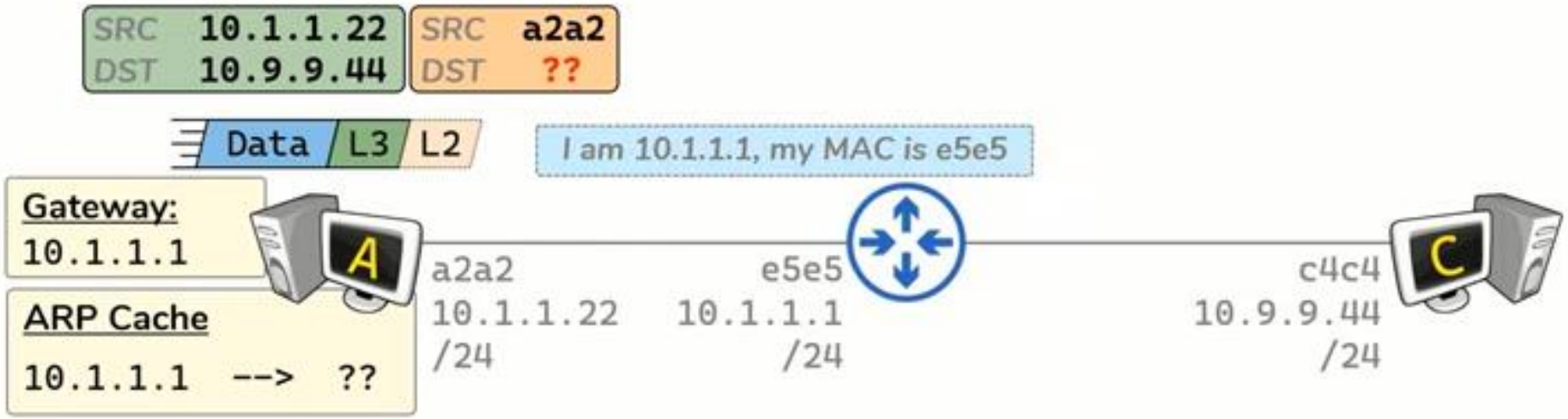

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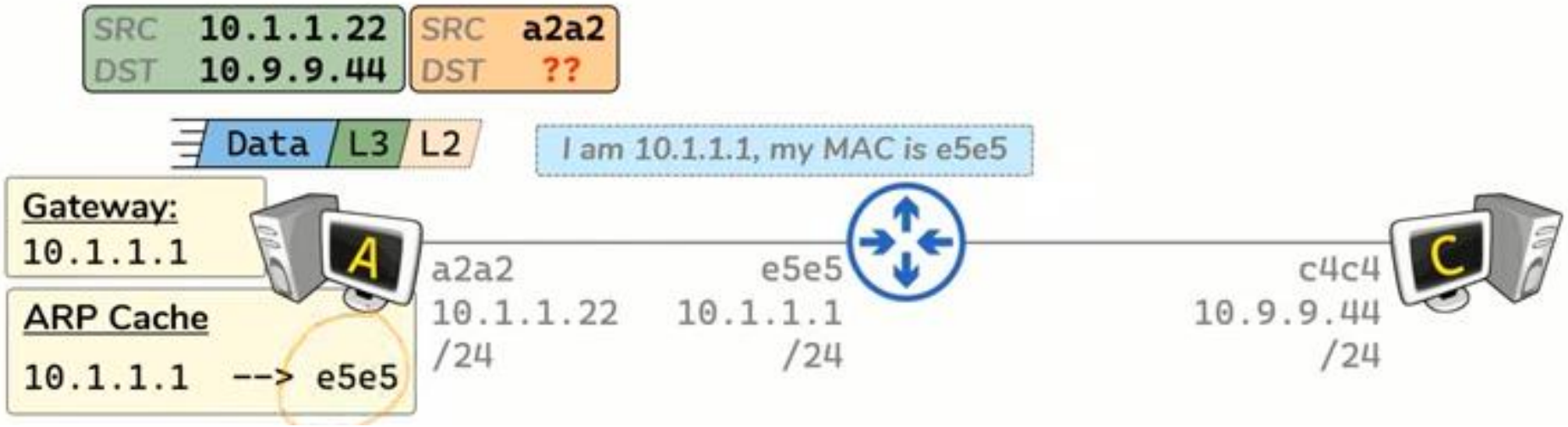

