The Internet

Putting Everything Together

Slides with “*” are not testable material

Concepts

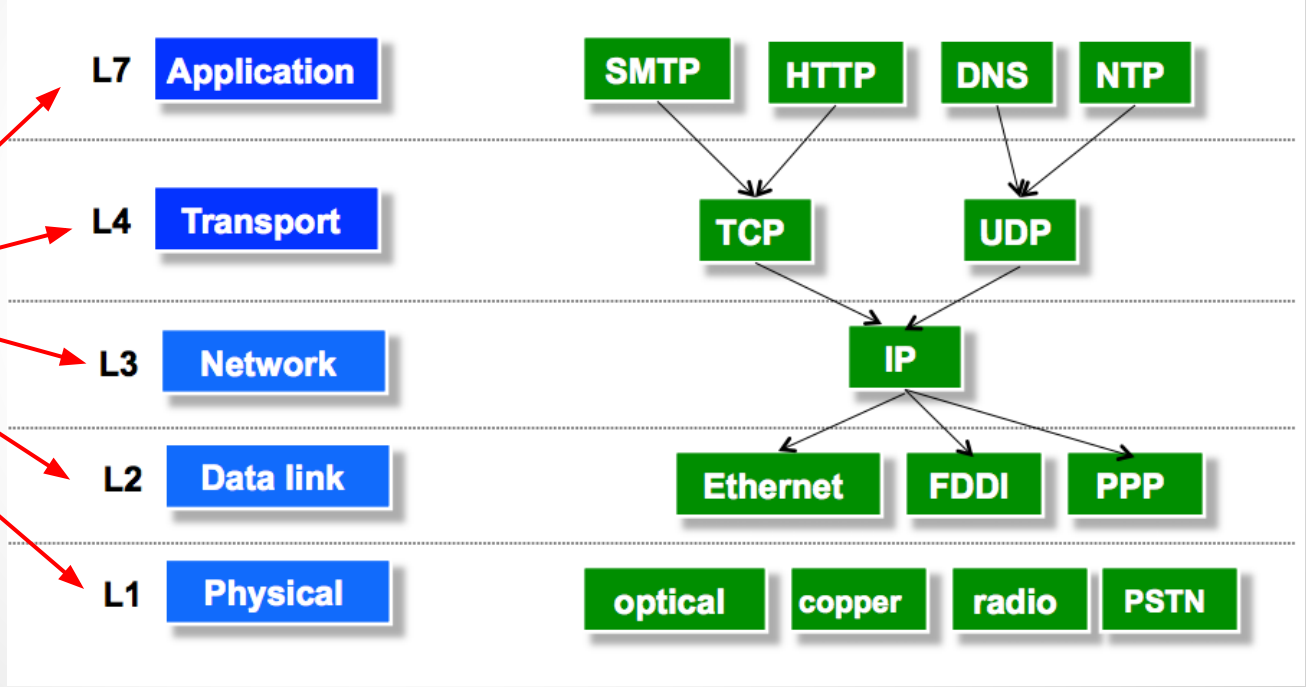
- There have been a lot of different Internet concepts covered so far
  - History of the Internet
  - IP Addresses
  - Network Topologies
  - Domain Name Service
  - Components of the Internet (Physical/Virtual)
  - Protocols
  - Information Transfer and Packets
  - Speed Metrics (latency, throughput)
  - Traceroutes, HTML sources
  - Encryption
  - Firewalls
  - Threats to the Internet
  - Social Media Privacy

But how do they all tie together?

