Cybersecurity
CSCS
Introduction to Networks
Part 2

Today's Adenda

- A basic intro to how data is delivered from one hop to another.
- Specifically, we will discuss the working of ARP

Communication Between Hosts

- Hosts connected directly to each other:

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

Communication Between Hosts

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Communication Between Hosts

- 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

Communication Between Hosts

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

Communication Between Hosts

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- Host A knows the IP address of Host B

Communication Between Hosts

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  - Maybe user typed: `ping 10.1.1.33`
  - Maybe IP address was acquired from DNS
    - DNS converts Domain Name into an IP address
    - *example:* `www.PracticalNetworking.net --> 192.249.124.38`

Communication Between Hosts

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  - Maybe user typed: `ping 10.1.1.33`
  - Maybe IP address was acquired from DNS
    - DNS converts Domain Name into an IP address
    - *example:* `www.PracticalNetworking.net` --> `192.249.124.38`
  - Host A knows `10.1.1.33` is in its own IP Network

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  - Layer 3 – End to End

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

Communication Between Hosts

- 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)

Communication Between Hosts

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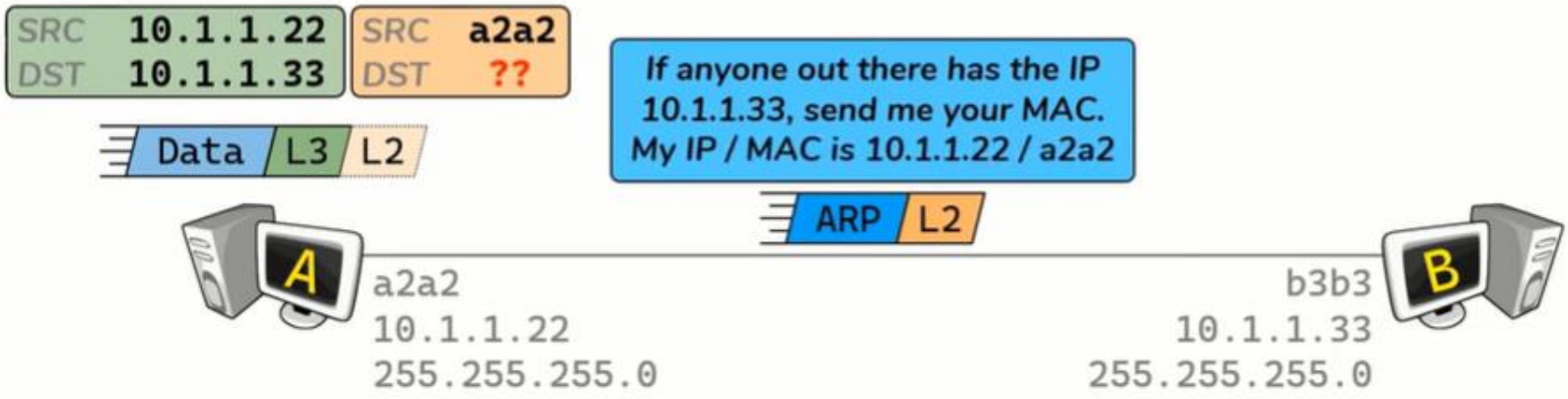
- Host A uses ARP to resolve target's MAC address
  - ARP Request asks for the MAC address associated with target IP
    - ARP Request includes sender's MAC address



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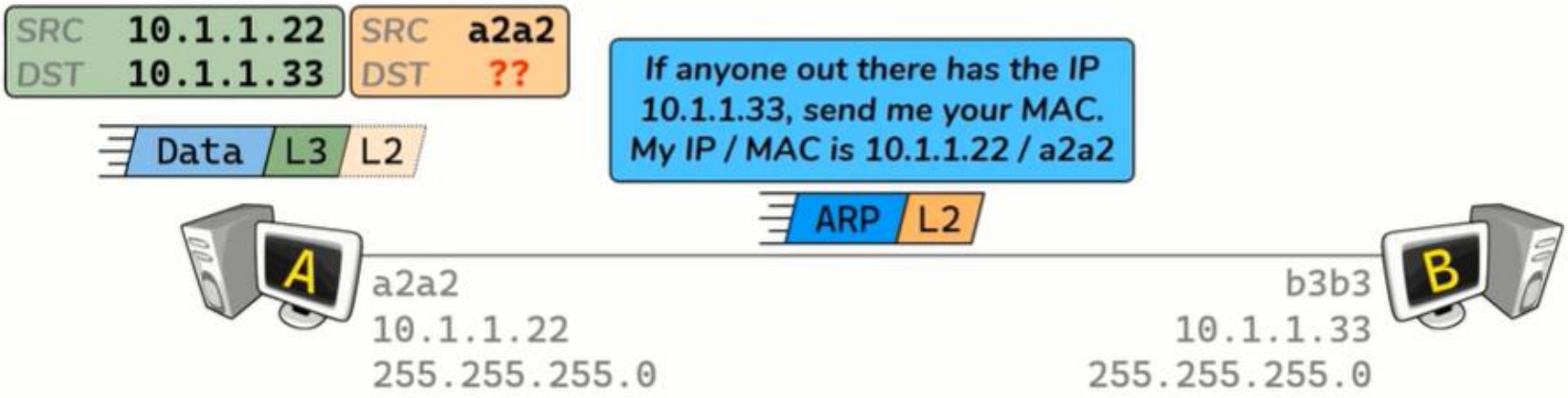