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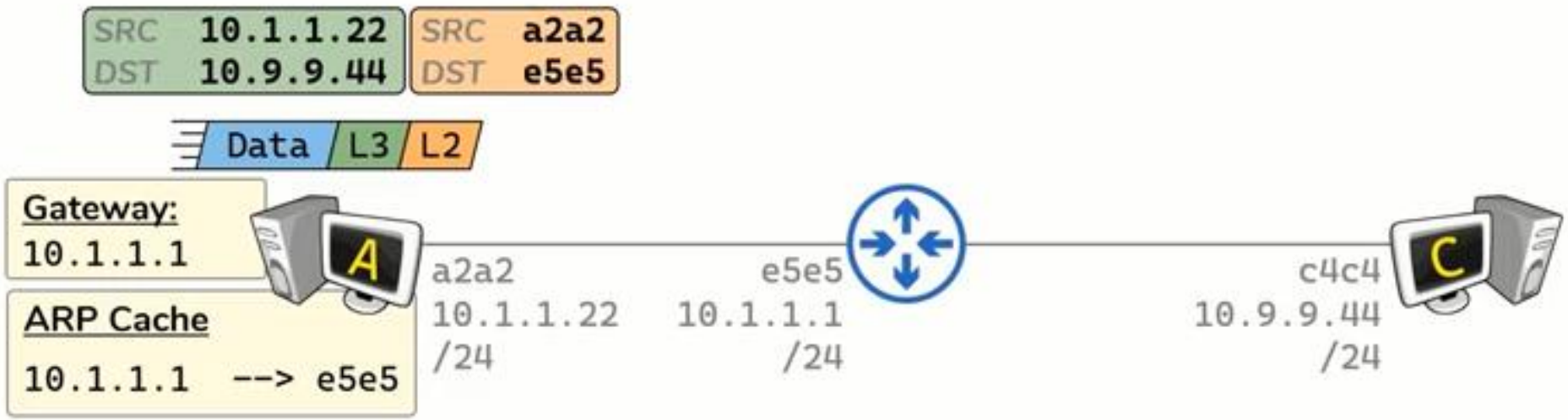
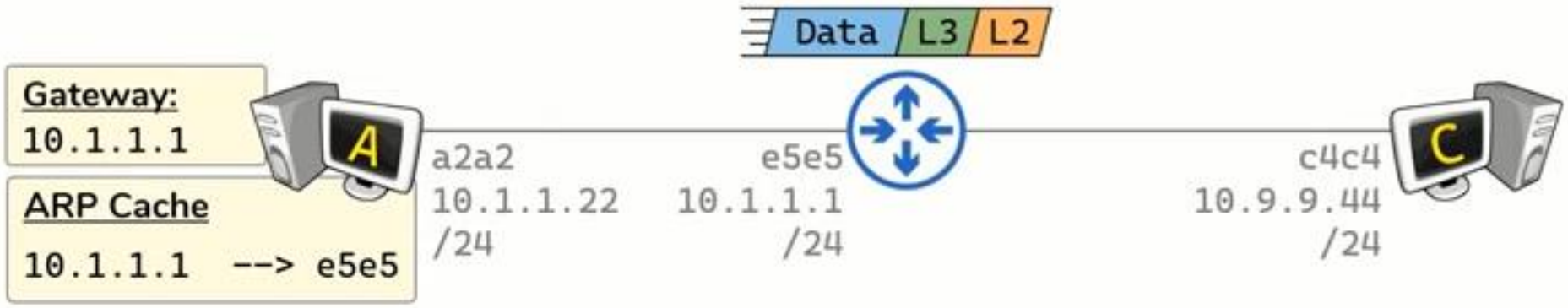


Everything Hosts do to speak on the Internet

- Host A creates L2 header
  - Layer 2 – Hop to Hop
- Data is sent to the Router



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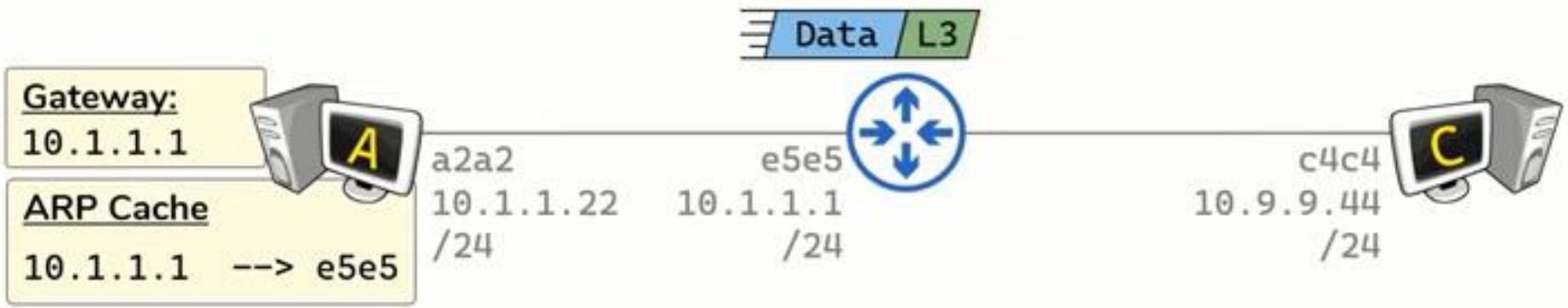
- Data is sent to the Router
  - L2 header is discarded



Everything Hosts do to speak on the Internet

- Host A creates L2 header
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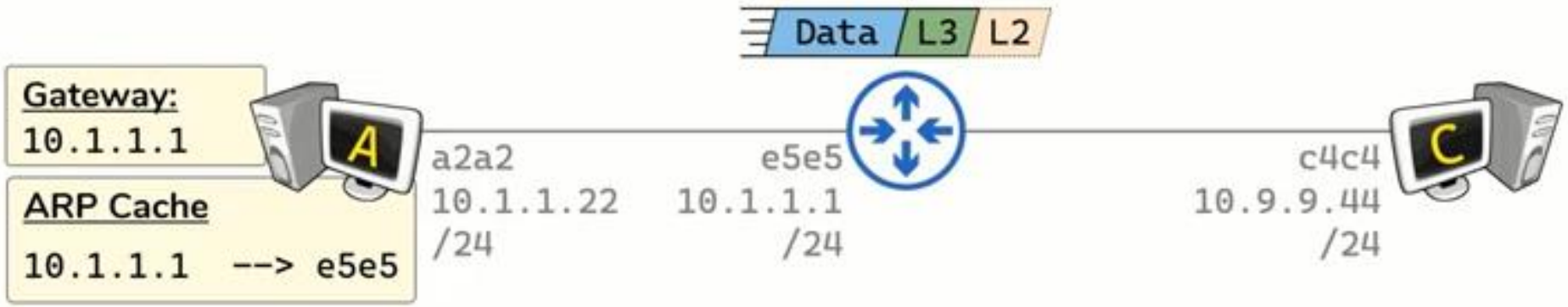
- Data is sent to the Router
  - L2 header is discarded
  - Router takes over from this point



