

FIT1047 - Week 8

Networks: Introduction, Layers



MONASH University



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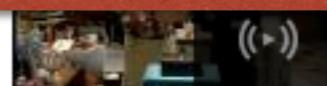


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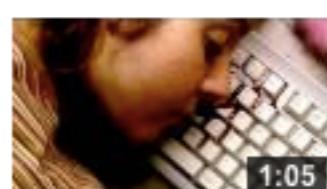
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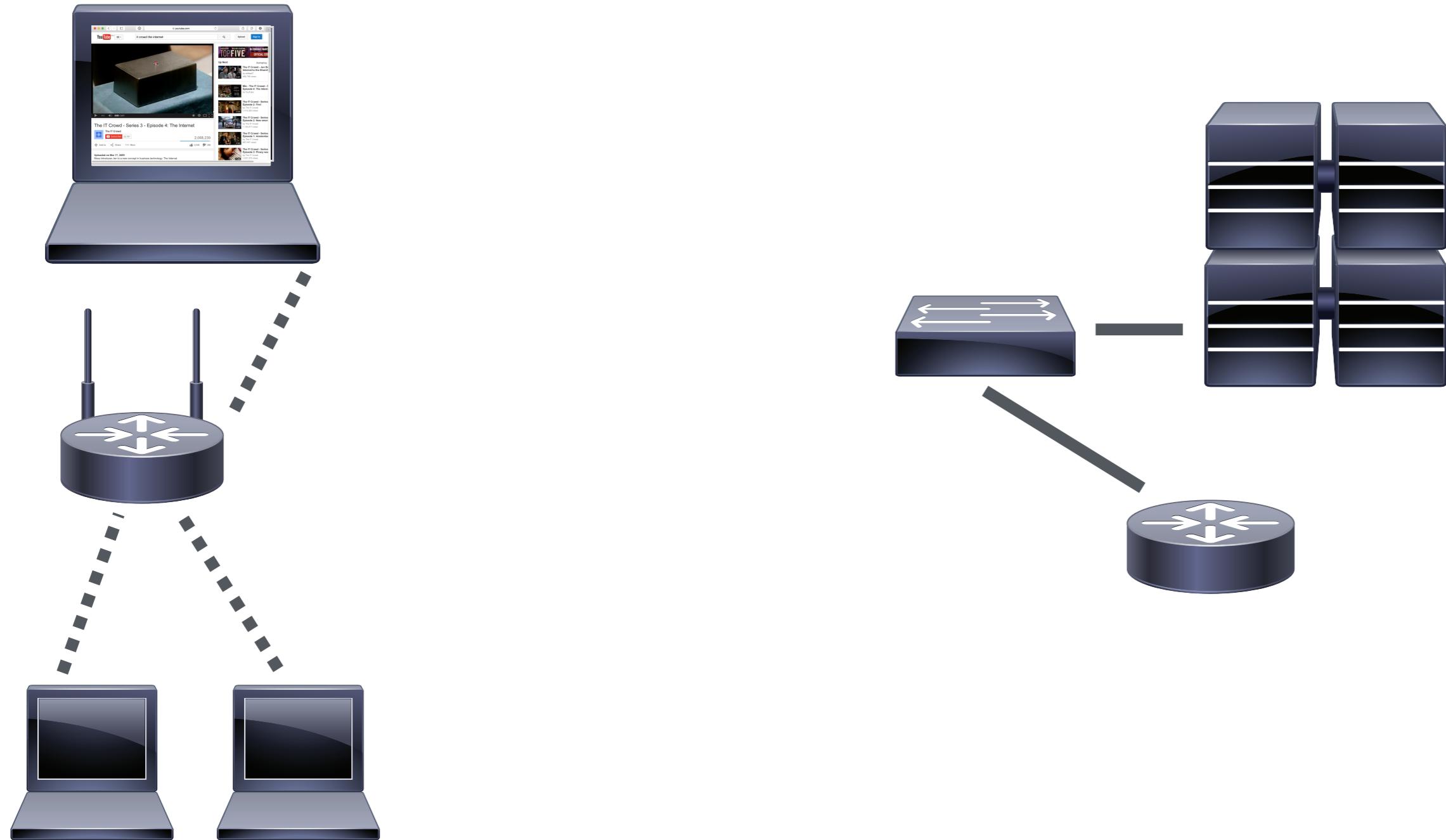
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but how does all this work?