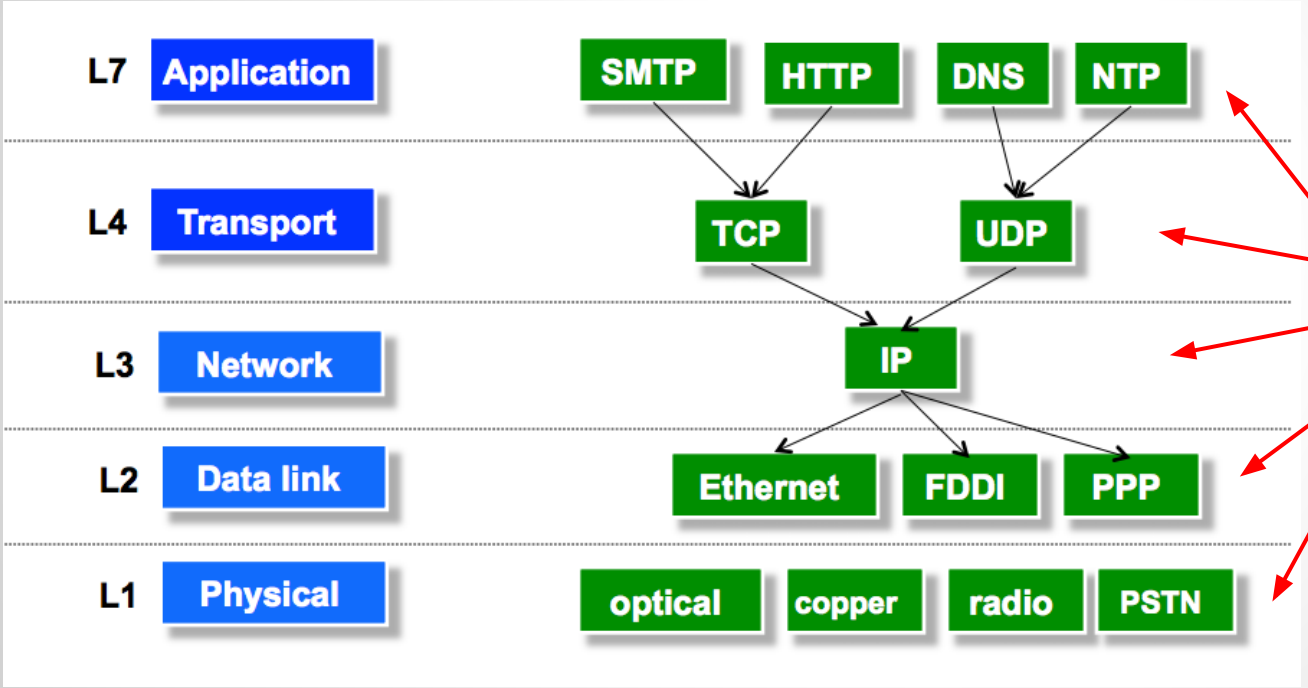
Well most of them anyway...

Layering

The 5 core layers of the Internet are the Application layer, Transport layer, Network layer, Data Link layer, and Physical layer.



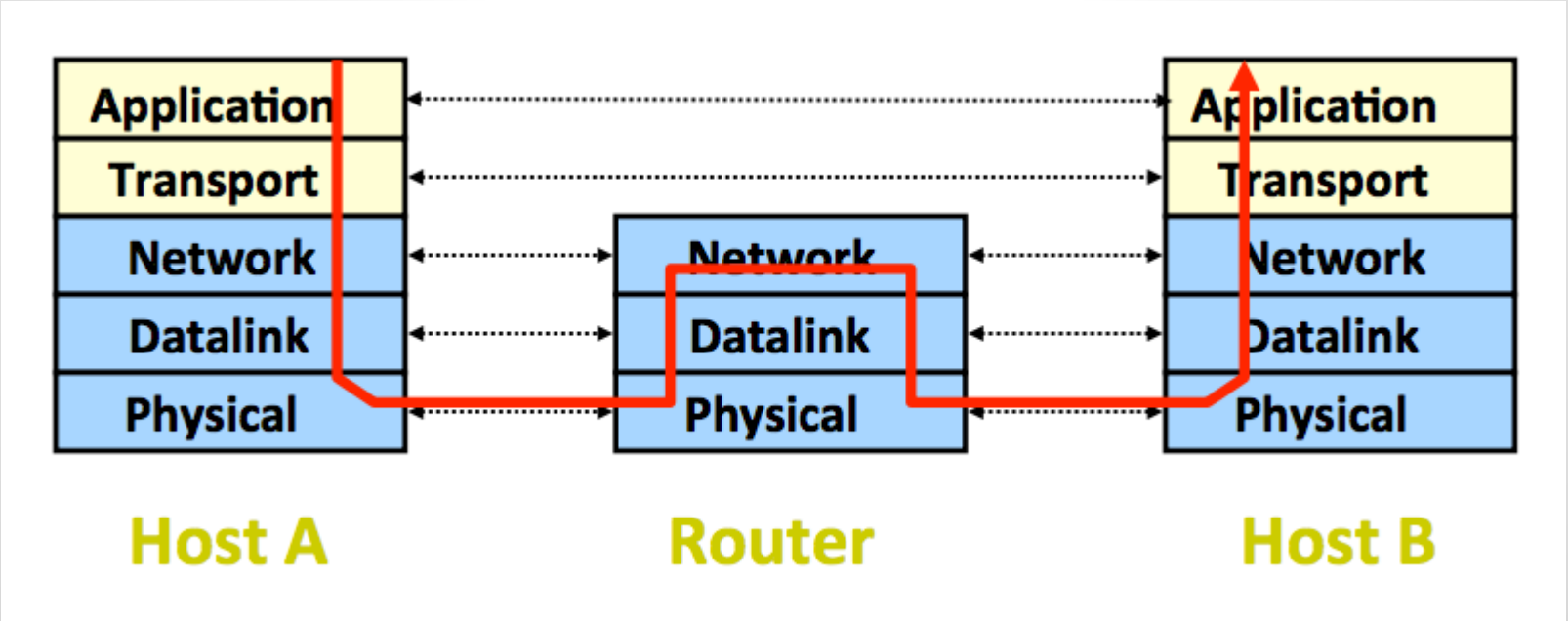
Layering



Each layer has its own set of protocols to communicate across different computers and systems, some of which you already know about or have seen in lecture (HTTP, DNS, IP, Ethernet).