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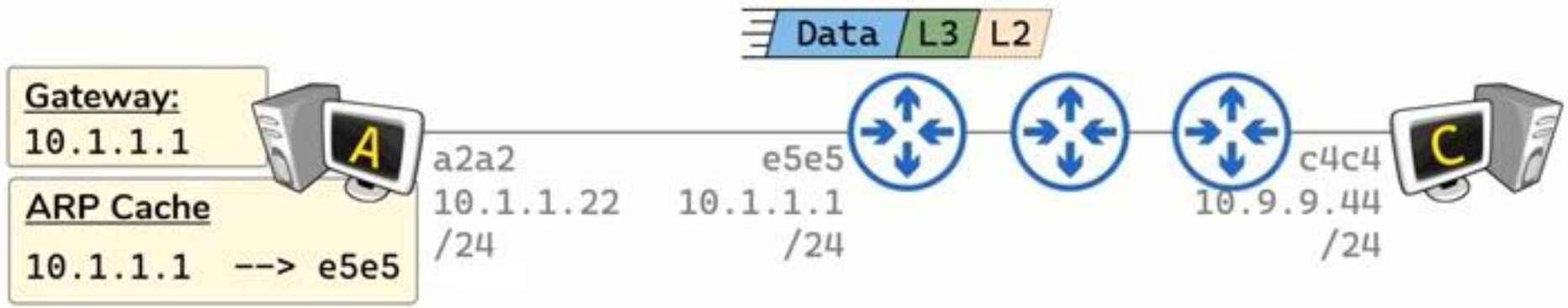

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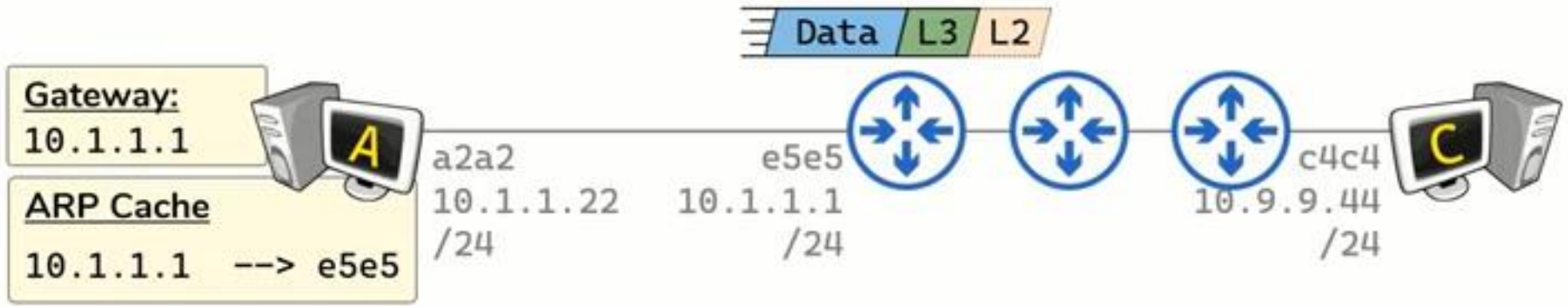
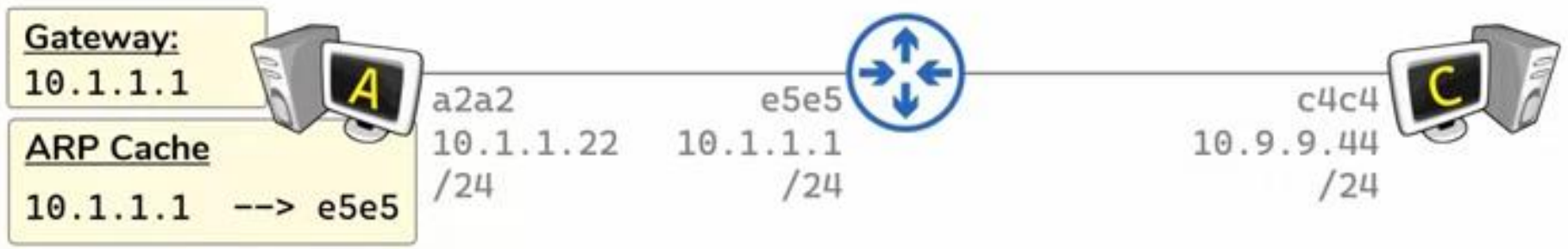
  - Host A's job is done



Everything Hosts do to speak on the Internet



Everything Hosts do to speak on the Internet

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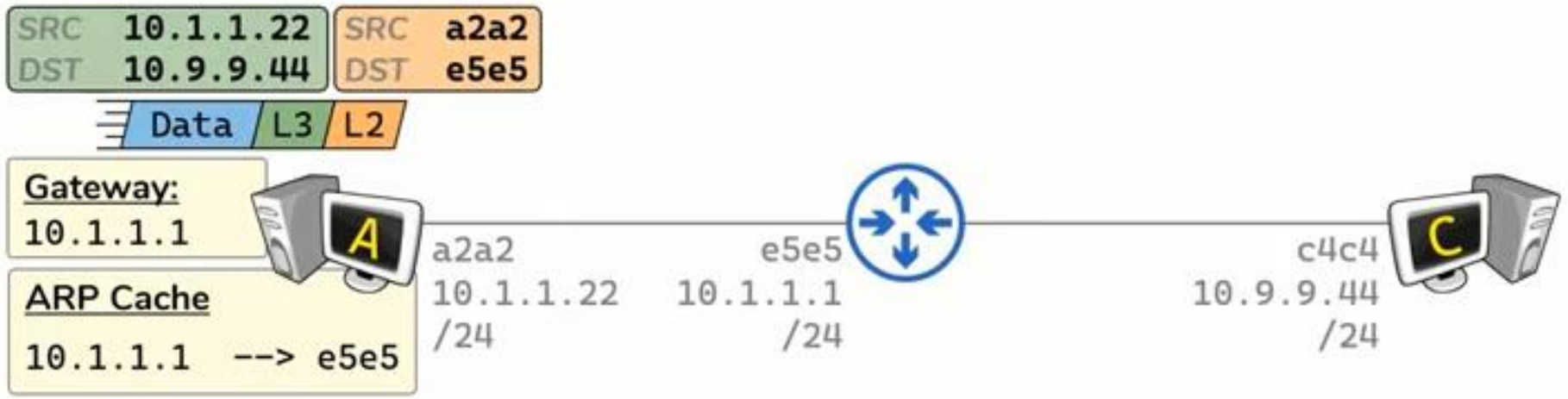