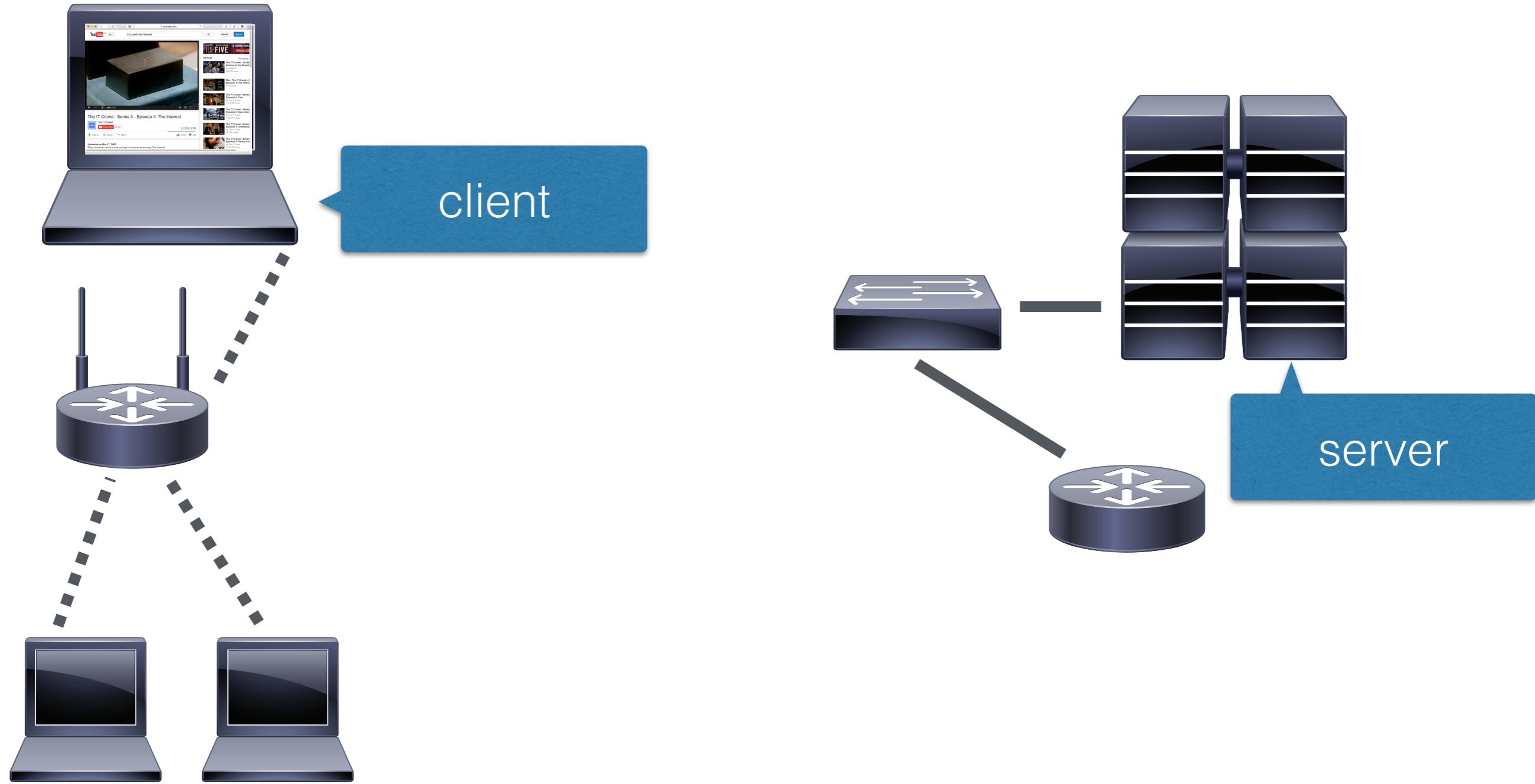
Network components



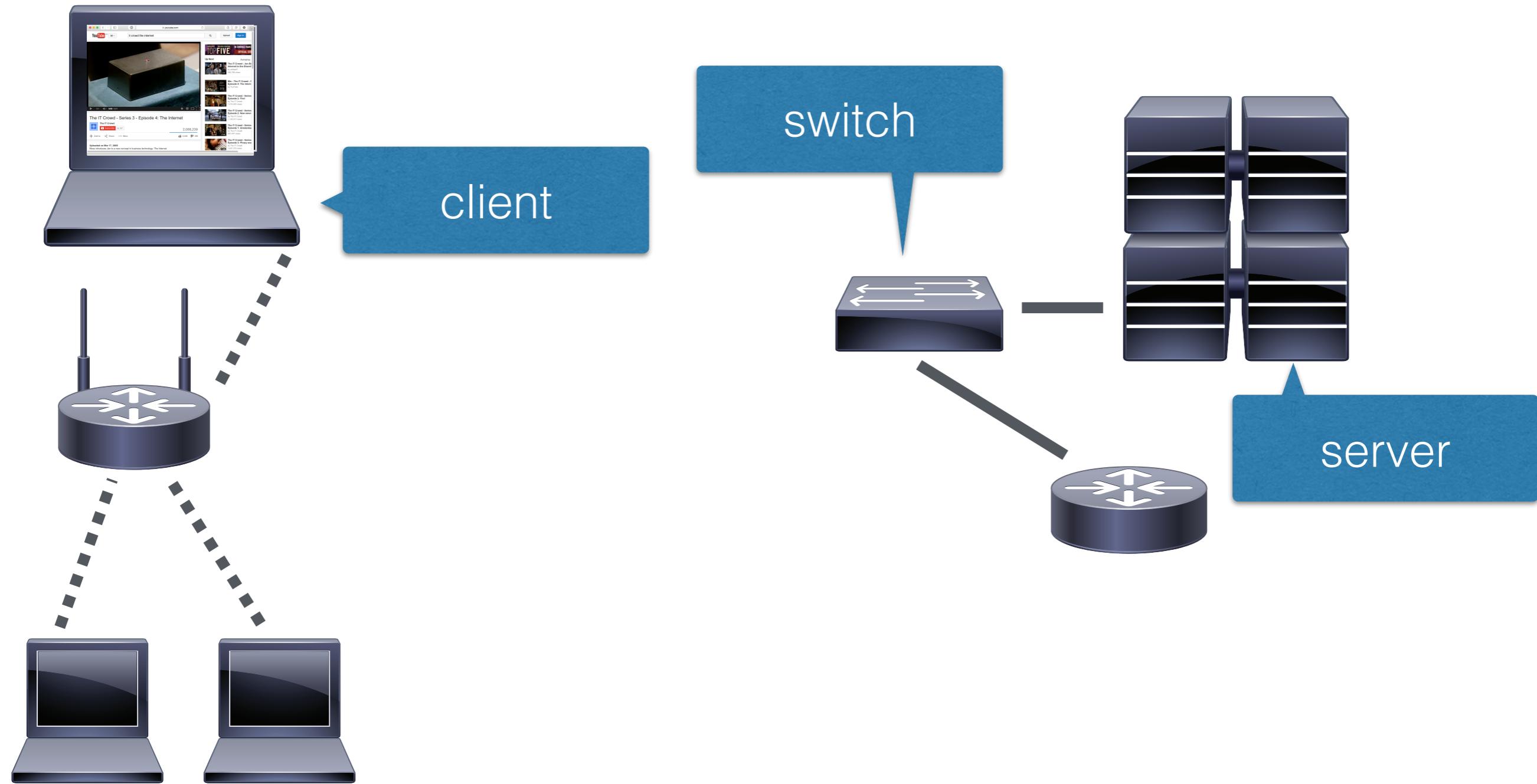
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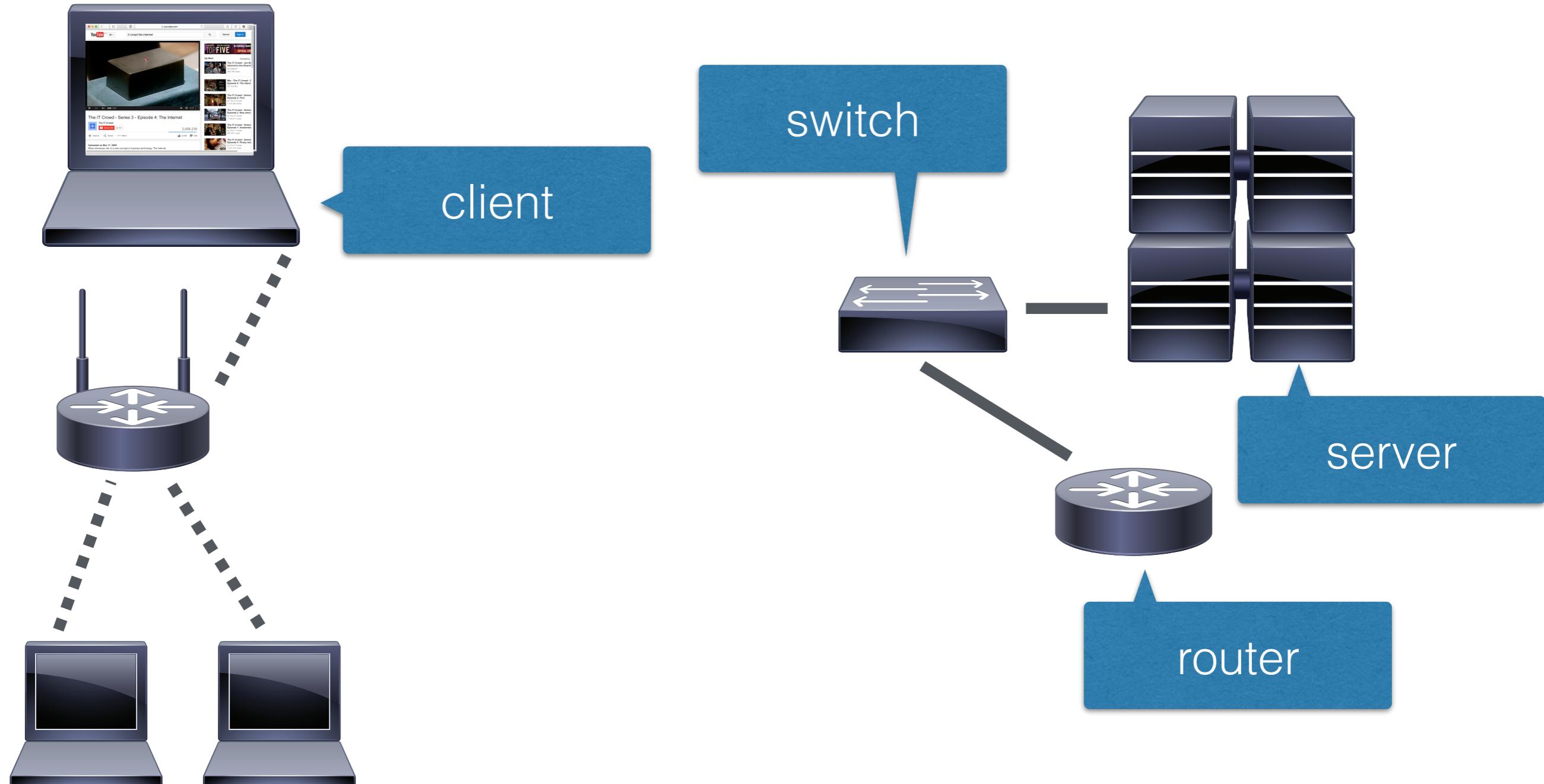
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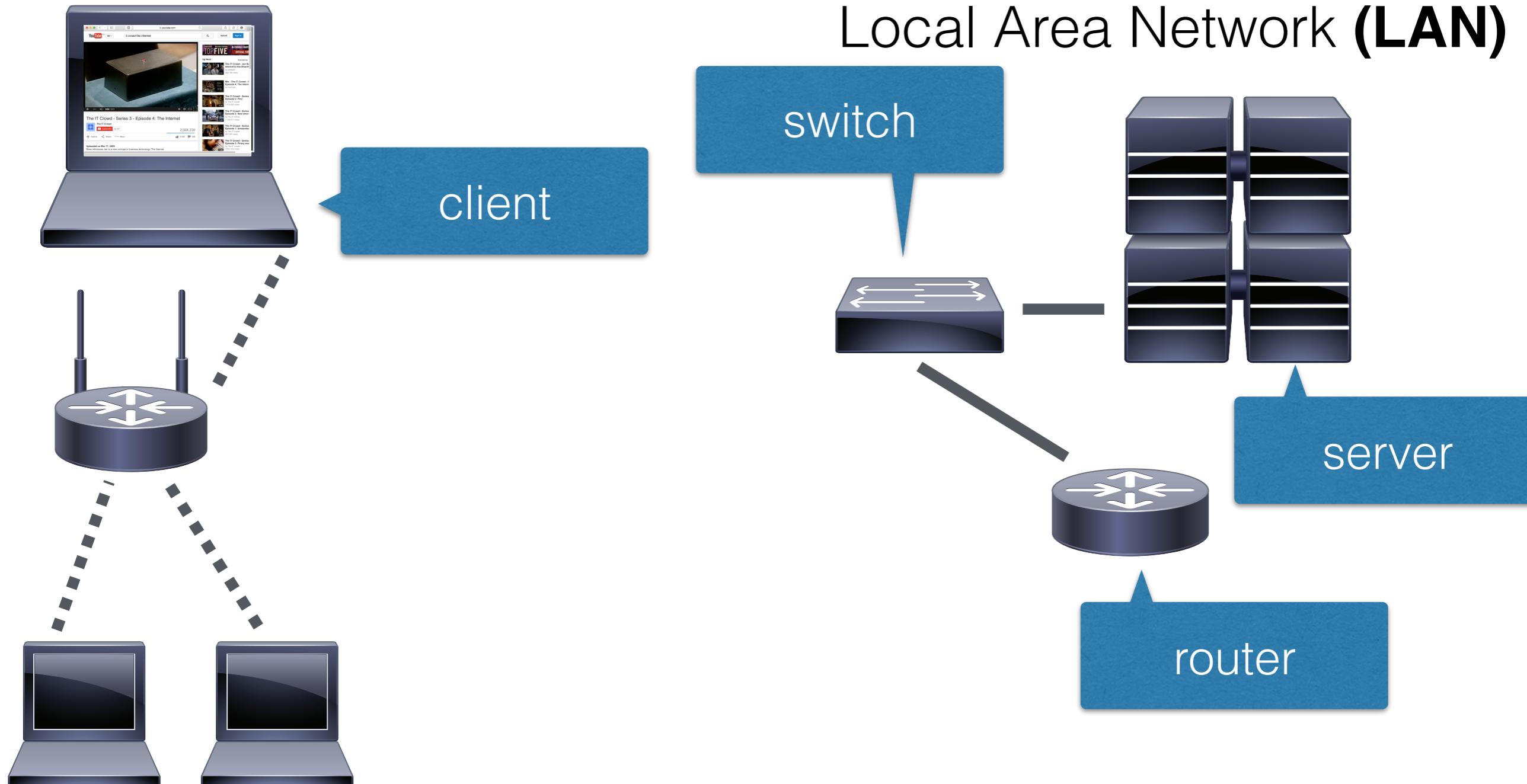
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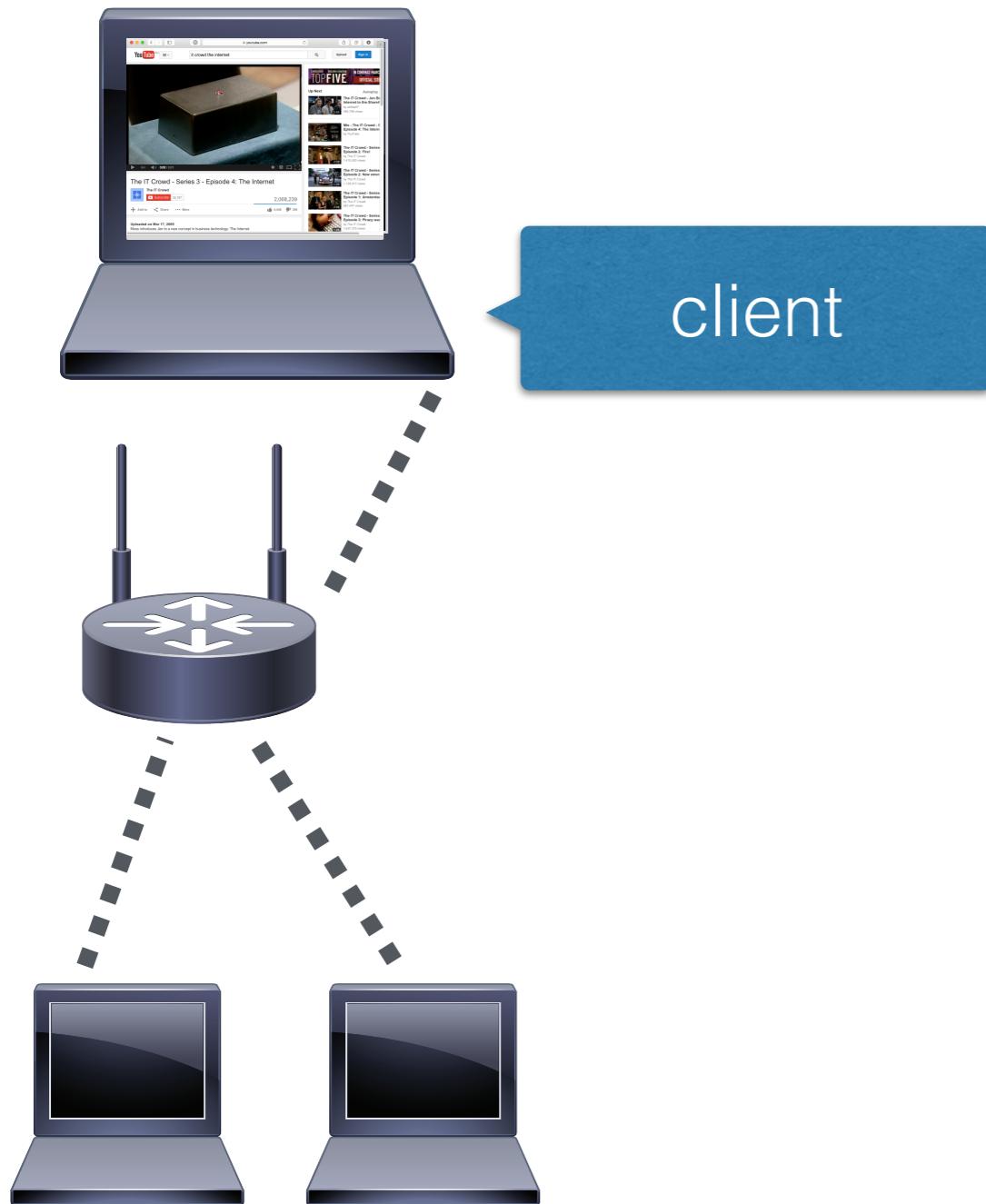


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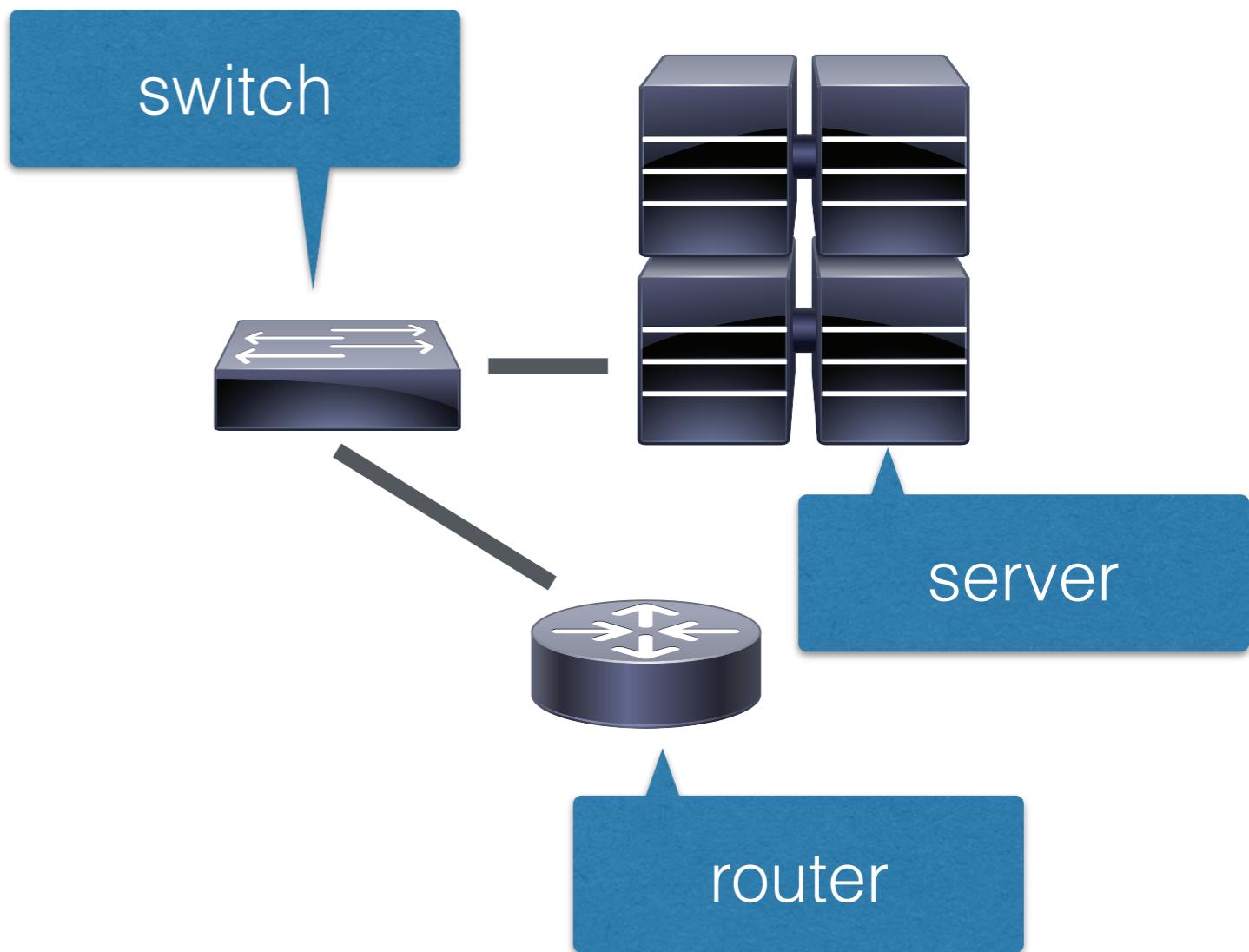


Network components

Wireless Local Area Network (**WLAN**)

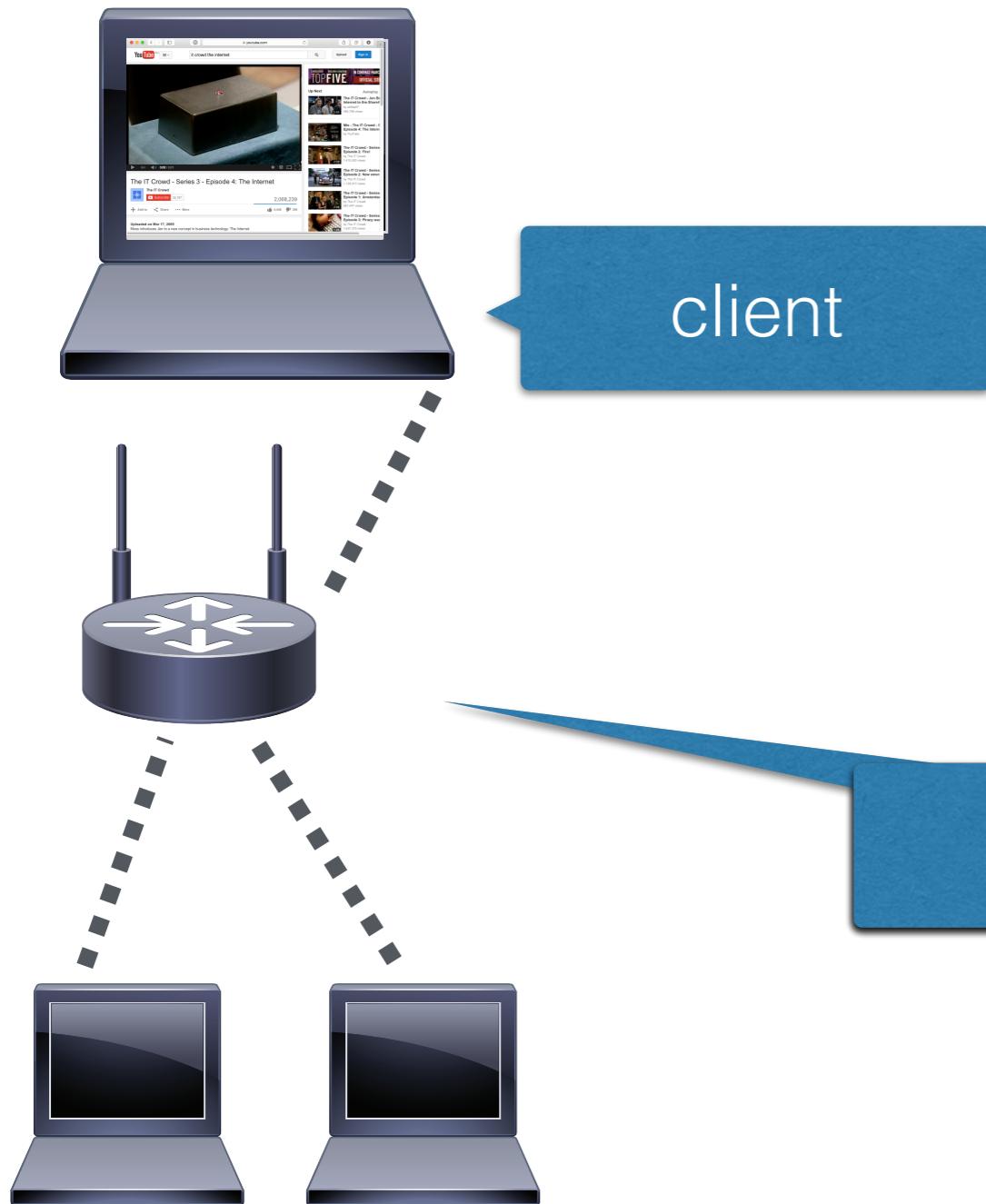


Local Area Network (**LAN**)

