

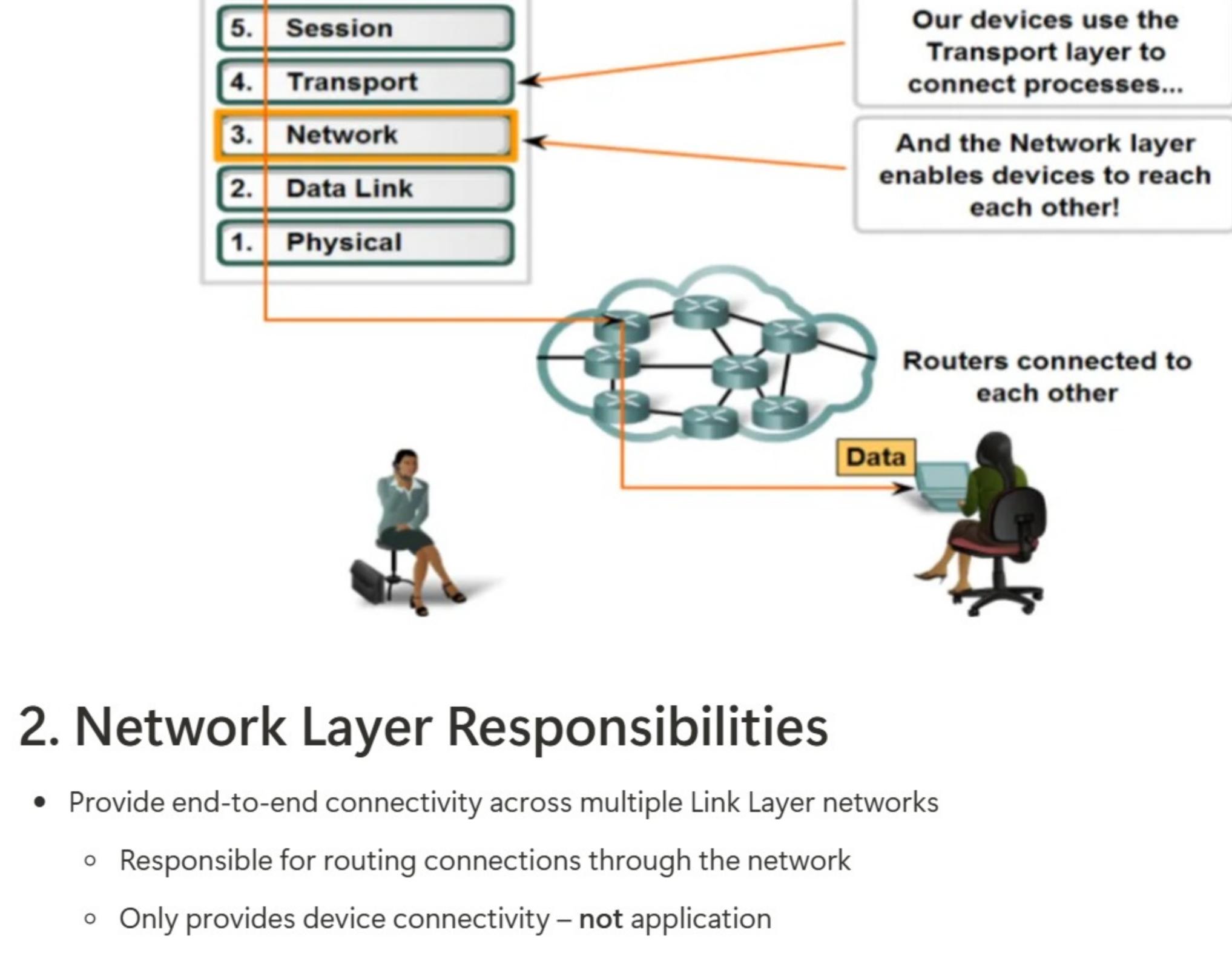
Lecture 4a - Network Layer

Type	Lecture
Materials	Empty
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1. Role of the Network Layer
2. Network Layer Responsibilities
3. Network Layer Addressing
4. Handling Problems
5. Quizzes:

1. Role of the Network Layer

- **Addressing:** Take care of unique identity devices
- **Encapsulation:**
 - Encapsulate Transport PDU into a layer 3 header \Rightarrow packets
 - In each layer of the communication, as the data is passed down, the stacks perform encapsulation tasks, and then the reverse process needs to happen at the receiving end (decapsulation)
- **Decapsulation:**
 - Remove the layer 3 header
 - Deliver the transport PDU to the upper layers.
- **Packet routing:**
 - The routing table specifies the exit interface a package should take based on the destination address in the layer three header.



2. Network Layer Responsibilities

- Provide end-to-end connectivity across multiple Link Layer networks
 - Responsible for routing connections through the network
 - Only provides device connectivity – **not** application \Rightarrow The job of the network layers is to make sure those packets are **successfully** righted across the multiple hosts and received by the server, **not** which application on the server is receiving the information.
 \Rightarrow Keeping track of the sending and receiving of applications is the job of the **Transport layer**
- Defines generic network behaviors:
 - Packet-based vs Connection-based
 - **Packet-based:** each packet goes in different ways (i.e. IP Network)
 - **Connection-based:** need to establish a connection between 2 hosts, and then send the packets
 - Best Effort or Guaranteed throughput
 - **Best-effort protocols** will not implement mechanisms to **detect** packet loss and **reception acknowledgment** on retransmitting lost packets. (i.e. IP network)
 \Rightarrow Instead, it will be the job of the transport layer to deal with the information loss.
 - **Guaranteed:** specify an implement mechanisms to guarantee **minimum connectivity** requirements and **same order delivery**.
 \Rightarrow Before sending information on during the session, establishment applications will inform the network layer of its requirements
 - Secure or Open
- Should aim to be Link Layer agnostic

3. Network Layer Addressing

- Should provide **unique, network-wide** addresses
- Addresses should have **structure** – helps routing traffic
- Addresses need to consider **potential network size**
 - The primary reason we now need IPv6

4. Handling Problems

- Network connectivity issues
 - Dealing with loss
 - Dealing with duplication \Rightarrow DHCP IP detection
- Network routing issues
 - Dealing with problems routing traffic
- Network throughput issues
 - How to guarantee performance
 - How to deal with bottlenecks

5. Quizzes:

- Handling problems at the Network Layer: Match the solution to the problem.

Routing Protocols	Network paths can become unavailable due to a hardware failure or a cable breakage along the path.
DHCP IP detection	Layer 3 addresses must be unique network wide. For example, IP address duplication will disrupt connectivity for the hosts involved.
Routing Protocols	Due to congestion or varying bandwidth links across the path, a device might not be able to transmit data at the same rate it's receiving it.
Resource Reservation	Different applications have different network requirements in terms of delay, bandwidth and packet loss.