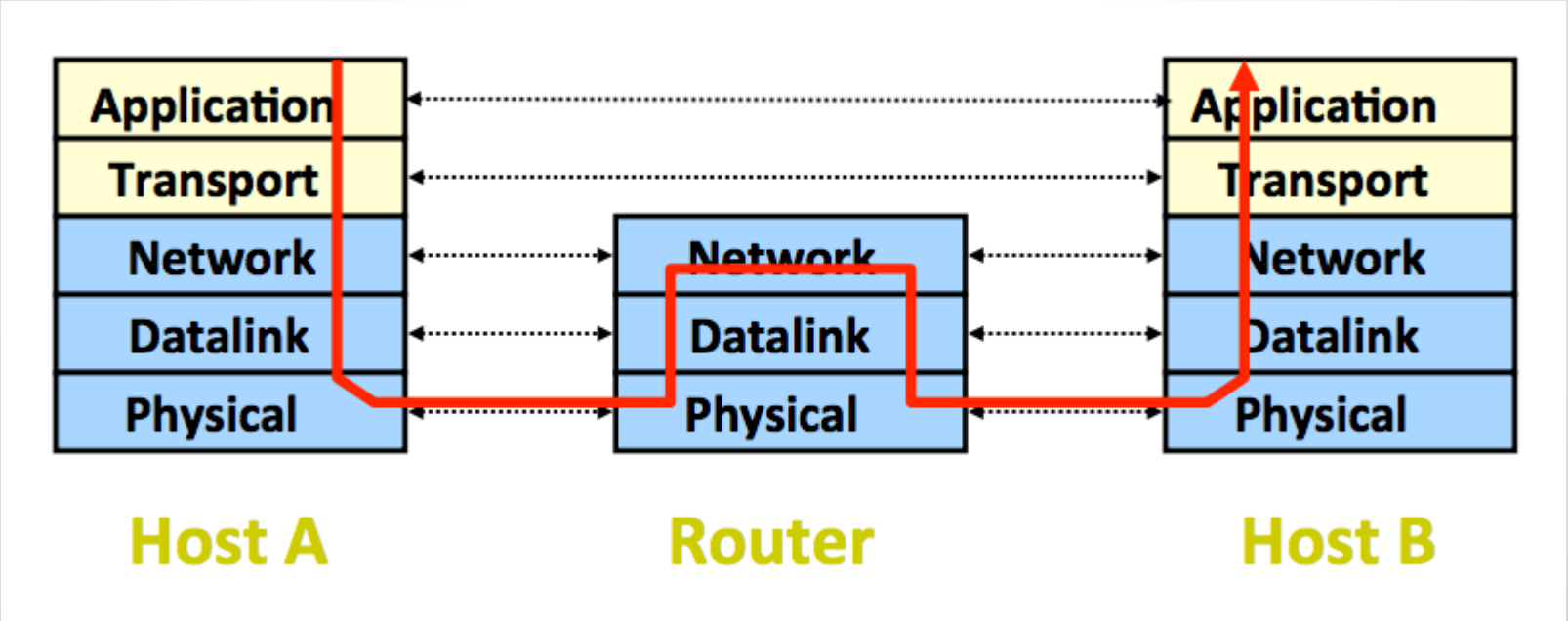
Layering

Communication in the Internet works by transferring information down and up these layers, starting at a source (Host A) and ending at a destination (Host B).