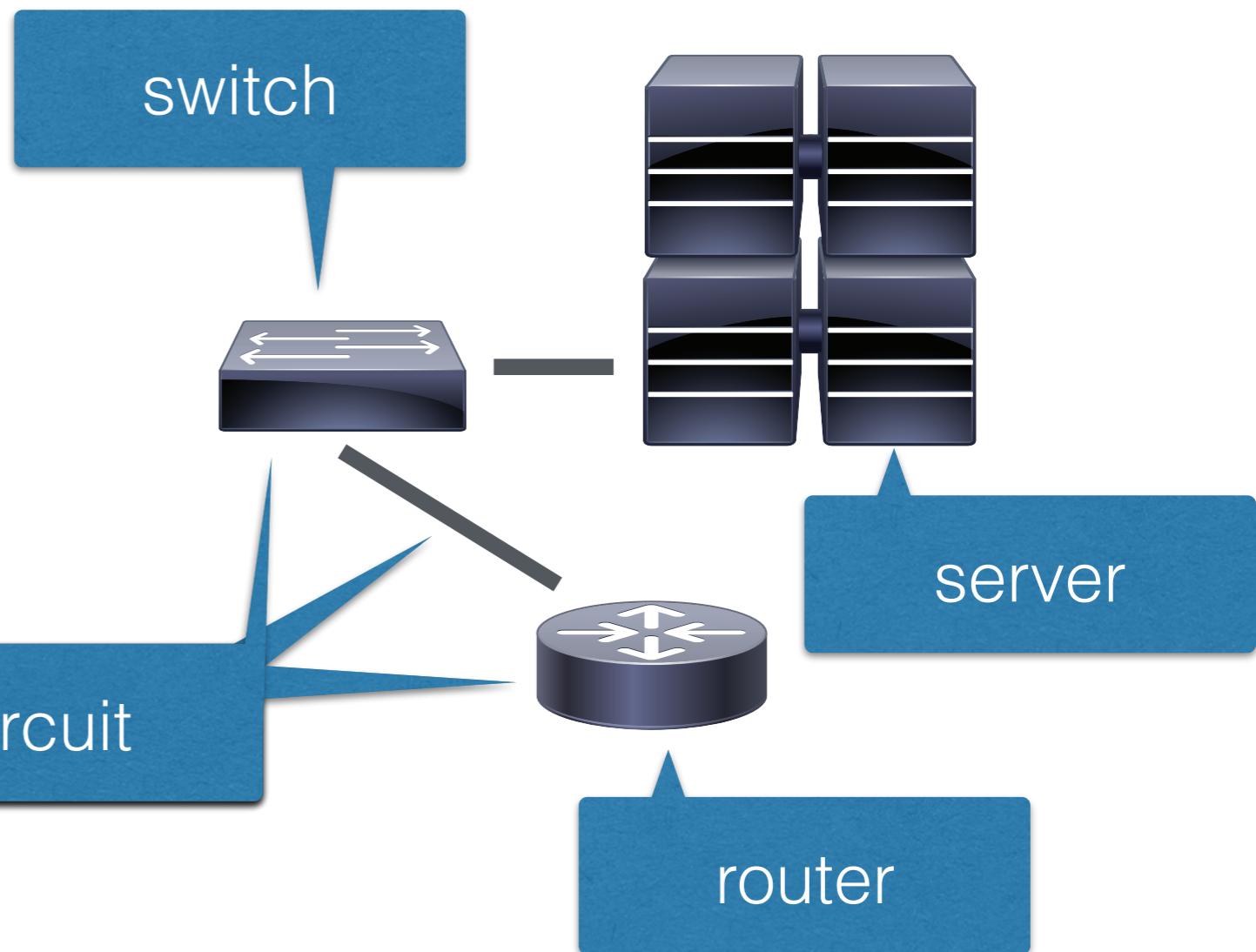


Network components

Wireless Local Area Network (**WLAN**)



Local Area Network (**LAN**)



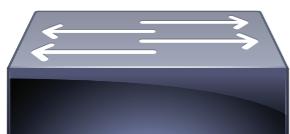
Network components



Client: gives users access to the network



Server: stores data or software and makes it available to the clients over the network



Switch: connects computers in a LAN



Router: connects two or more networks

Types of networks

Networks within an organisation:

Types of networks

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- Local Area Network (**LAN**) (room, building):
a group of clients and servers that share a circuit

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high-speed connection between LANs

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Networks **within** an organisation:

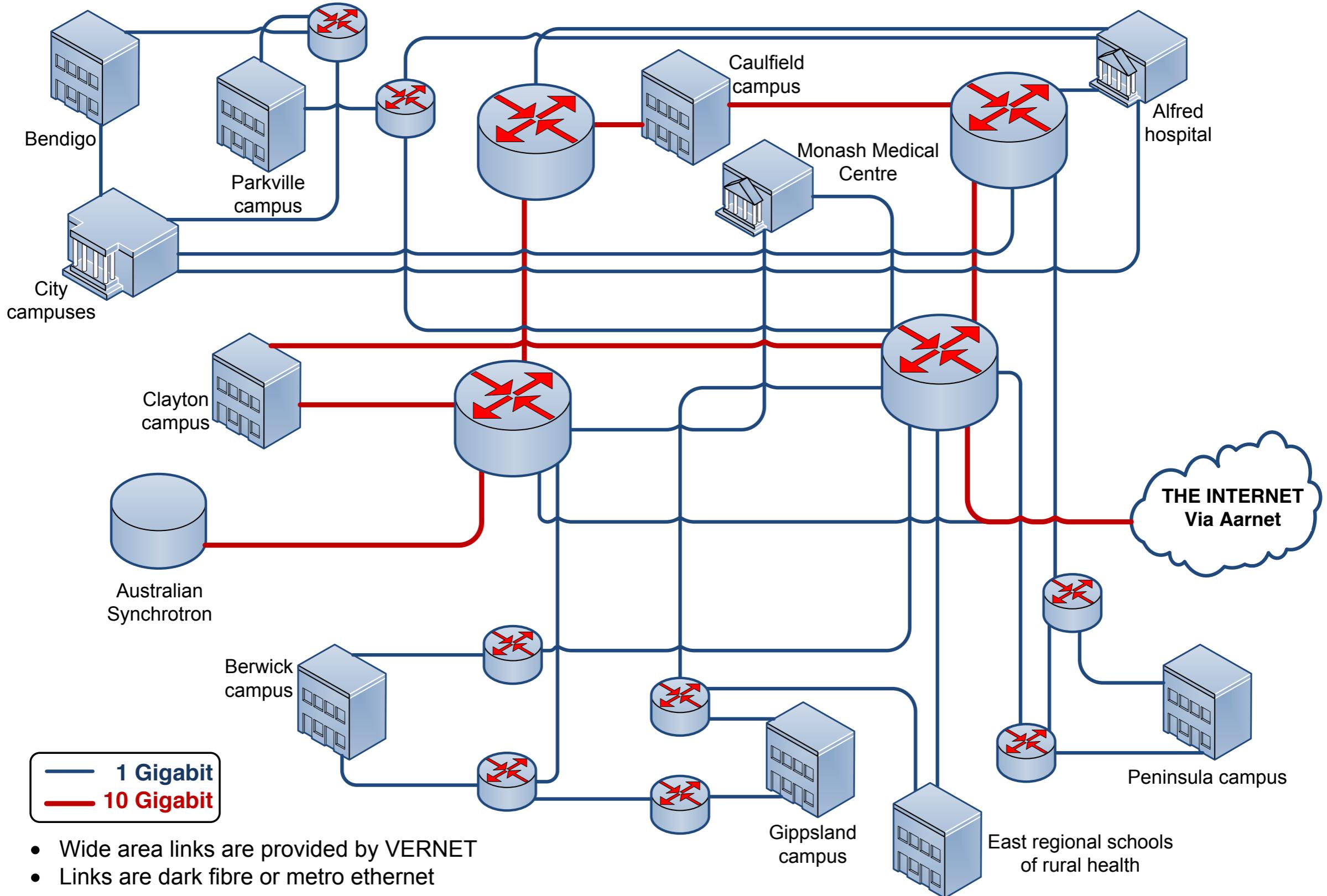
- Local Area Network (**LAN**) (room, building):
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- Backbone Network (**BN**) (< a few km):
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- Metropolitan Area Network (**MAN**) (> a few km):
connect LANs and BNs across locations

Types of networks

Networks **within** an organisation:

- Local Area Network (**LAN**) (room, building):
a group of clients and servers that share a circuit
- Backbone Network (**BN**) (< a few km):
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- Metropolitan Area Network (**MAN**) (> a few km):
connect LANs and BNs across locations
- Wide Area Network (**WAN**):
same as MAN except longer distances

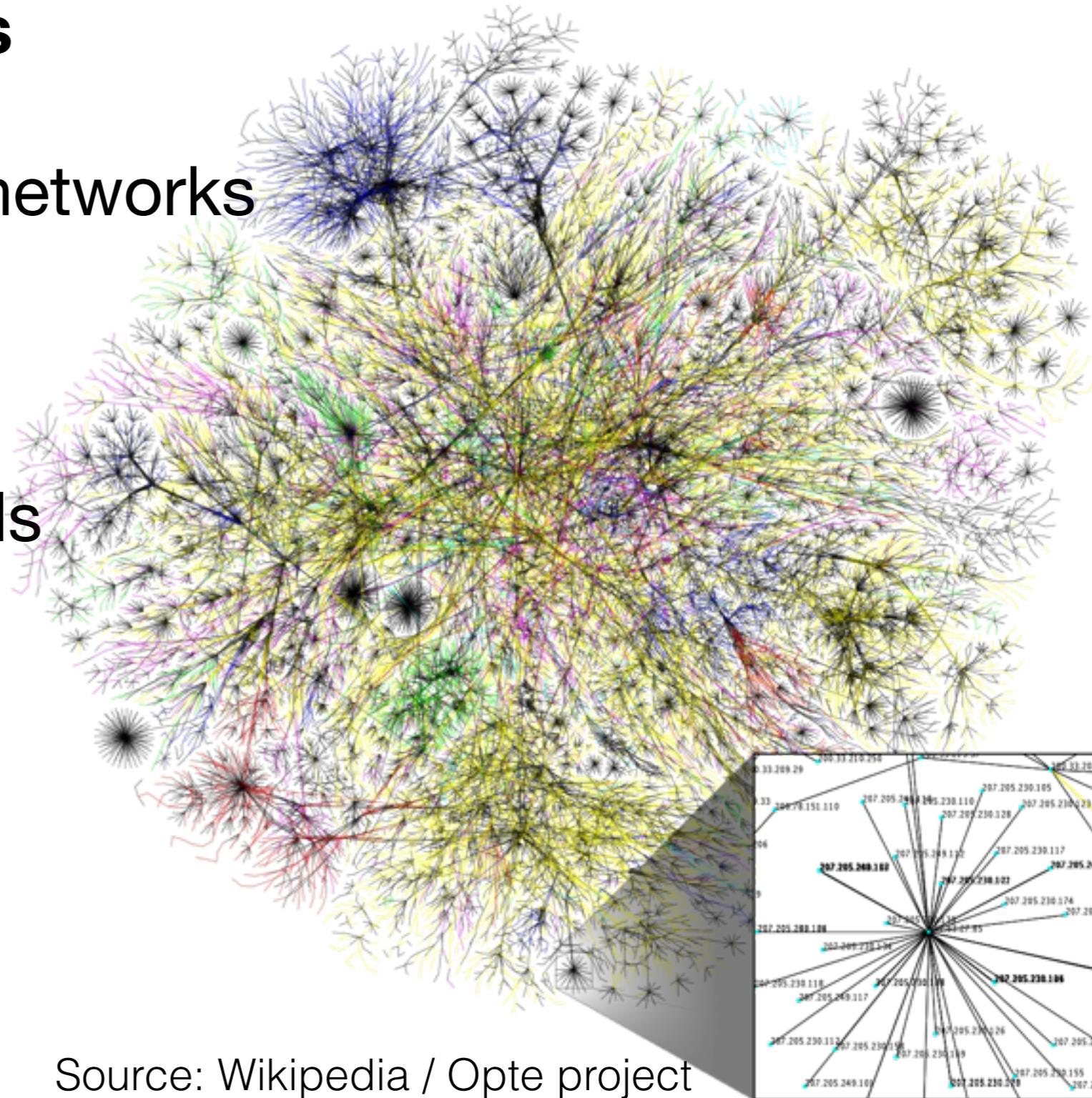
The Monash Network



- Wide area links are provided by VERNET
- Links are dark fibre or metro ethernet

The Internet

- A **network of networks**
- Connecting millions of networks and billions of devices
- Based on a common, standard set of protocols



Source: Wikipedia / Opte project

Data transmission rates

- Fundamental characteristic of a network:
how many **bits per second** can it transmit?
- Typical transmission rates:
 - 1 Mbps (million bits per second) from your home to your ISP (Internet Service Provider), 10-20 Mbps in the other direction
 - 50-500 Mbps within your WLAN (wireless network)
 - 1 Gbps in LANs (local area network, e.g. Monash lab)
 - 10 Gbps in backbone networks
 - Tbps (tera bits per second, 10^{12}) in optical fibre networks

Layers and Protocols

How to transfer messages

- Networks run on very diverse and complex hardware and software:
How can we make sure they all understand each other?

How to transfer messages

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- Solution:
 - hierarchical **layers of abstraction** each with well-defined tasks and **interfaces**
 - formal languages (**protocols**) within each layer

How to transfer messages

- Networks run on very diverse and complex hardware and software:
How can we make sure they all understand each other?
- Solution:
 - hierarchical **layers of abstraction** each with well-defined tasks and **interfaces**
 - formal languages (**protocols**) within each layer
- This is typical software engineering!

Layers of Abstraction

Application
(manage user data)

Logical connections
(break up into packets, make
sure they arrive)

Routing
(where should packets go?)