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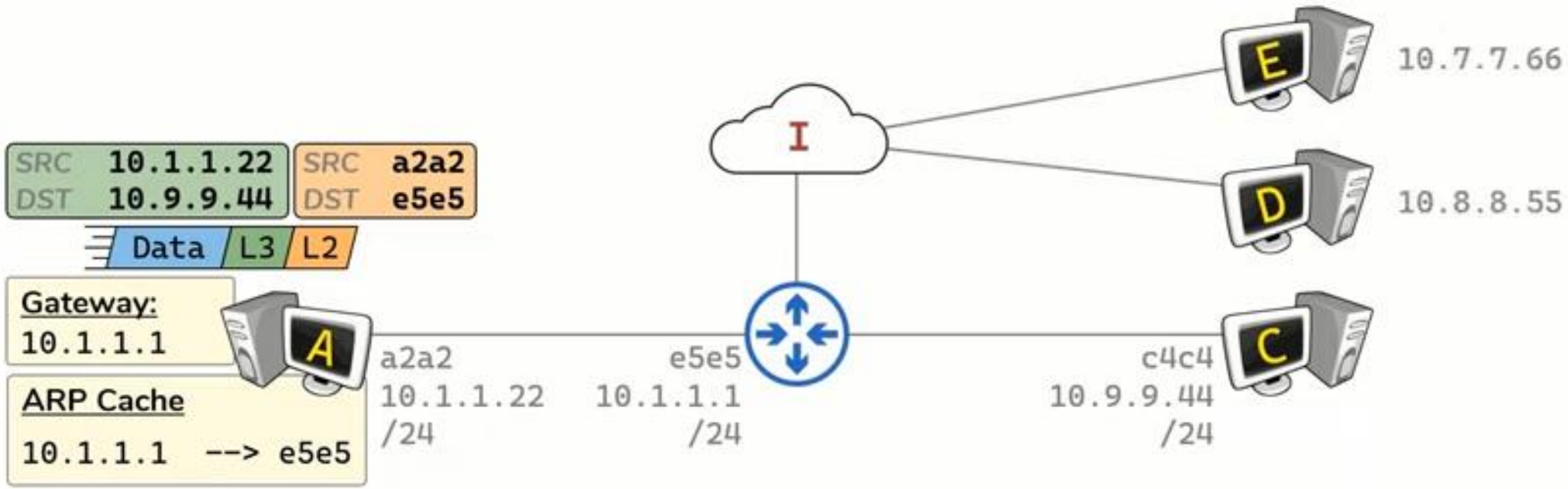

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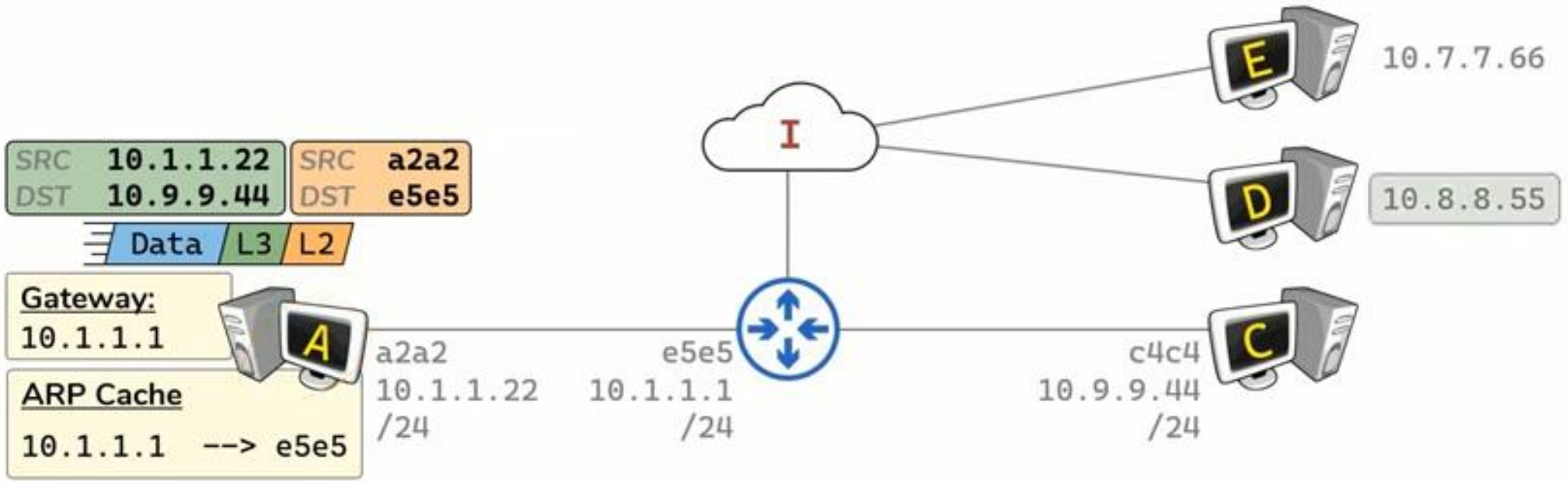