Layering

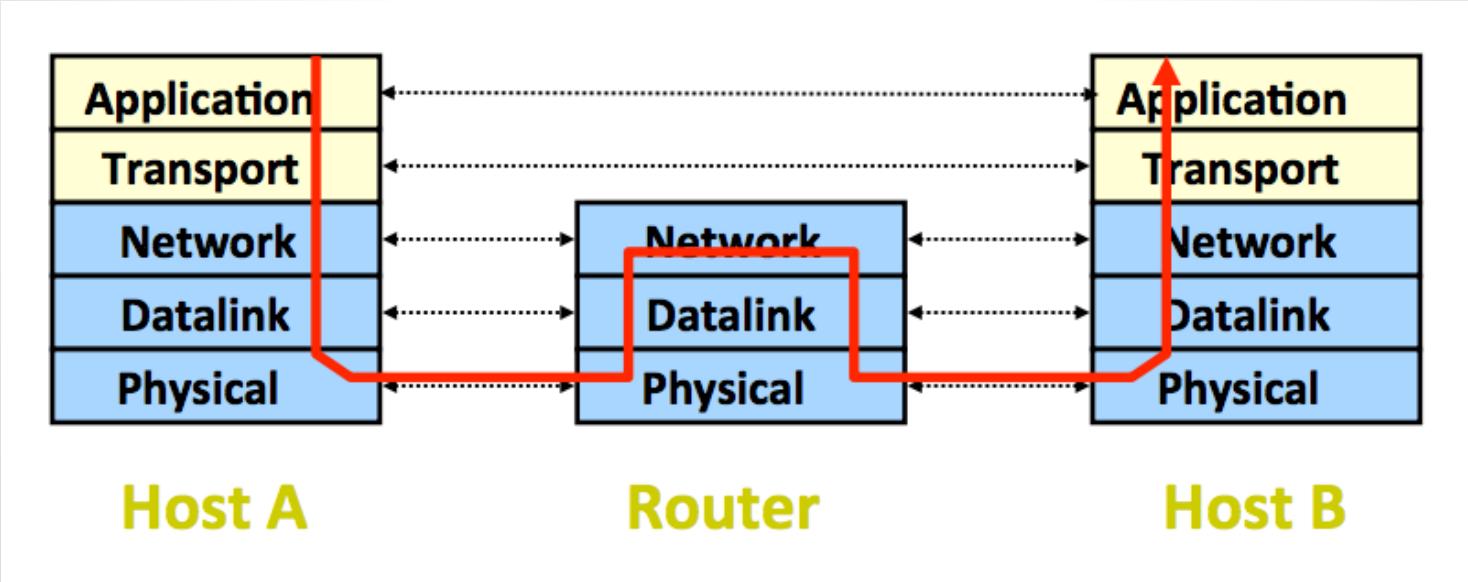
There can be any number of routers in between Host A and Host B that are forwarding your data/requests, nearly all of which can be found with traceroute.



Layering*

As an example, let's say we are trying to connect to google.com (74.125.28.147)

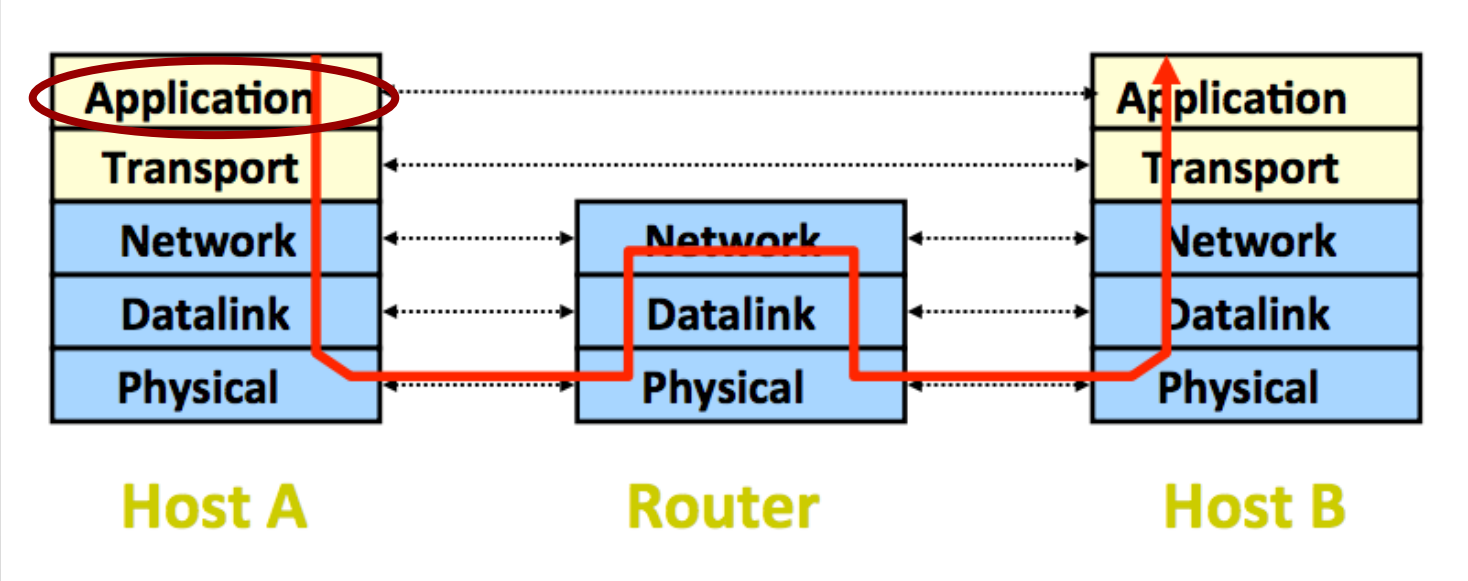
- Starting from Host A...