Low-level connections
(computer-to-computer)

Hardware
(cables, WIFI etc)

Layers of Abstraction

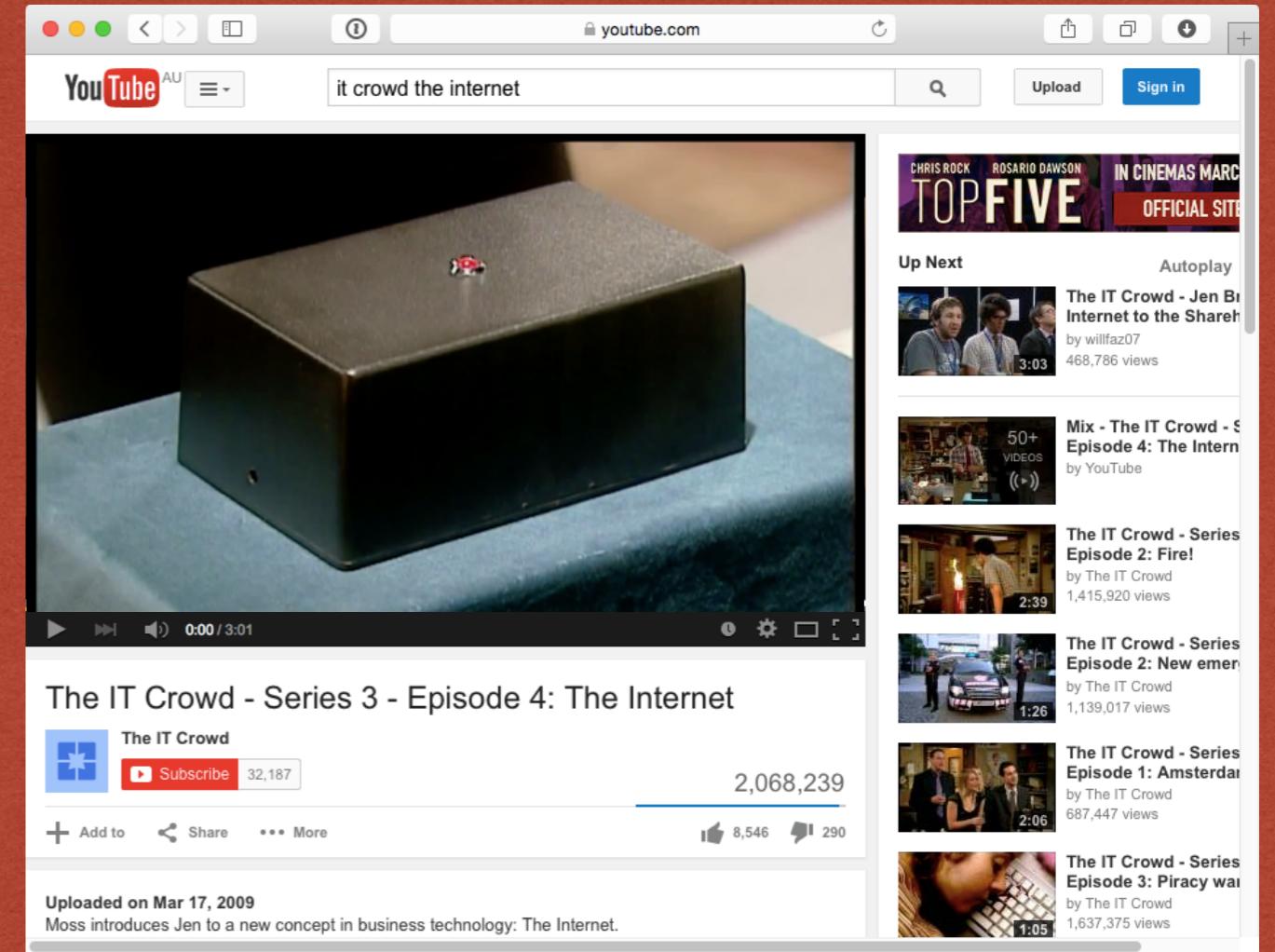
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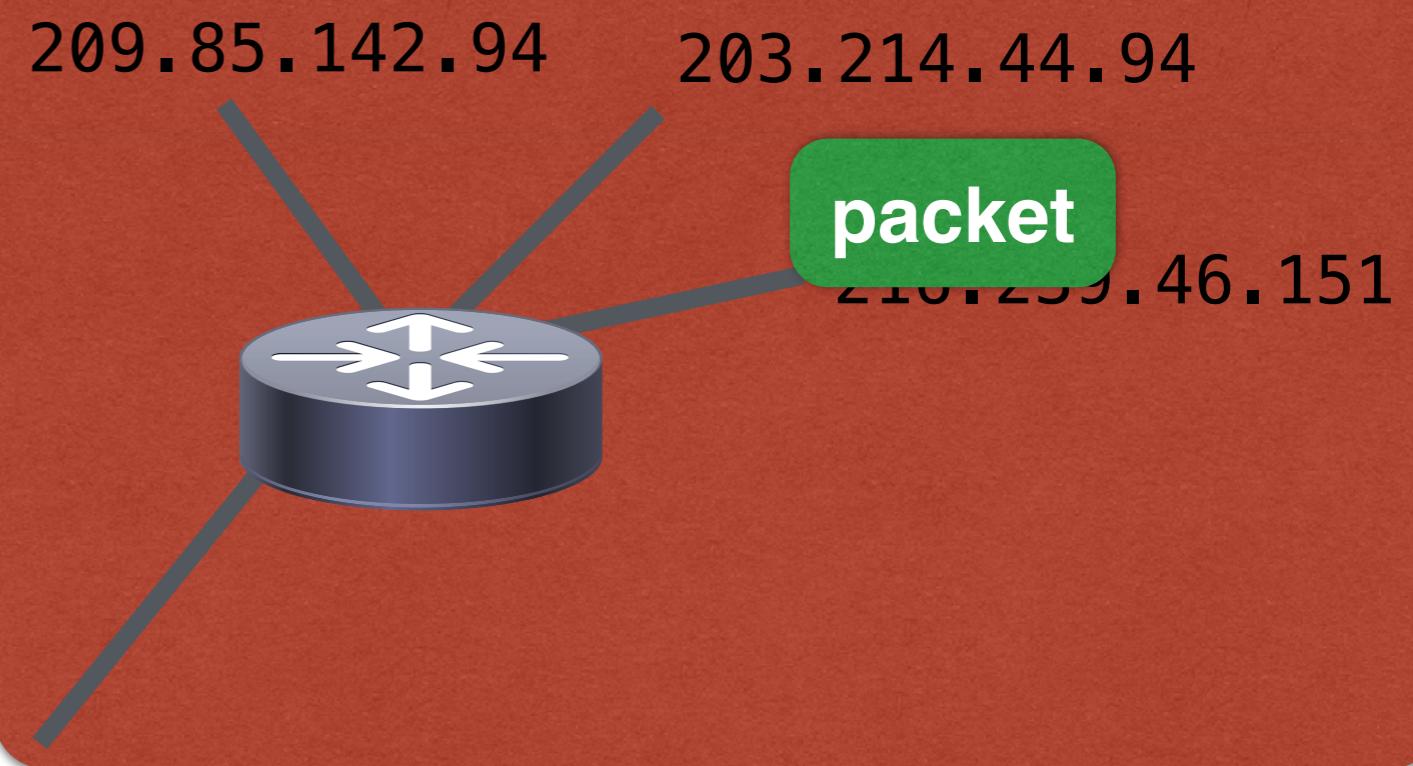
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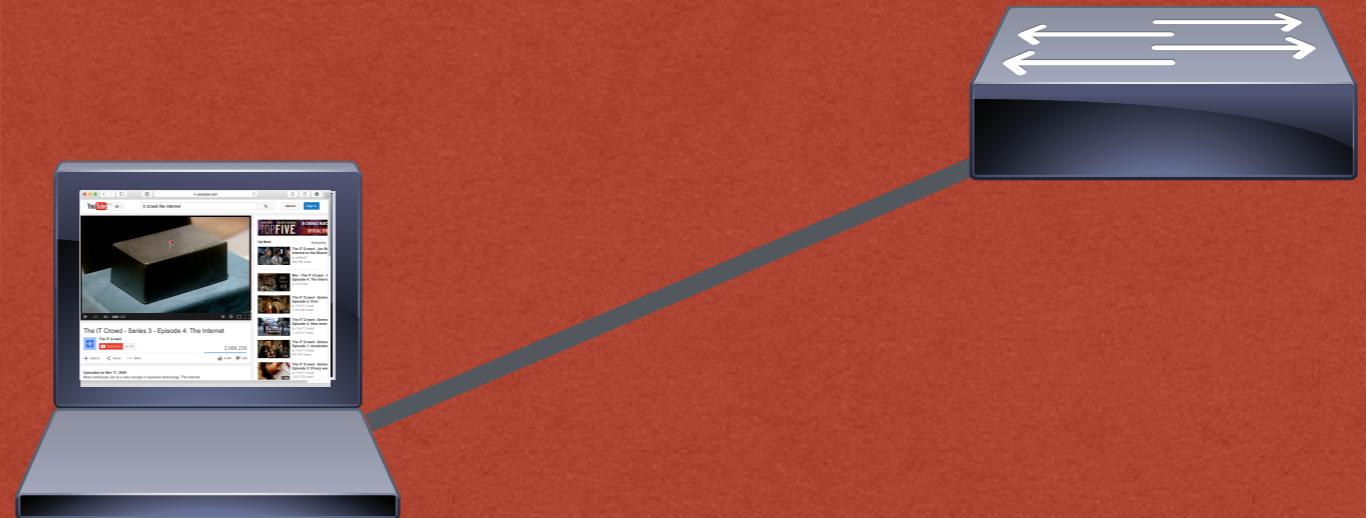
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Low-level connections
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Layers of Abstraction

Application
(manage user data)

Transport
(break up into packets, make
sure they arrive)

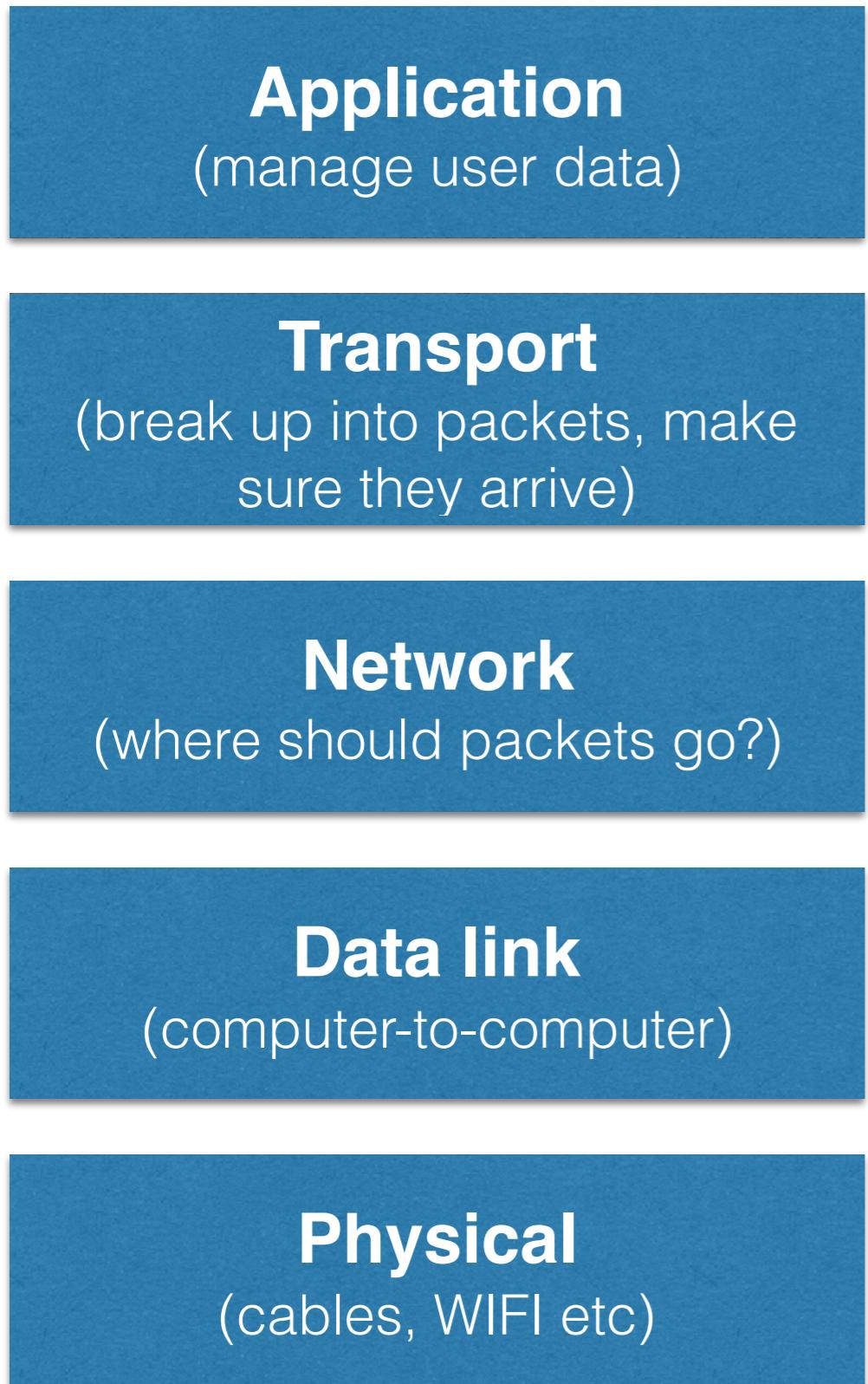
Network
(where should packets go?)

Data link
(computer-to-computer)

Physical
(cables, WIFI etc)

Internet Model

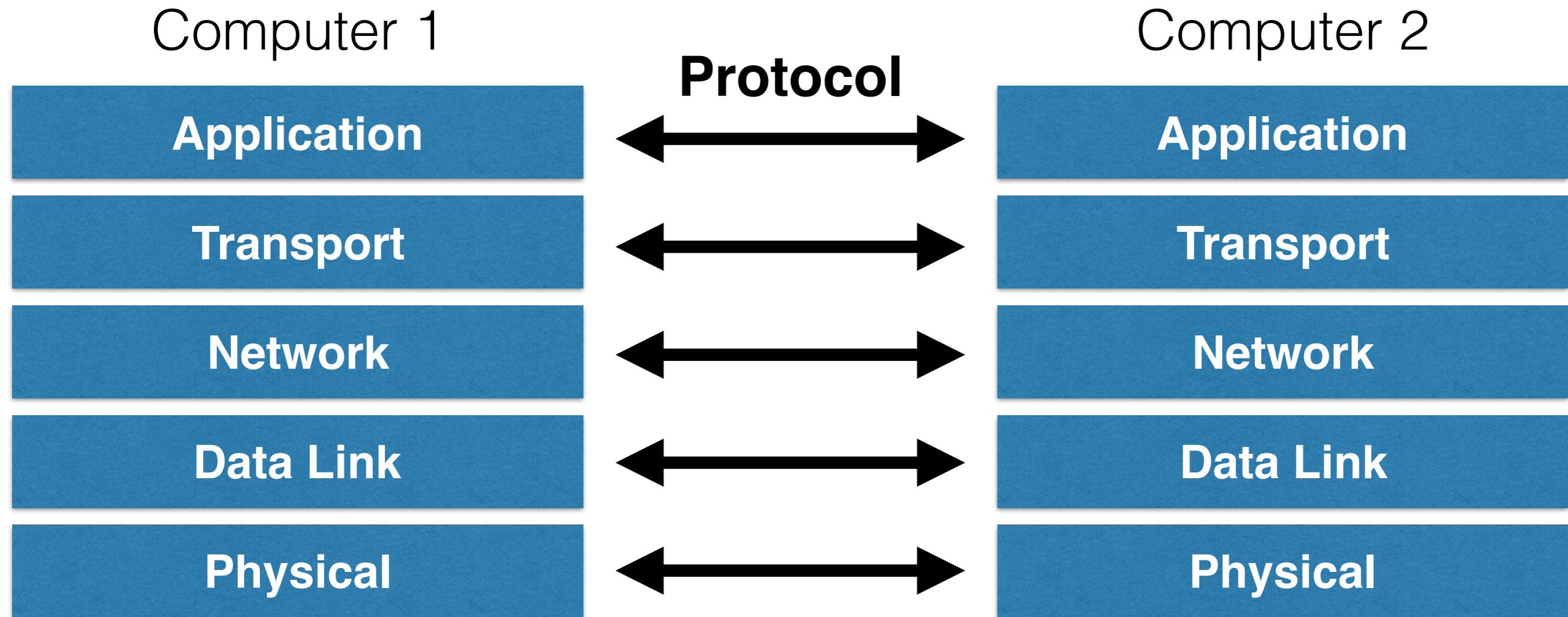
Layers of Abstraction



Interface

Interfaces define how each layer “talks” to the one above and below.