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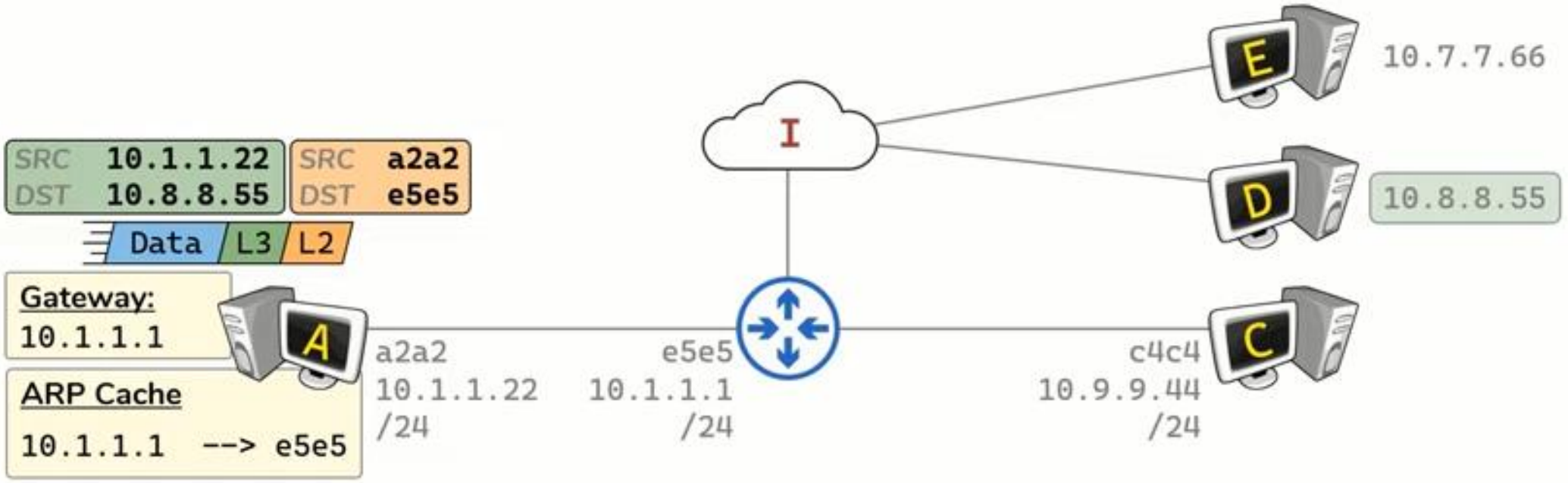

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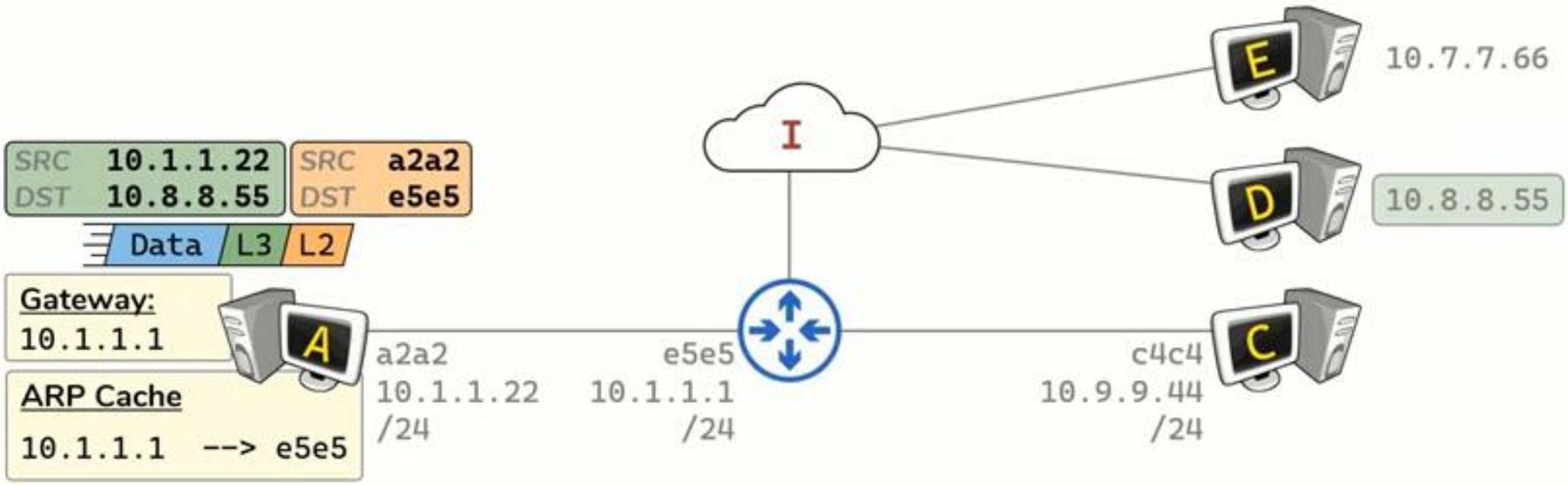