Layering*

Connecting to google.com (74.125.28.147)

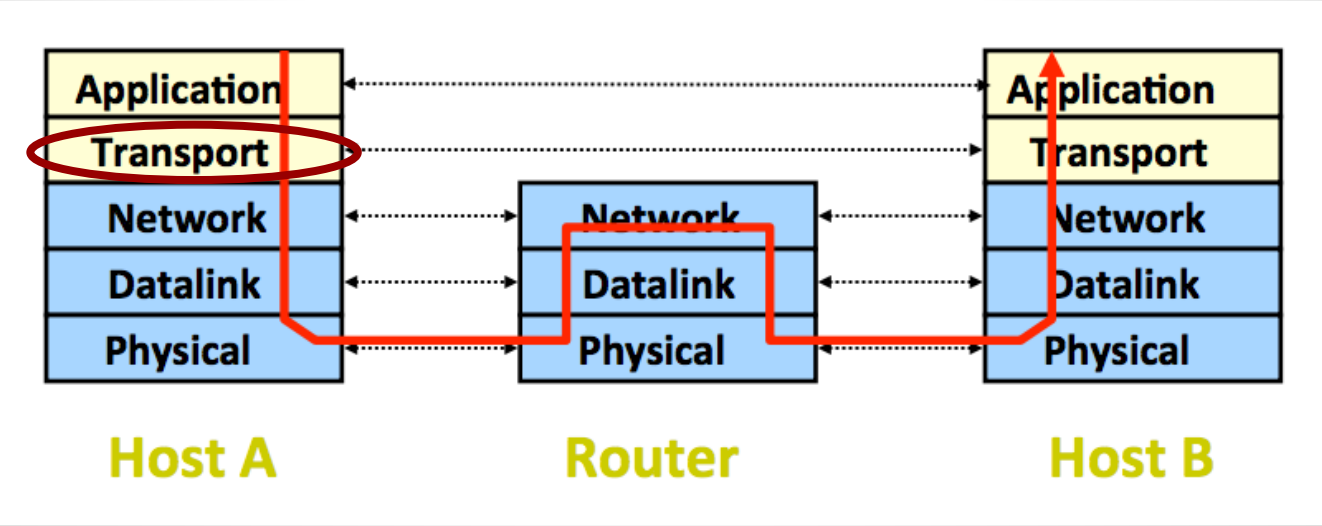
- At the Application layer, an HTTP request is formed saying what information we want from Google



Layering*

Connecting to google.com (74.125.28.147)

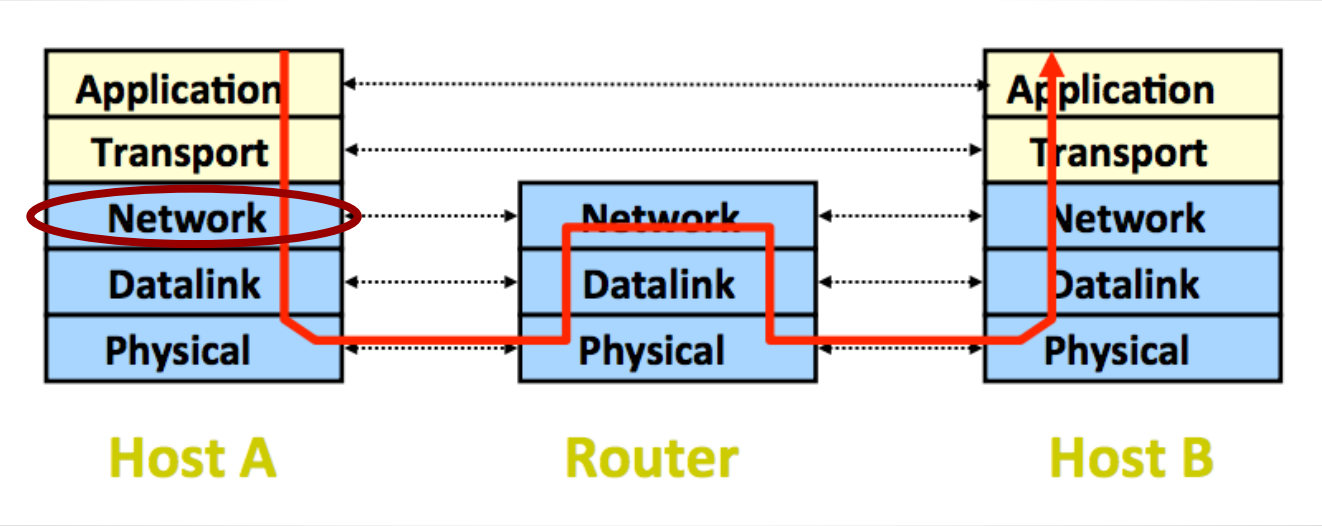
- At the Transport layer, our computer specifies the part of the operating system (port) associated with the request, so information is sent to the correct application



Layering*

Connecting to google.com (74.125.28.147)