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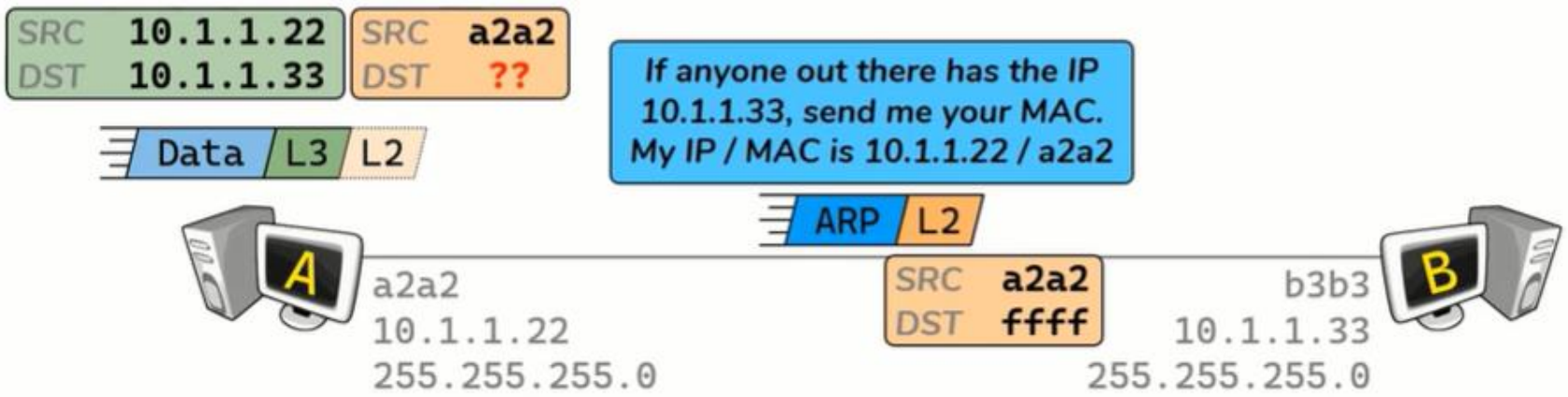
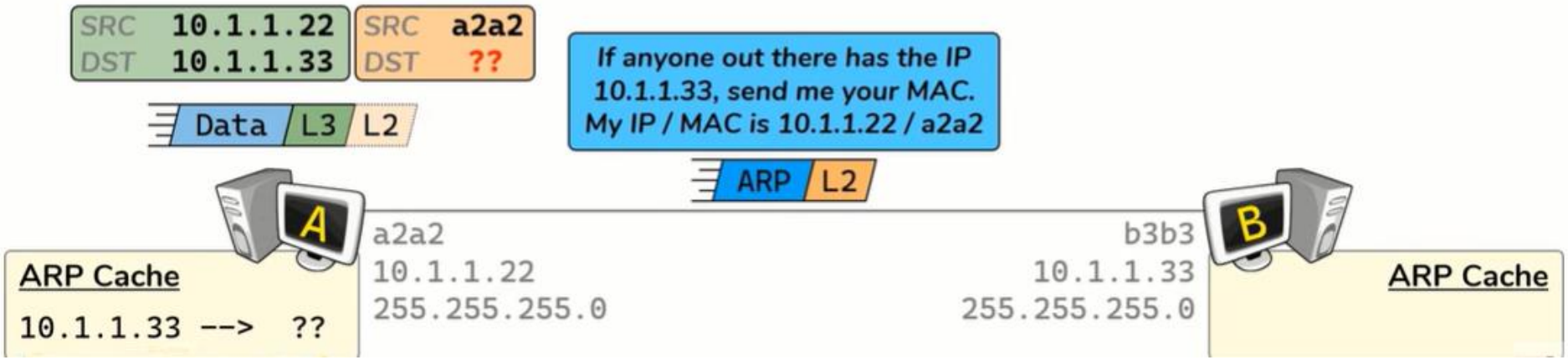
- Host A uses ARP to resolve target's MAC address
  - ARP Request asks for the MAC address associated with target IP
    - ARP Request includes sender's MAC address
    - ARP Request is a Broadcast – sent to everyone on the network
      - Destination MAC address: `ffff.ffff.ffff`
      - Reserved MAC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