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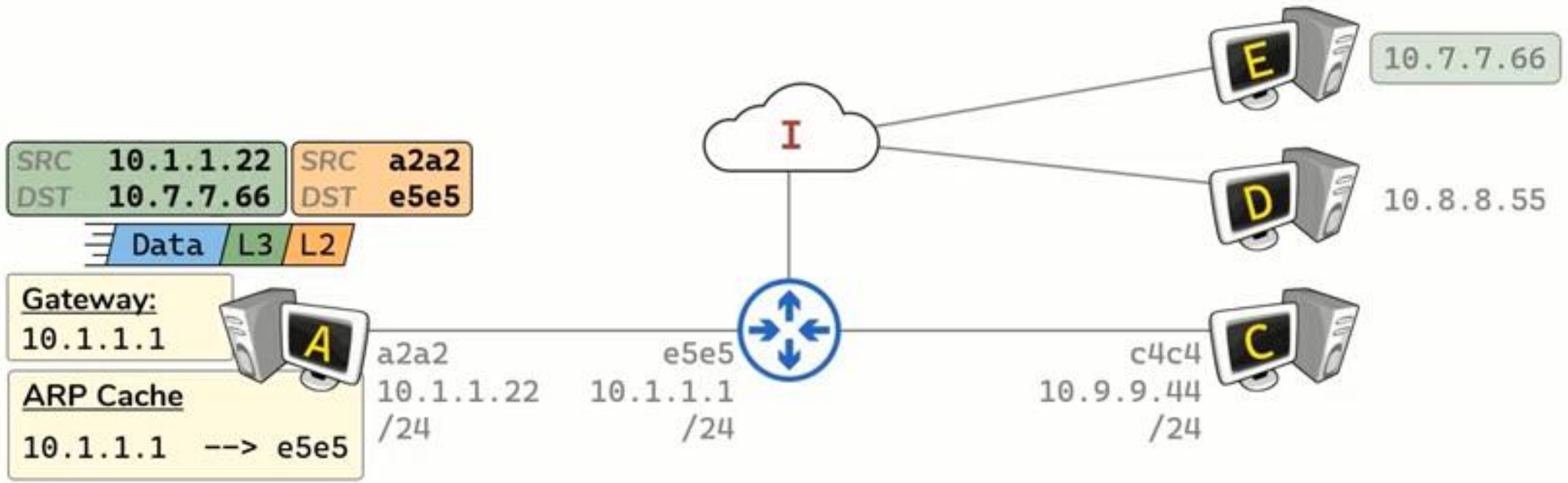

Everything Hosts do to speak on the Internet

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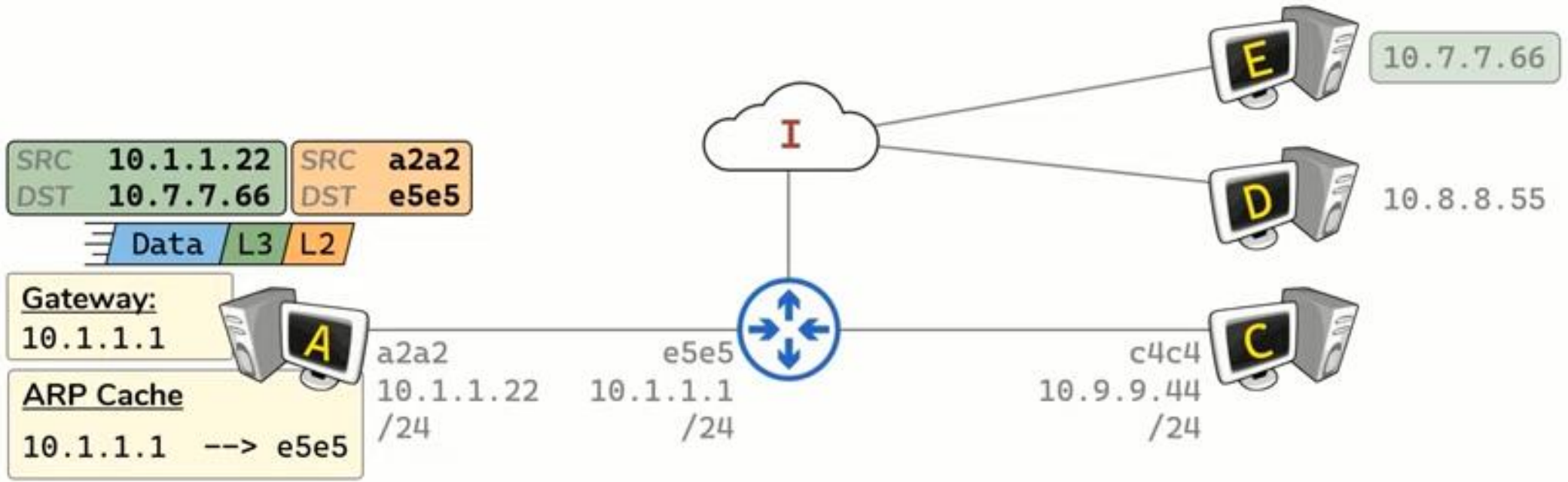

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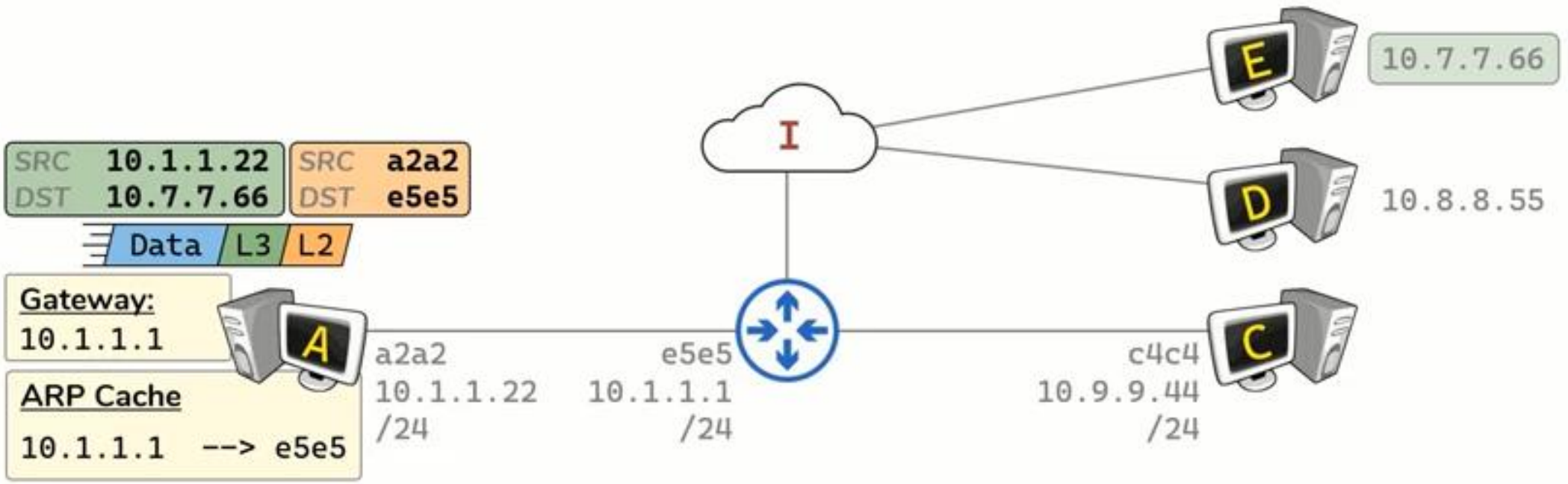