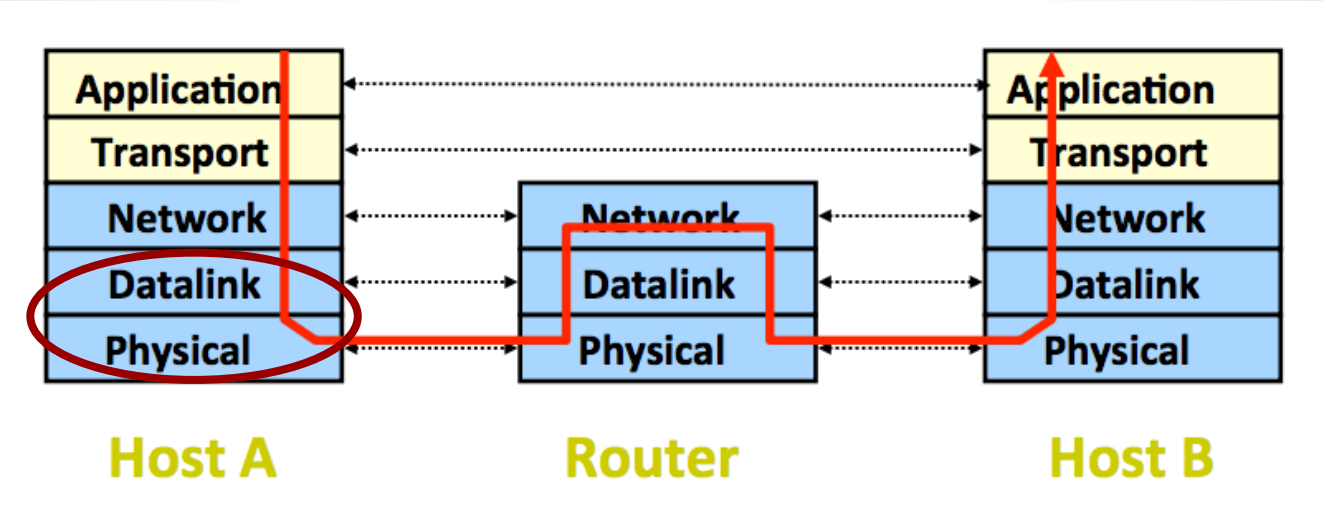
- At the Network layer, the IP Addresses of Host A and Host B are noted, and the first router to send the information to is decided upon



Layering*

Connecting to google.com (74.125.28.147)

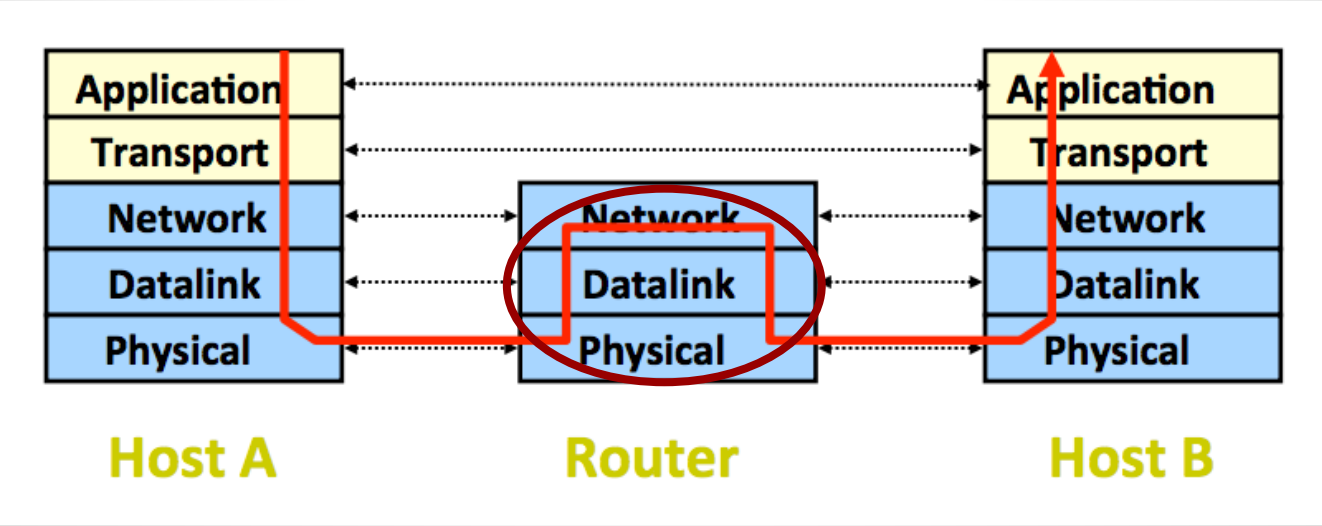
- Now the Datalink and Physical layers do the part of actually transferring all this information to one of our neighbor routers (e.g. through ethernet cables made up of optical fibers)



Layering*

Connecting to google.com (74.125.28.147)