Layers of Abstraction



Protocols define how the **same** layers communicate between **different** computers.

Layers of Abstraction

Application

Transport

Network

Data Link

Physical

Layers of Abstraction

Application

Transport

Network

Data Link

Physical

Layers of Abstraction



Application

Transport

Network

Data Link

Physical



Layers of Abstraction



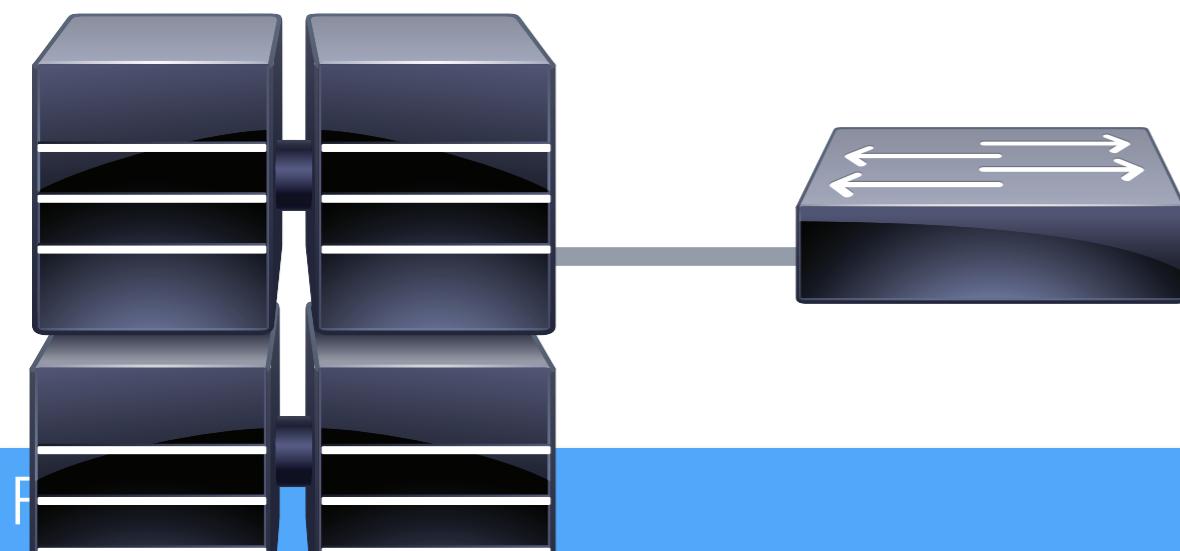
Application

Transport

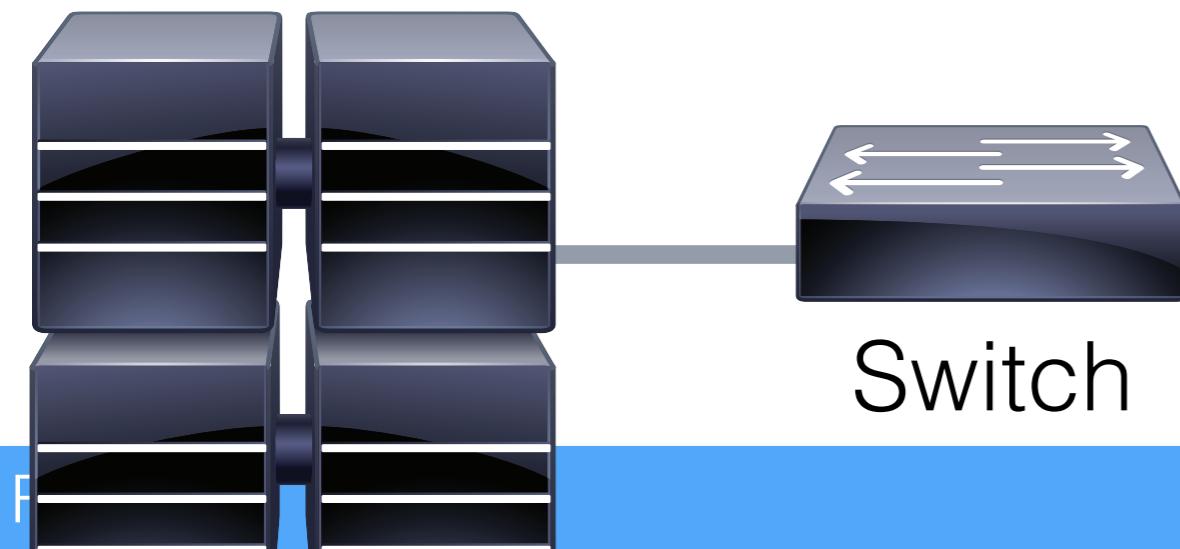
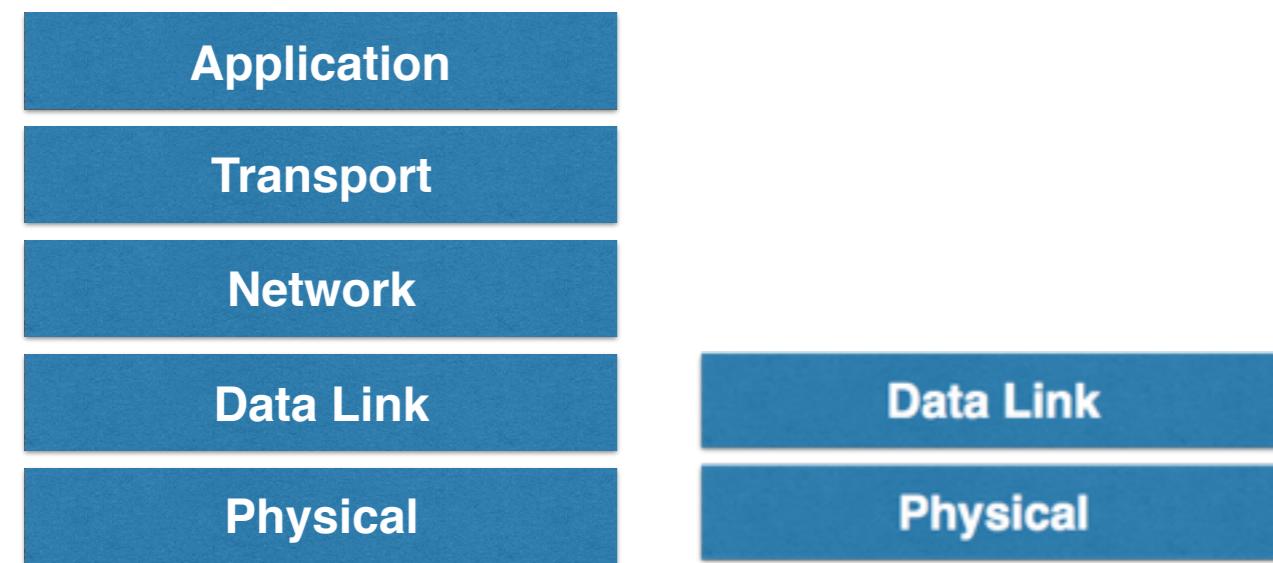
Network