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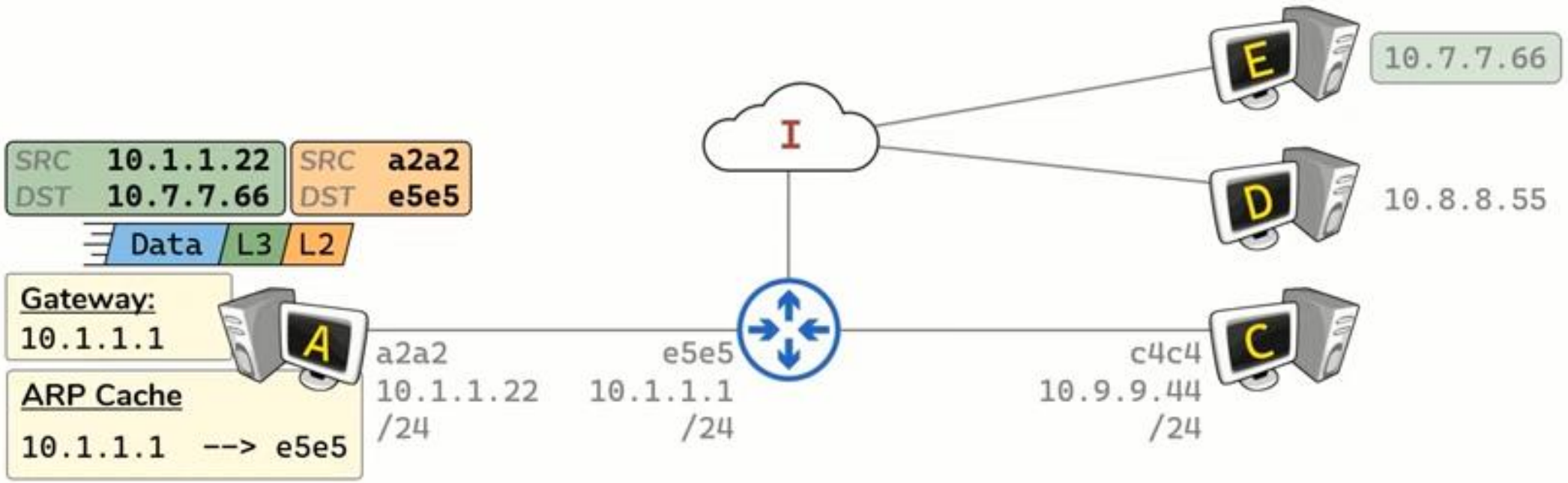

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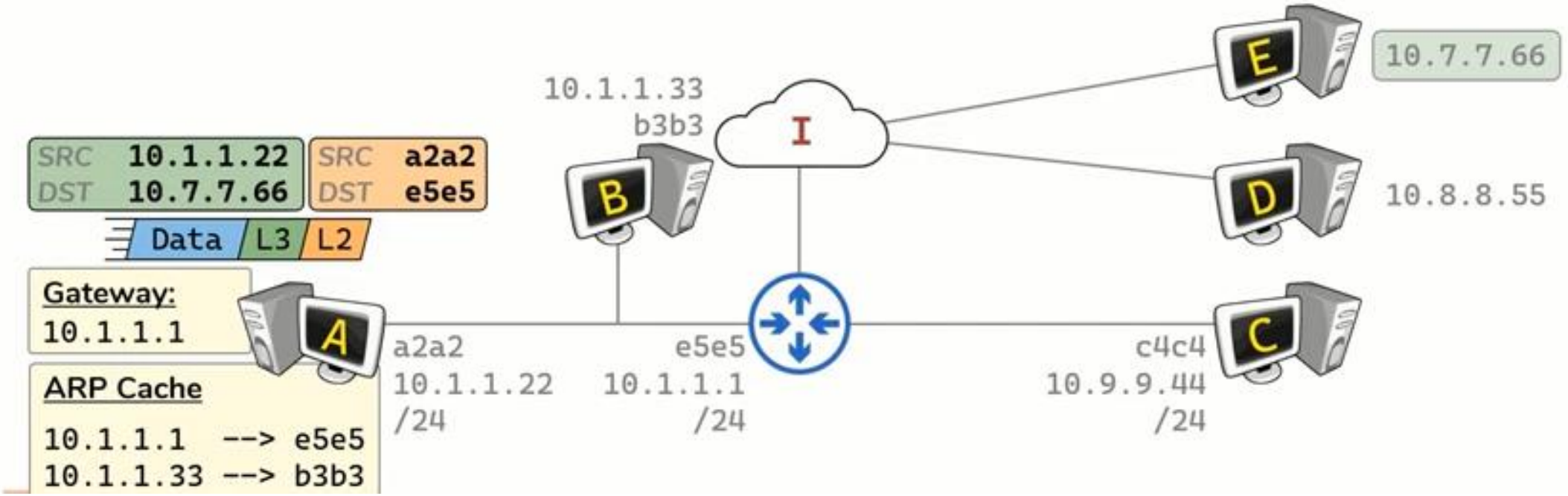