Communication Between Hosts

- 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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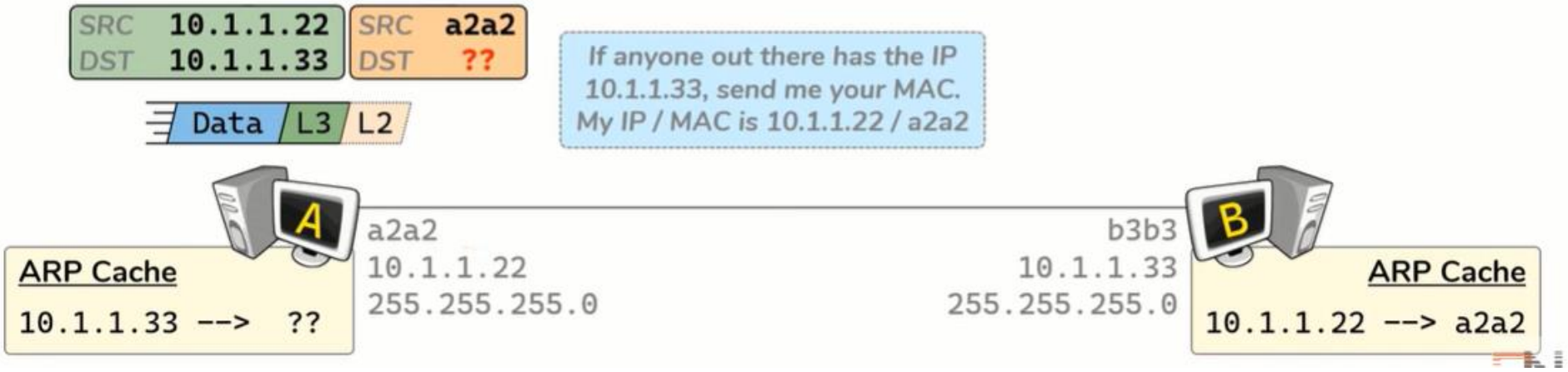

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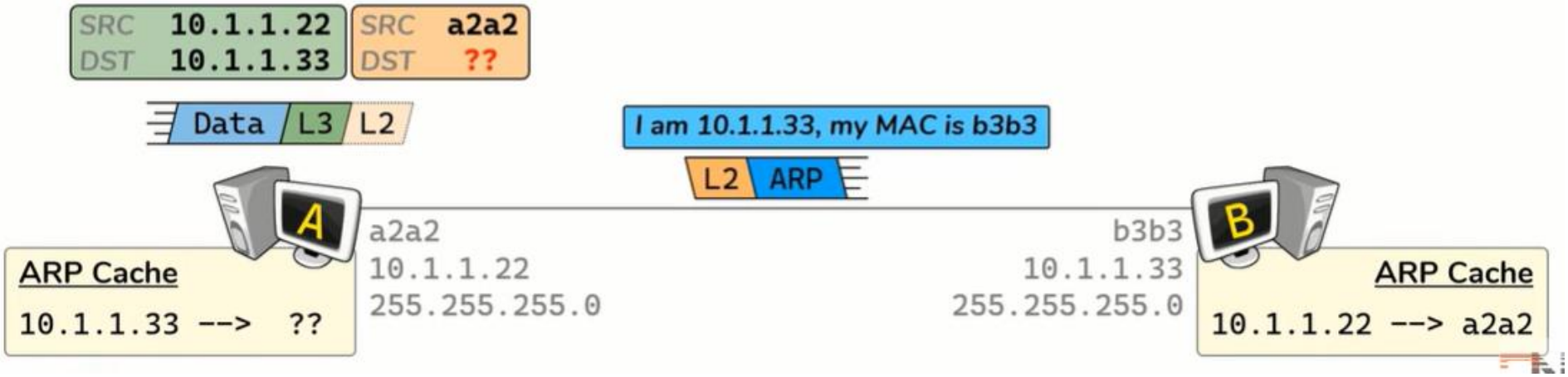