Data Link

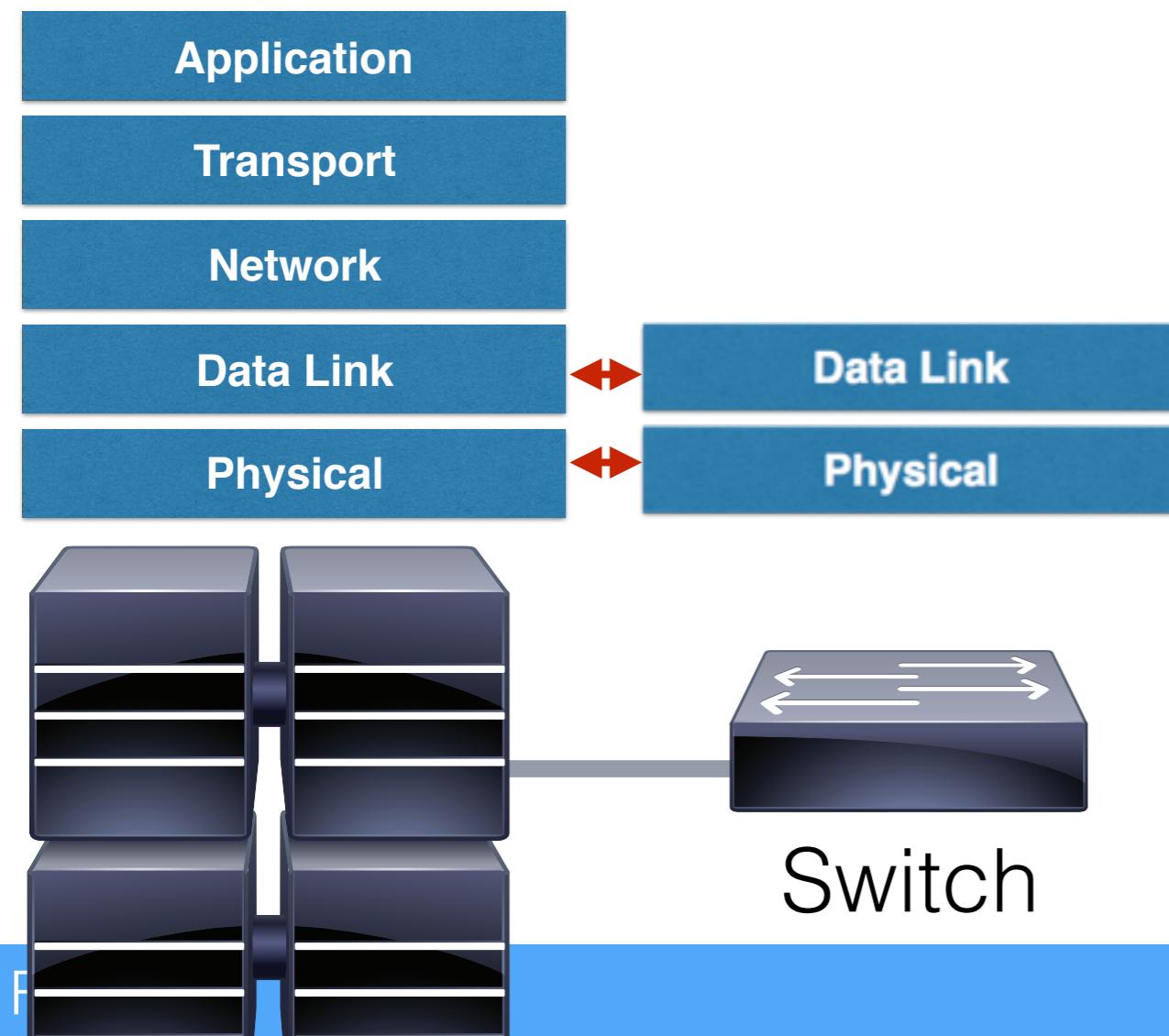
Physical



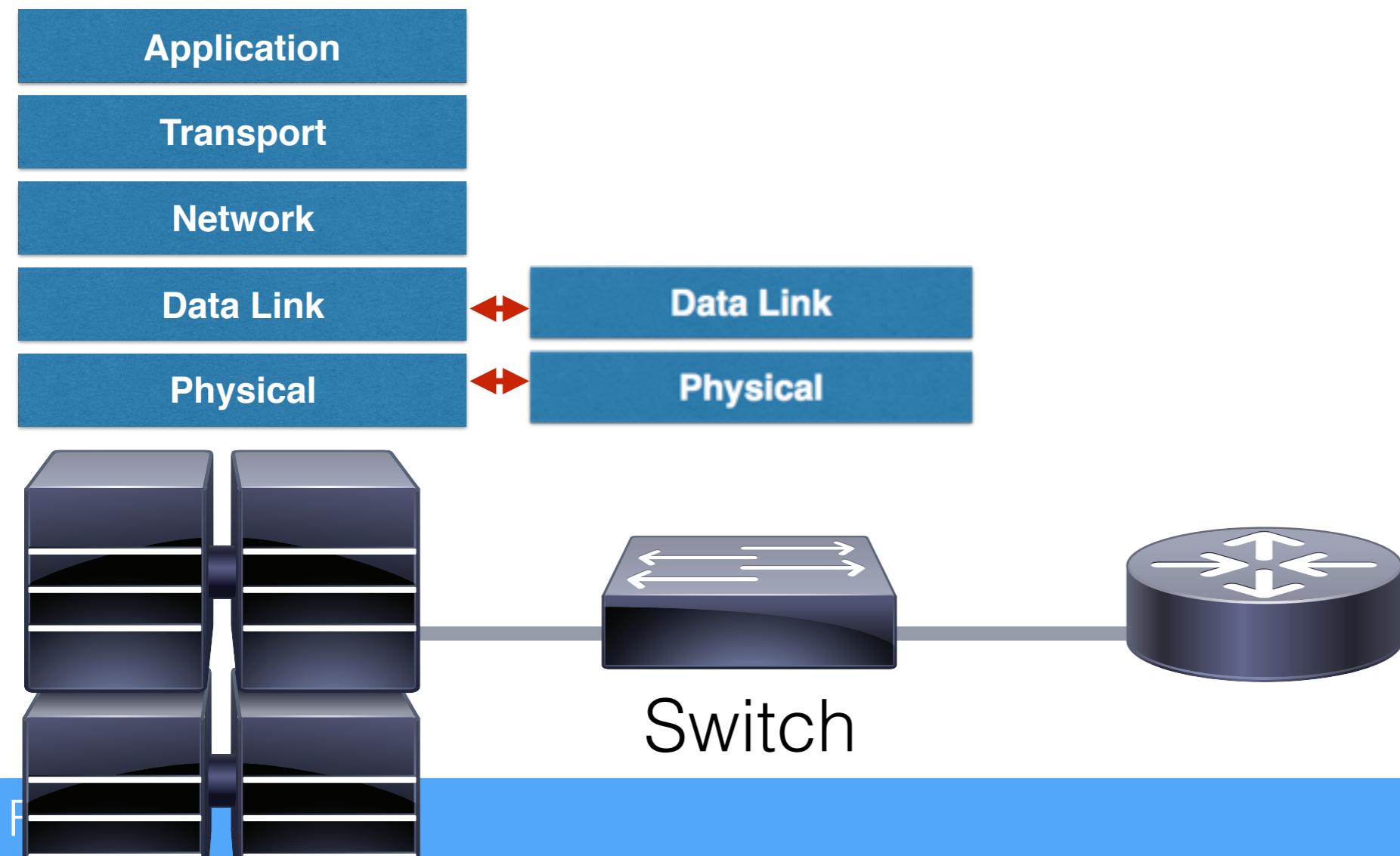
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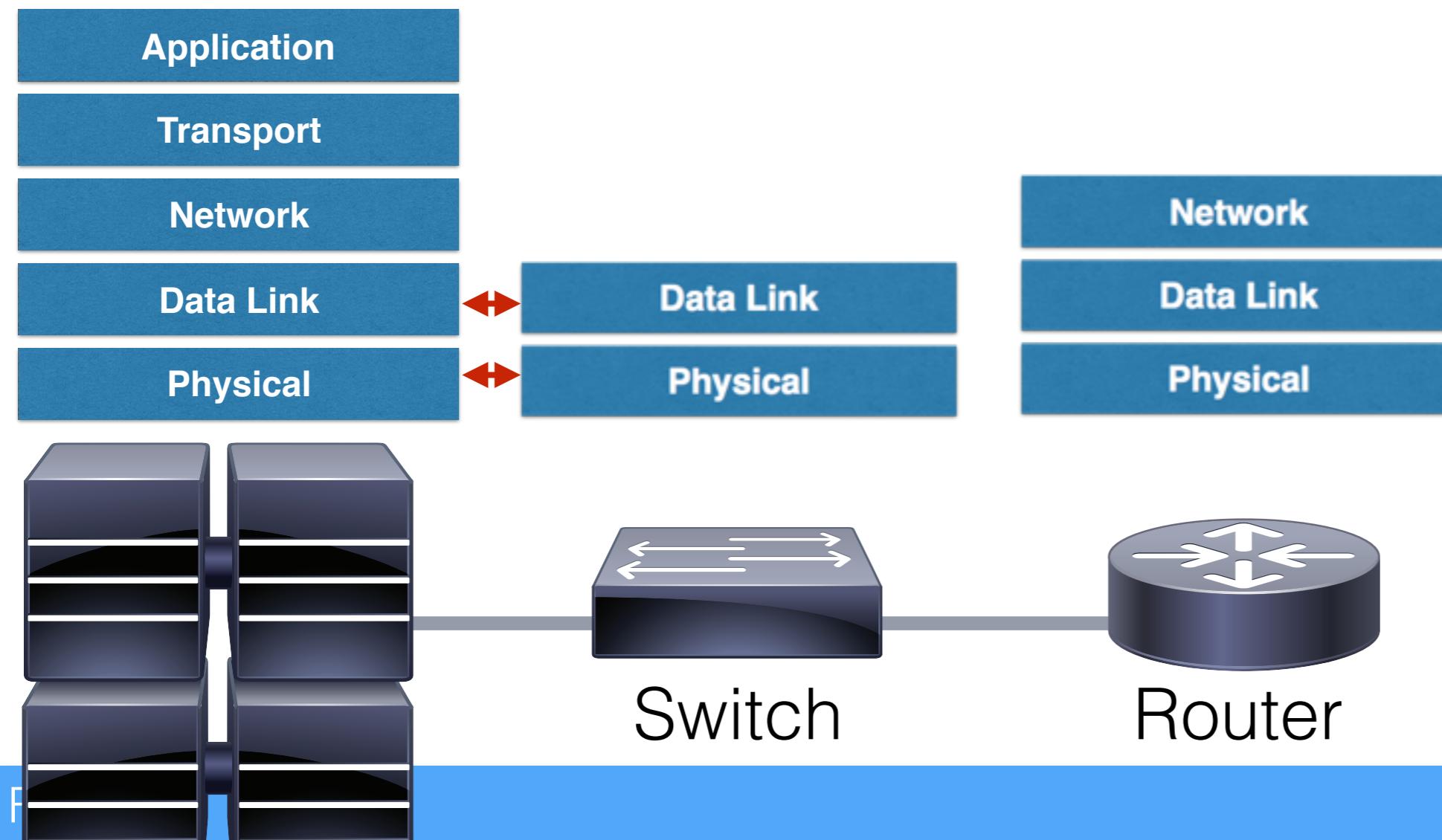
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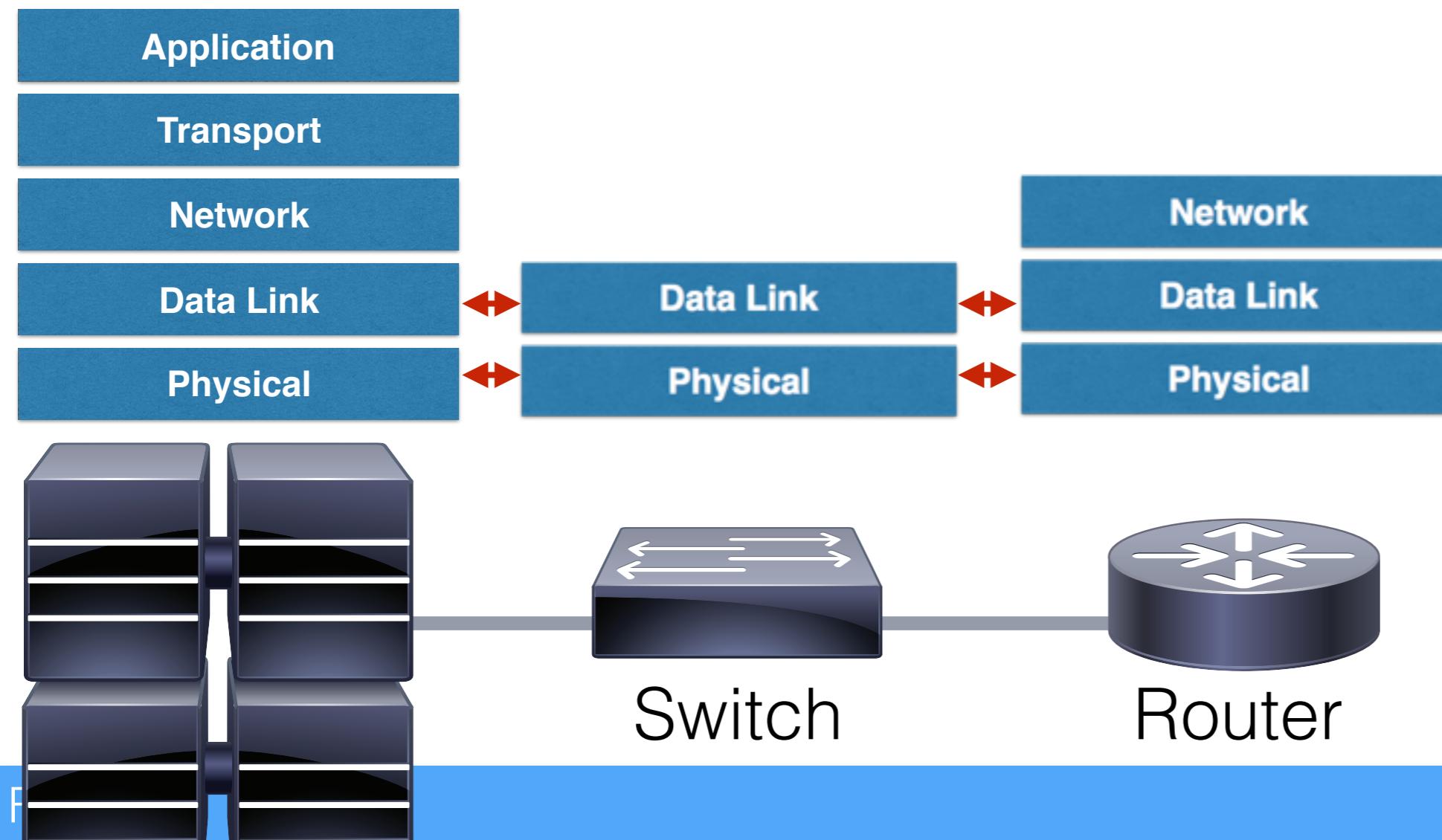
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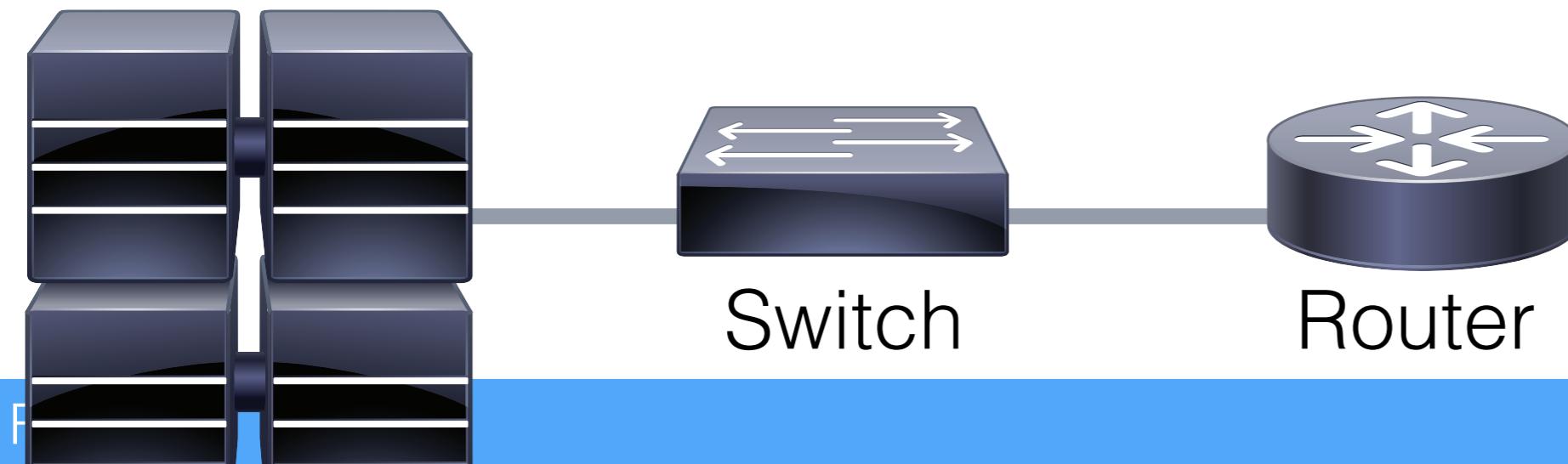
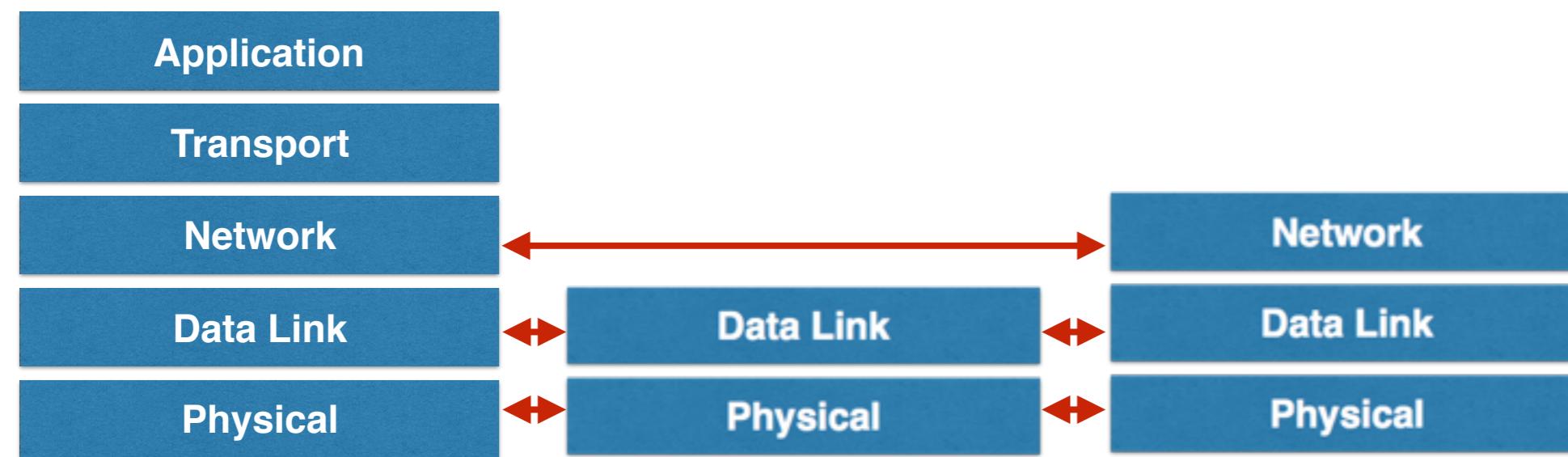
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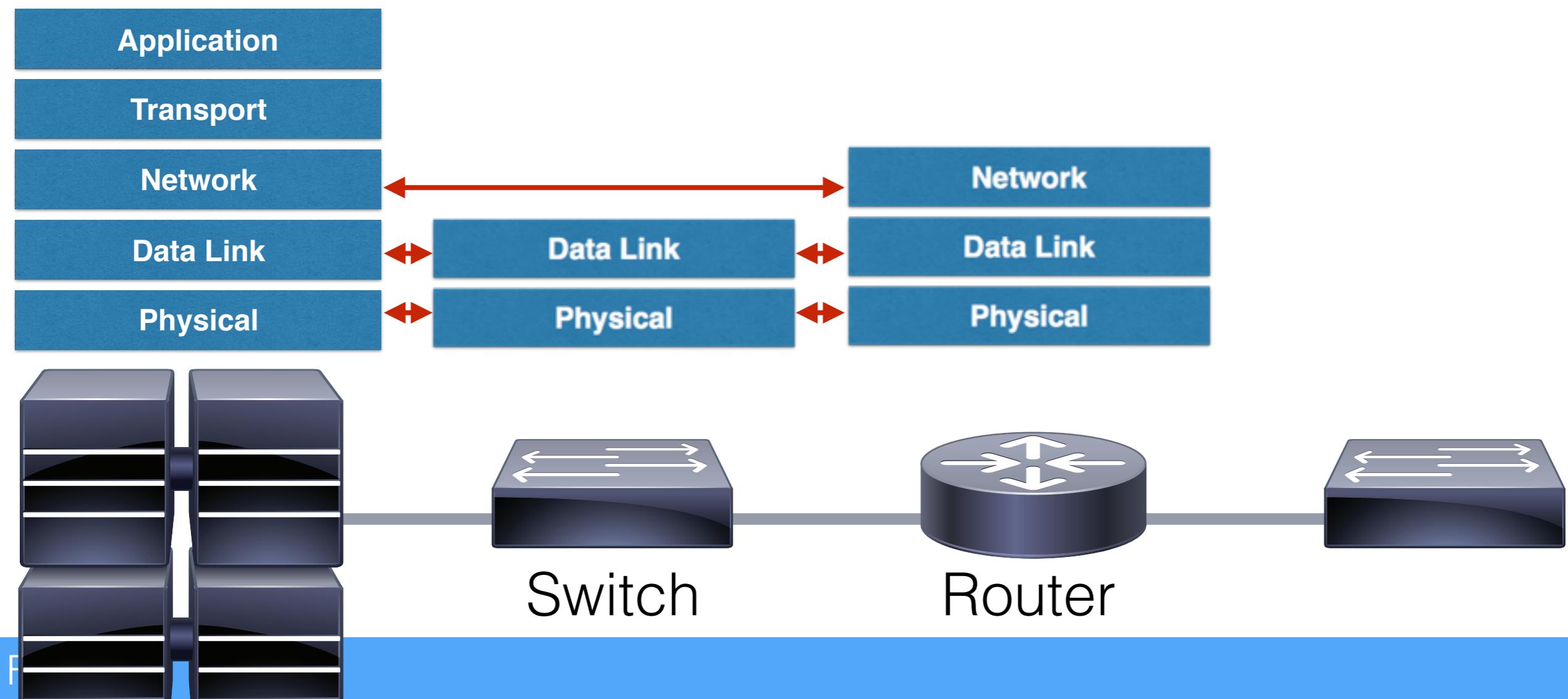
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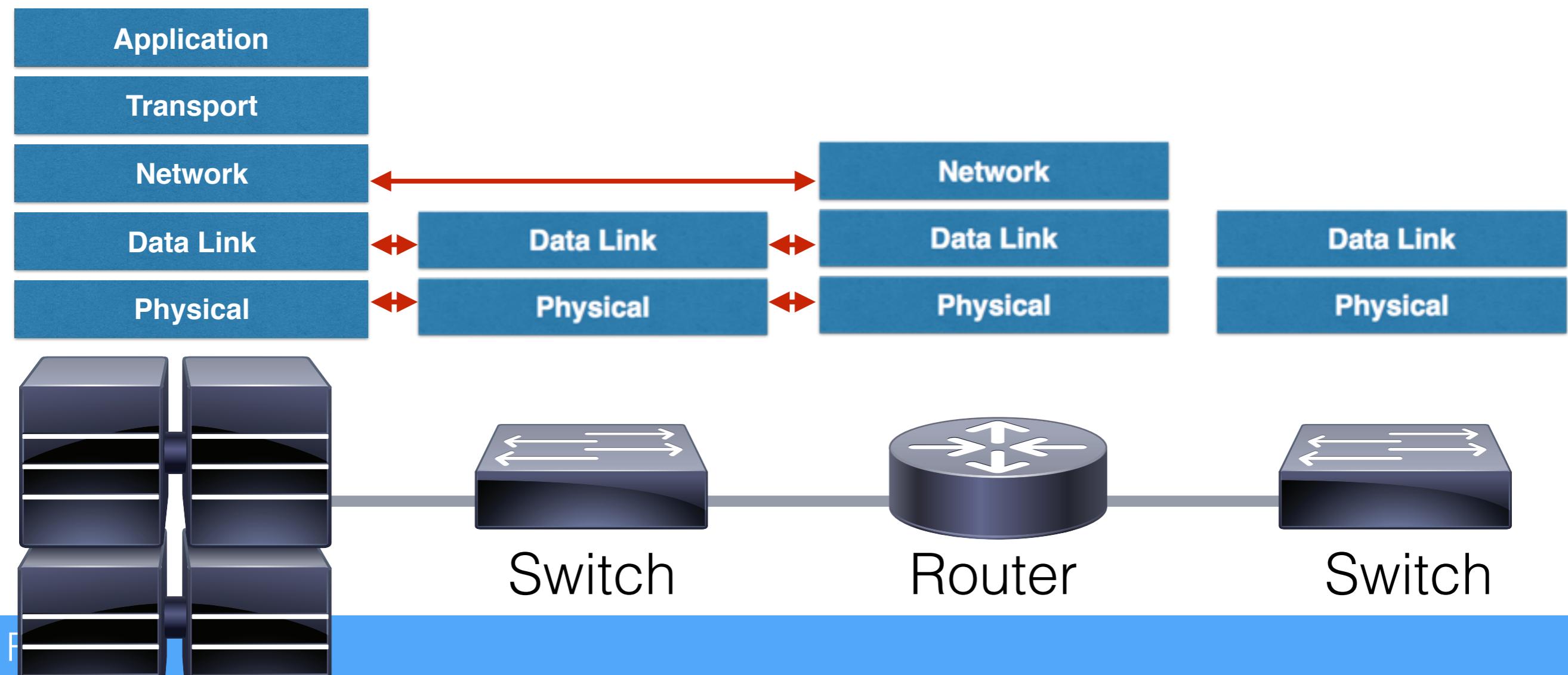
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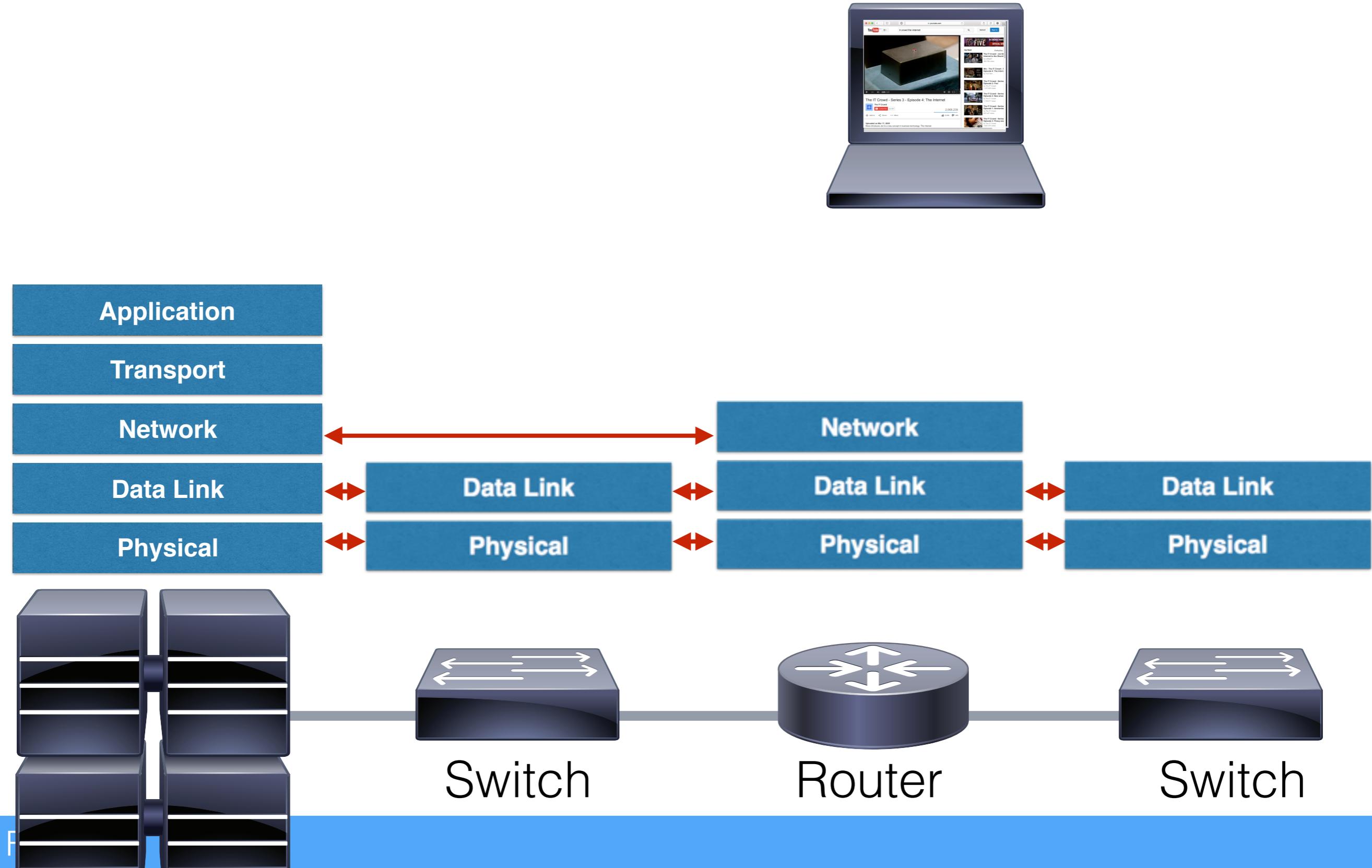