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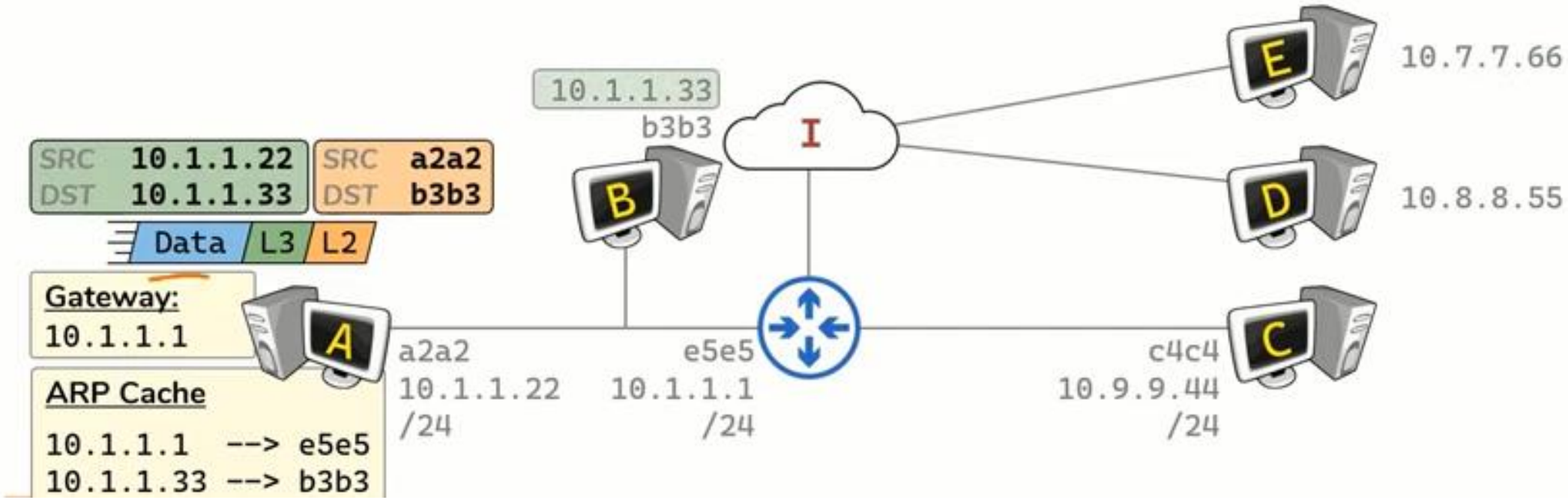

Everything Hosts do to speak on the Internet

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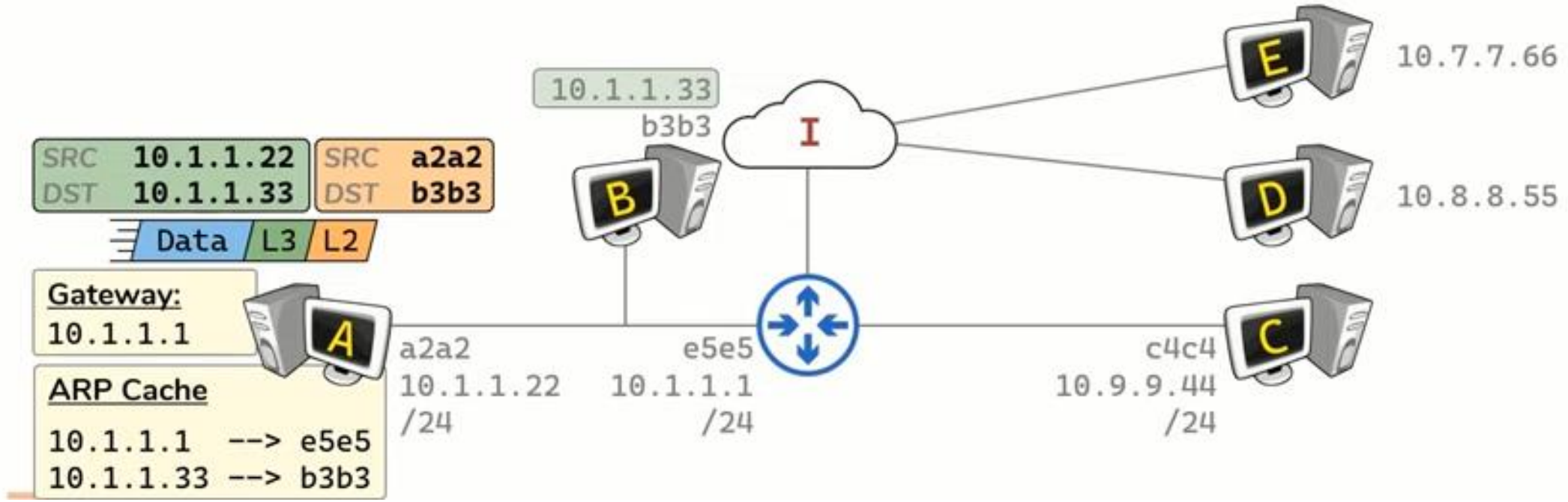

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*Hosts communicating to another host in the **same** network*

*Hosts communicating to another host in a **foreign** network*