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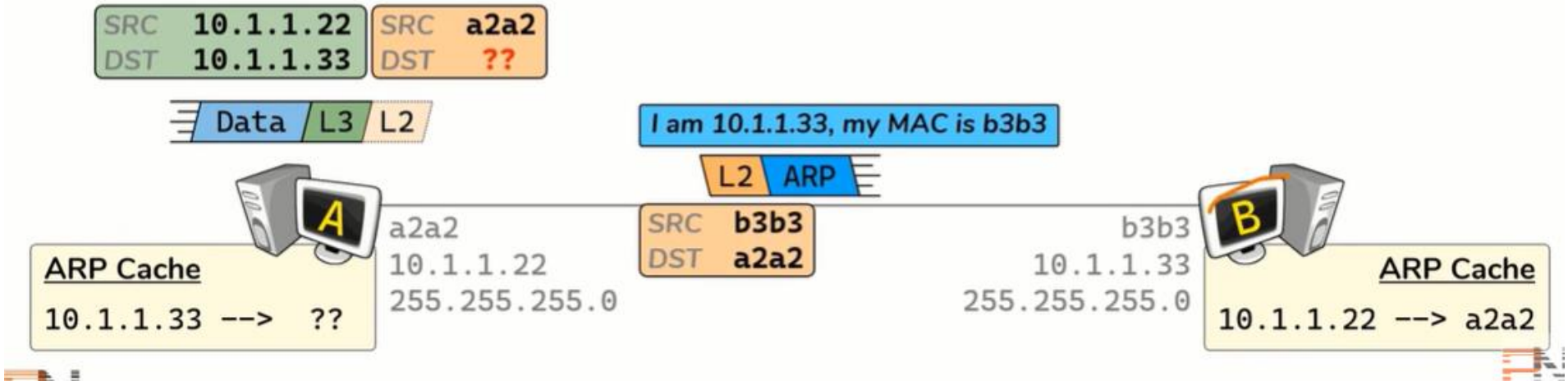

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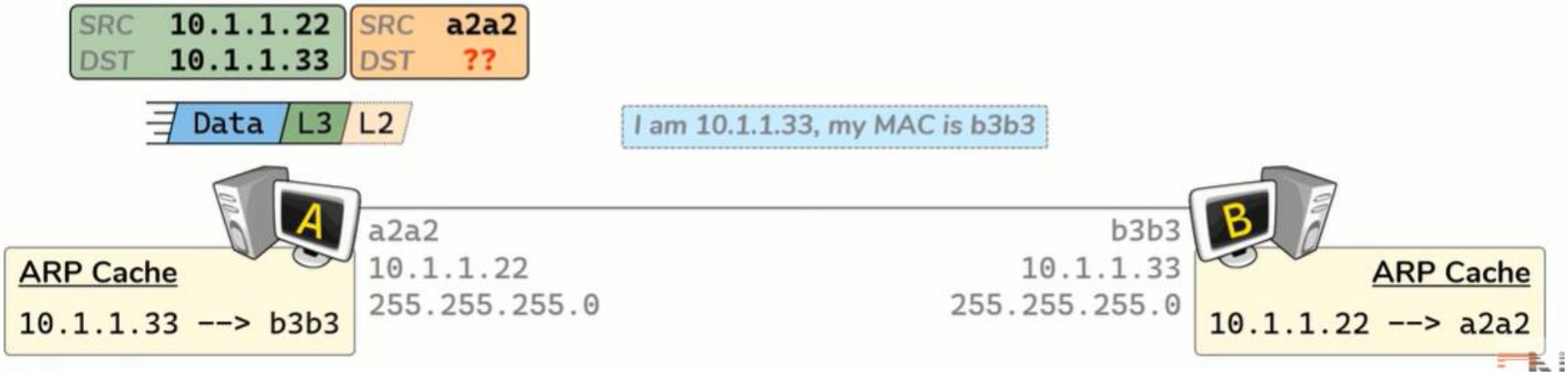
  - ARP Mappings are stored in an ARP Cache
  - Host B responds by sending an ARP Response
    - Response is sent Unicast (directly to Host A)
  - Host A populates it's ARP cache with Host B's IP/MAC mapping



Communication Between Hosts

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

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- Host A creates L2 header
- Data is sent to Host B
  - L2 header is discarded

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Communication Between Hosts

- 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

Communication Between Hosts

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Communication Between Hosts

- 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