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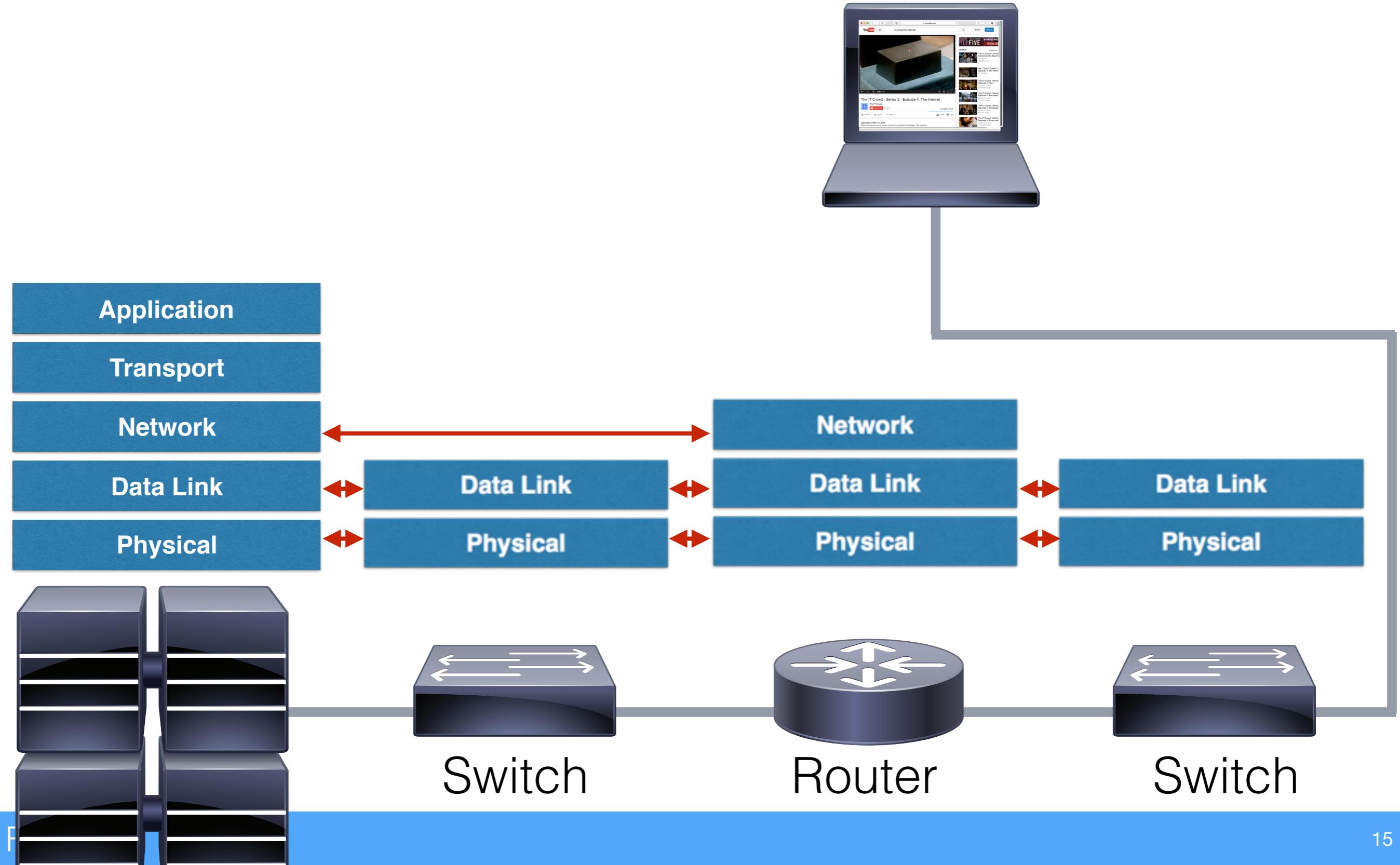
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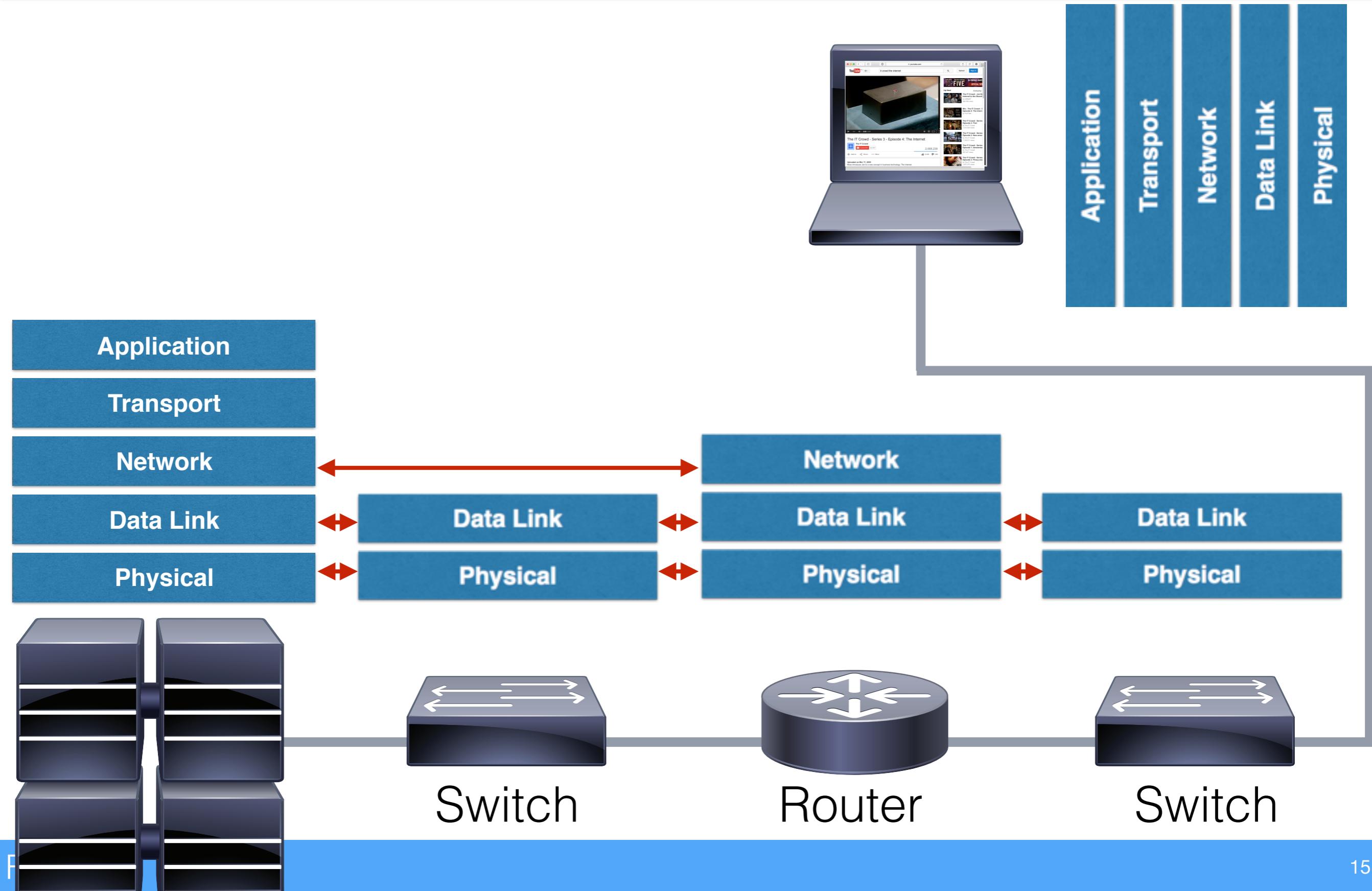
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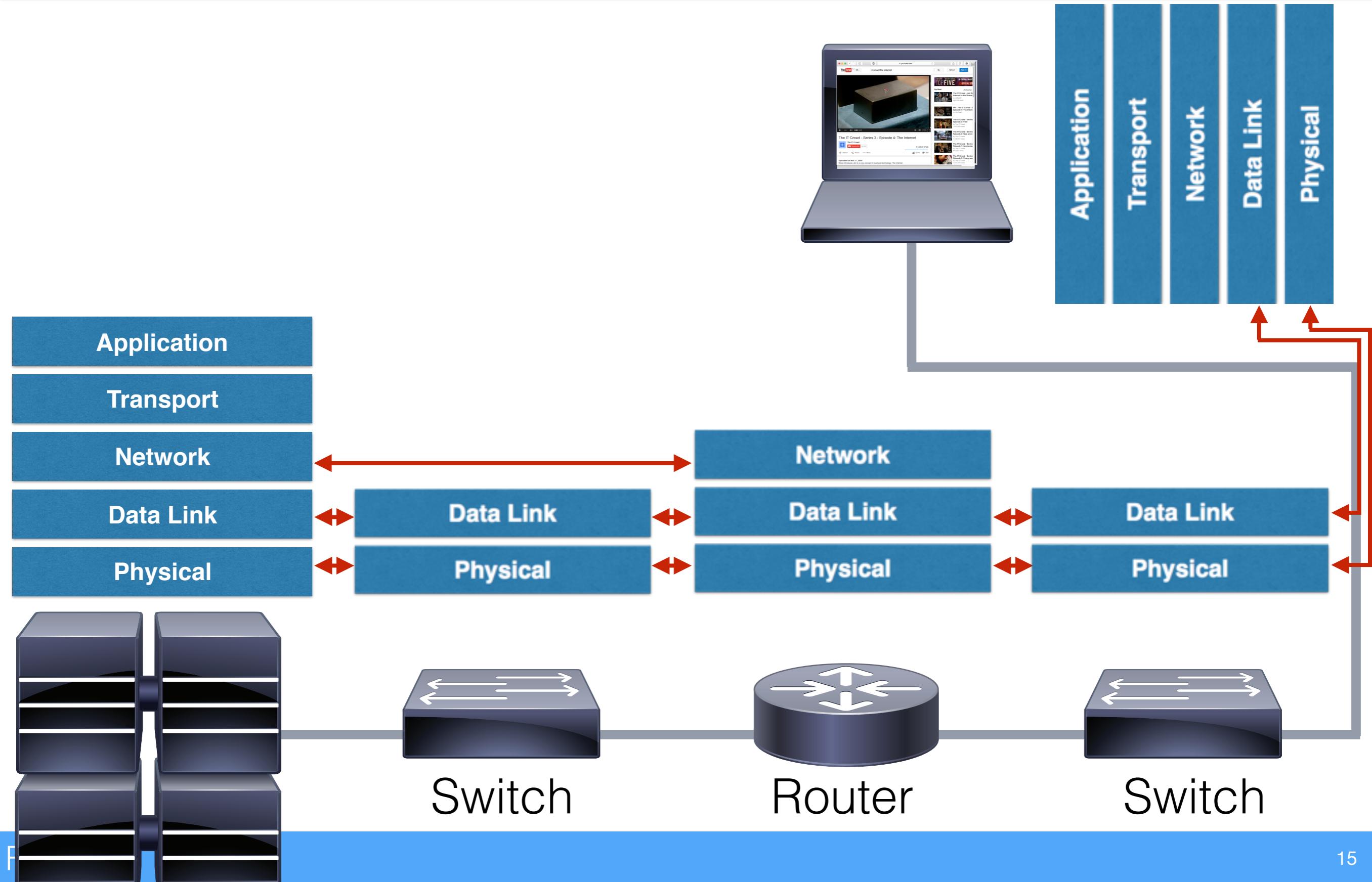
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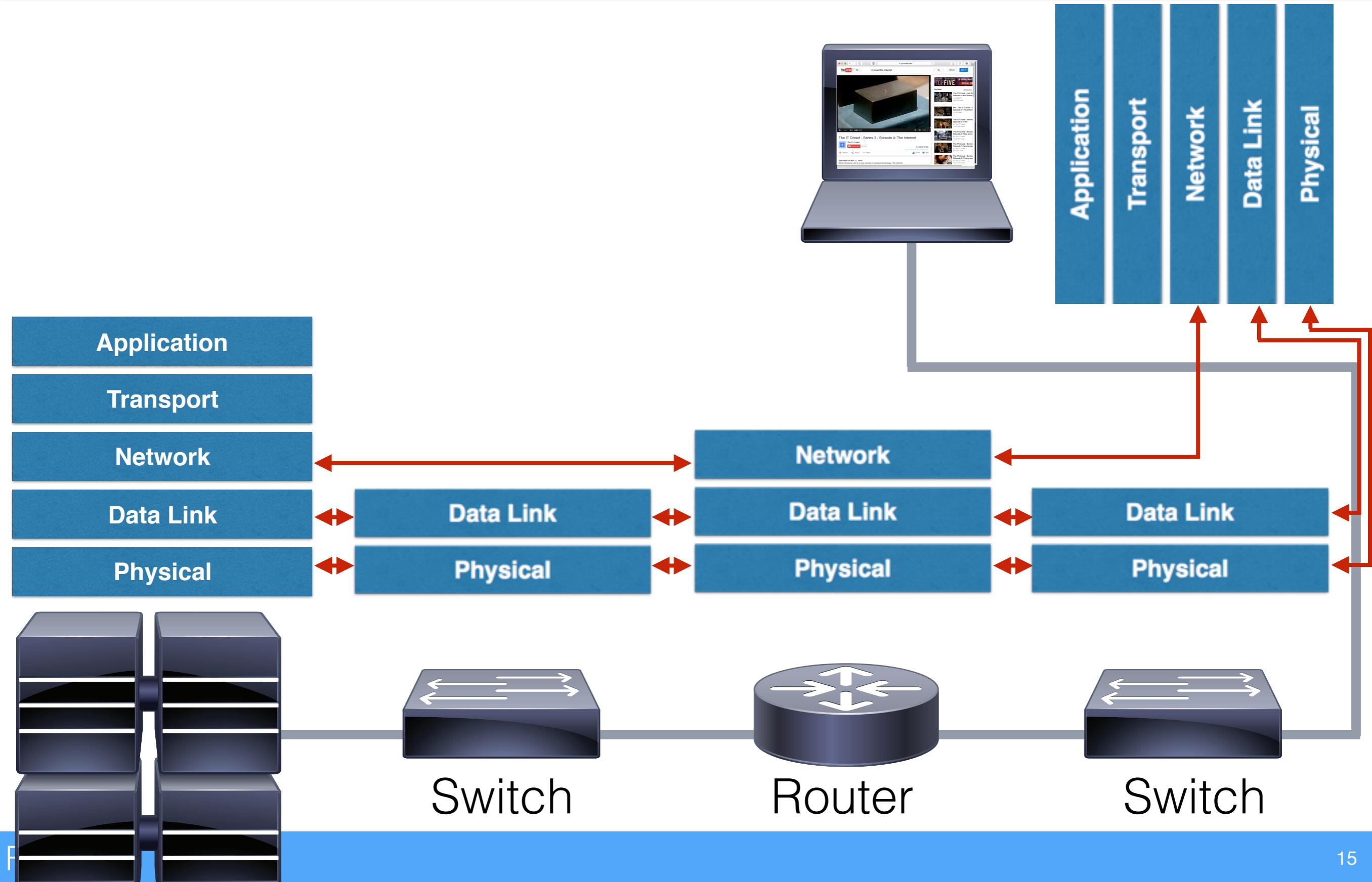
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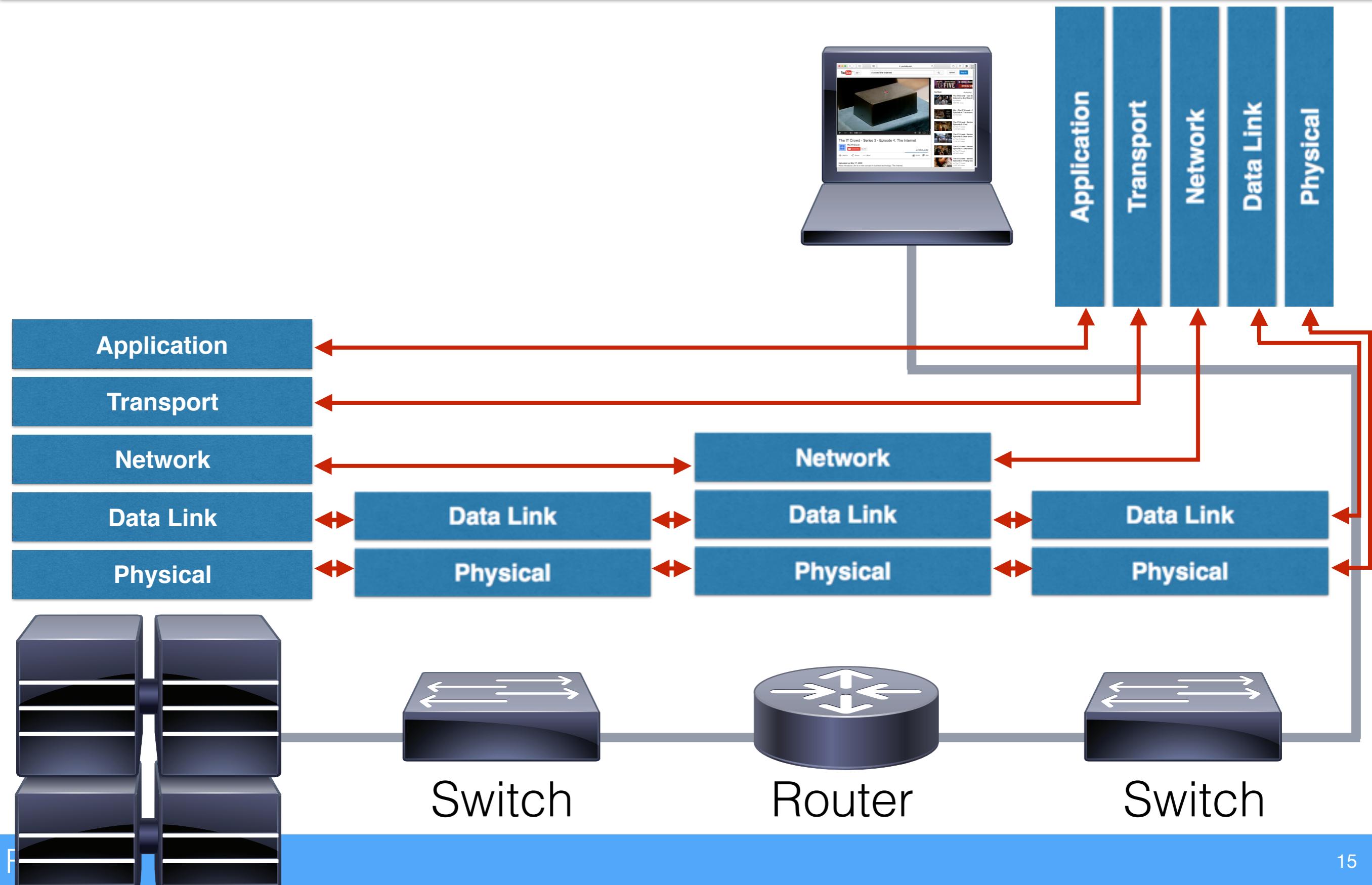
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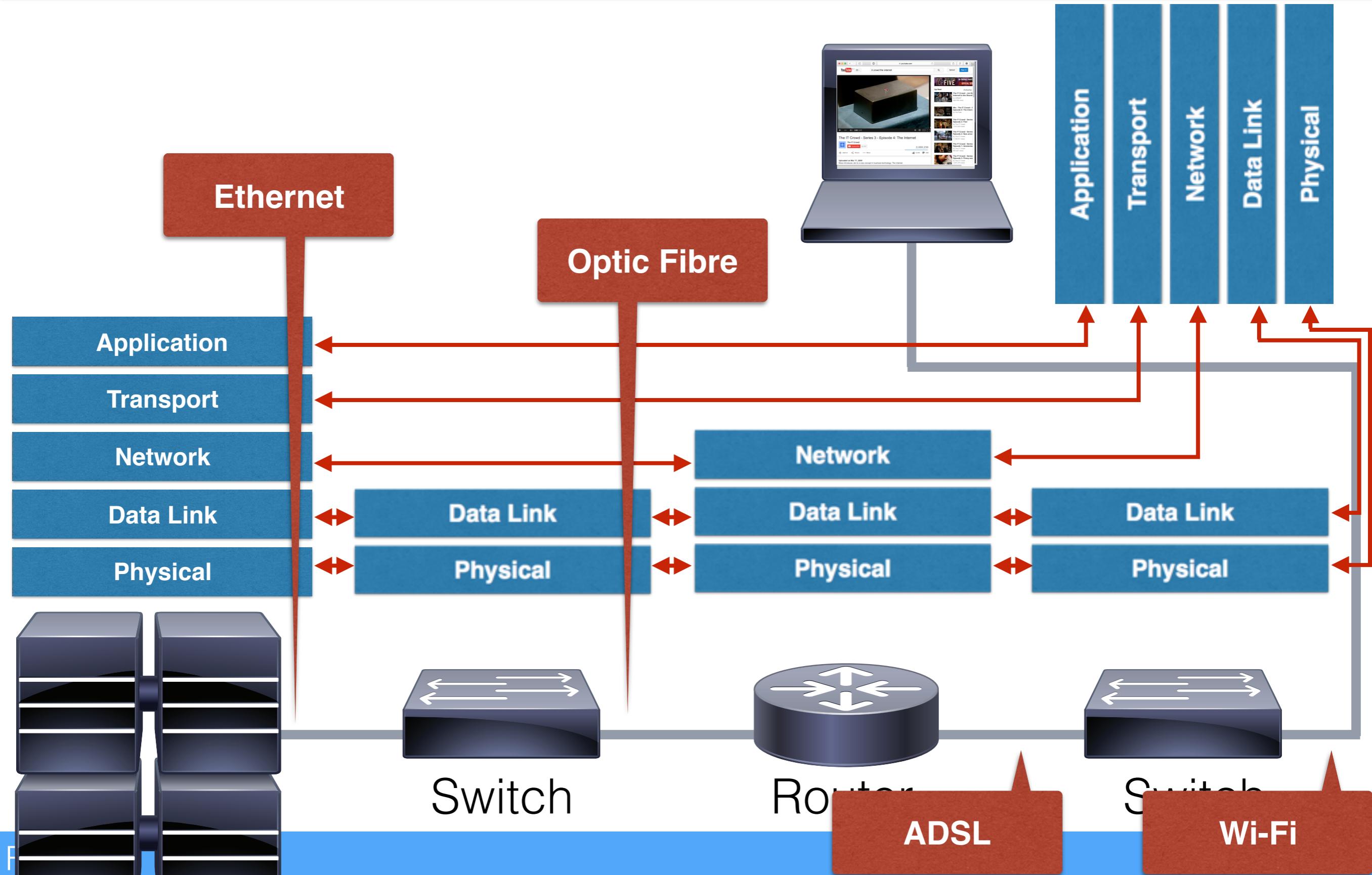
Layers of Abstraction



Layers of Abstraction



Layers of Abstraction



Message Encapsulation

<https://youtu.be/4B44hy7BPYk>

Message Encapsulation

Application

HTTP www.youtube.com

Transport

TCP

Network

IP

Data Link

Ethernet

Physical

Message Encapsulation

Protocol Data Unit **(PDU)**

Application

Message

HTTP www.youtube.com

Transport

Segment

TCP

Network

Packet

IP

Data Link

Frame

Ethernet

Physical

Bit

Message Encapsulation

Protocol Data Unit **(PDU)**

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Message

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Bit

PDU contains:

- Addresses (sender/receiver)
- Error detection codes
- Protocol-specific information
- Special start and end symbols

Summary

- Networks consist of clients, servers, switches, routers, and other circuit hardware (e.g. cables)
- LANs connect computers directly with each other
- The Internet model has five layers
- Each layer encapsulates the message and adds its own PDU