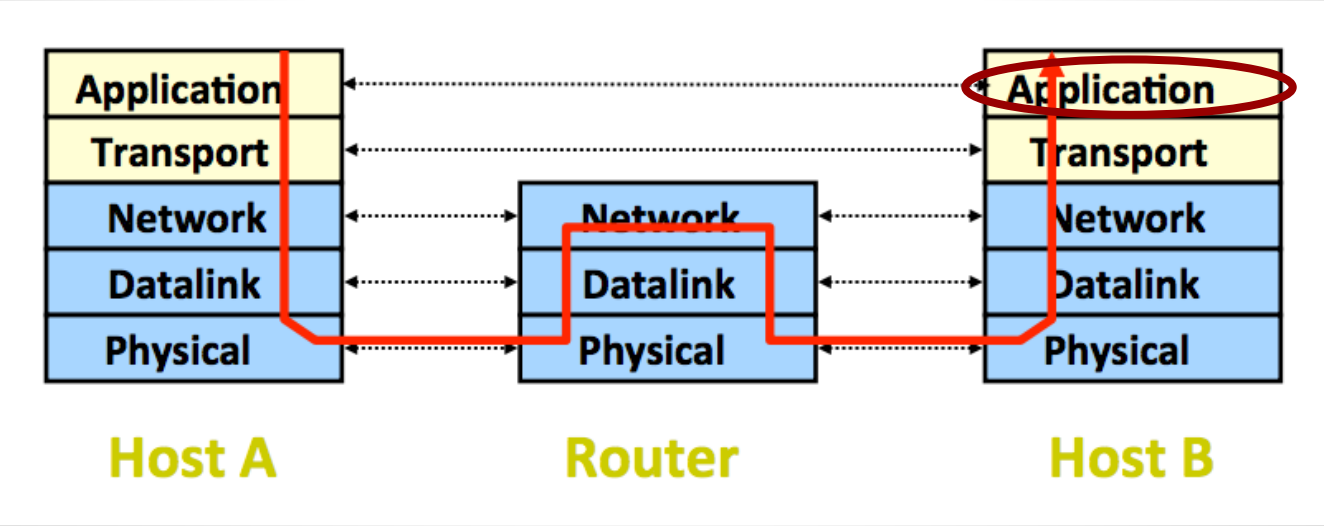
- Each router does its part to forward the information from Host A closer and closer to Host B. It does this by trying to match more and more of Host B's IP Address (74.125.28.147) with each consecutive router



Layering*

Connecting to google.com (74.125.28.147)

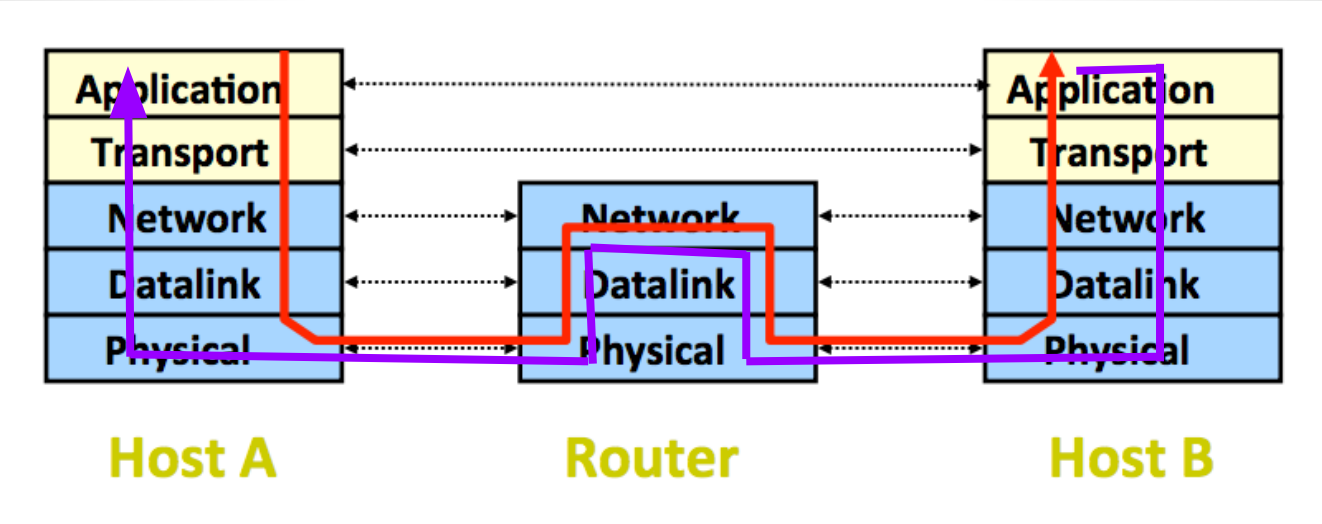
- Finally, Host B is found and the data from Host A travels up to the application layer of Host B to be processed



Layering*

Connecting to google.com (74.125.28.147)

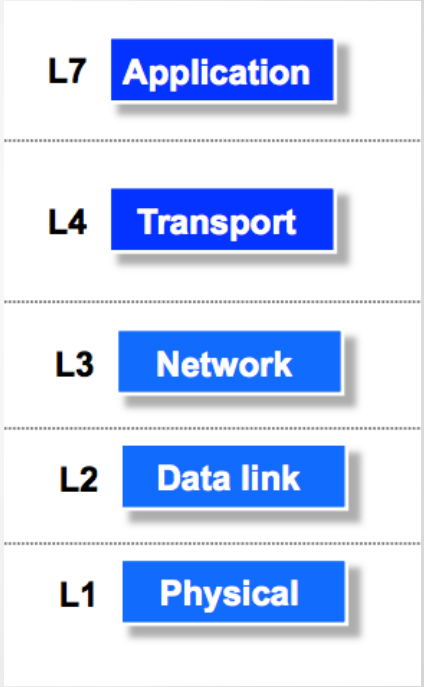
- If Host B accepts the request, it will send the requested information back to Host A, following a procedure similar to what was shown in the previous slides



The Application Layer

Concepts in this class relevant to the Application layer:

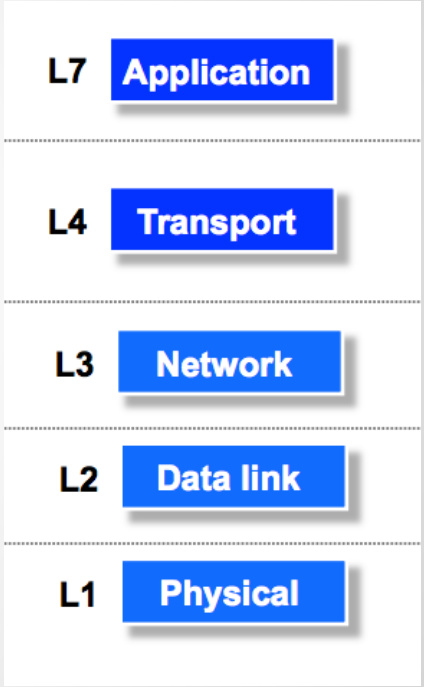
- DNS (Domain Name System)
  - Translates domain names to the numerical IP addresses needed for the purpose of locating computer services and devices worldwide
- Encryption
  - Used in applications where privacy is important (e.g. email, messaging)
  - The data in the application, specifically the data in each packet, is encrypted using different types of symmetric and asymmetric encryption (e.g. AES, RSA)
- Firewall
  - Useful as it is able to detect if an unwanted protocol is attempting to bypass the firewall, or detect if a protocol is being abused in any harmful way



The Network Layer

Concepts in this class relevant to the Network layer:

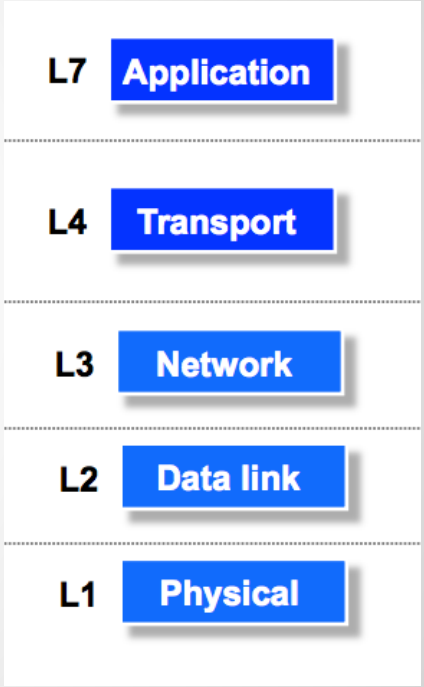
- Network Topologies
  - Different groupings of computers, servers, and routers to transfer information through
- IP Addresses
  - Unique identifier which all computers, servers, and routers have
- Traceroutes
  - Used to find out the different routers traversed to reach the destination
- Speed Metrics (Latency and Throughput)
  - Factors that determine how long it takes to establish a connection and the rate at which information is transferred through the network



The Network Layer

Concepts in this class relevant to the Network layer:

- Firewalls
  - Network layer firewalls, also called packet filters, do not allow packets to pass through the firewall unless they match the established rule set
- Threats to the Internet
  - Packet delays open window for sneaky attacks
  - Malware (Virus, Worms, etc)
  - Denial of Service (DOS) Attacks



All Layers

Concepts in this class relevant to pretty much every layer:

- Components of the Internet
  - Clients, routers, and servers are the physical devices that make up the foundation of the Internet
  - Most are connected through telephone wires, underground wires, or satellite signals
- Protocols
  - Each layer has its own set of protocols, each used for different purposes
- Information transfer and packets
  - Pretty much all information transferred through the layers of the Internet is sent in packets