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Fundamentals Internet & Networking

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Goal of the Submodule

The goal of this submodule is to cover the basics of how the Internet works.
By the end of this submodule, the learners should be able to understand fundamentals of:

- Communication over the Internet
- URLs
- HTTP and HTTPS
- DNS
- IP Address

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Topics

- Communication over the Internet
- URLs
- HTTP and HTTPS
- DNS
- IP Address

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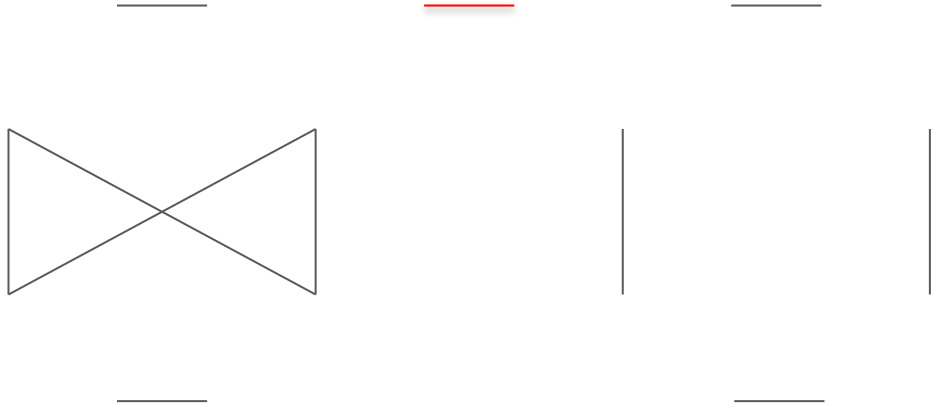
Glossary

Term	Definition
TCP/IP	**Transmission Control Protocol** / **Internet Protocol;** “Internet protocol suite”. Set of communications protocols used in the Internet.
UDP	**User Datagram Protocol**; One of the internet protocol suite, used to send messages to other host on an internet protocol network.
DNS	**Domain Name System**; standardized hierarchical and decentralized naming and addressing system for the Internet
URL	**Universal Resource Locator**; a specific kind of address used a lot on the Internet.
ISP	**Internet Service Provider**. An organization that provides services for accessing the internet.

How the Internet works

The Internet is a network of servers



The Internet is basically a bunch of servers connected to each other like a web.

Servers are just computers, either physical or virtual.

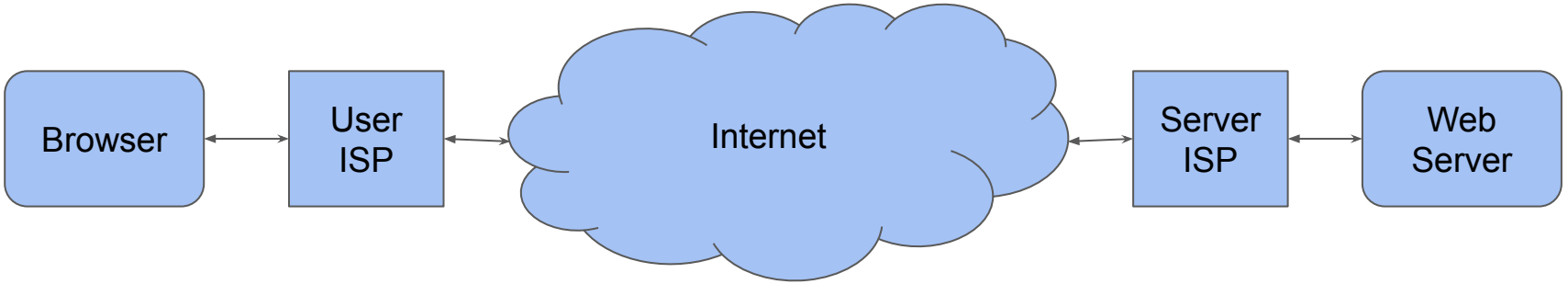
These servers exchange information using standardized communication protocols.

Many kinds of specialized servers, providing many services.

Data / Information flow online

Users and servers both are connected to the Internet via an Internet Service Provider

Information flows from one machine to another over the network of computers, sometimes passing many different nodes.



TCP/IP

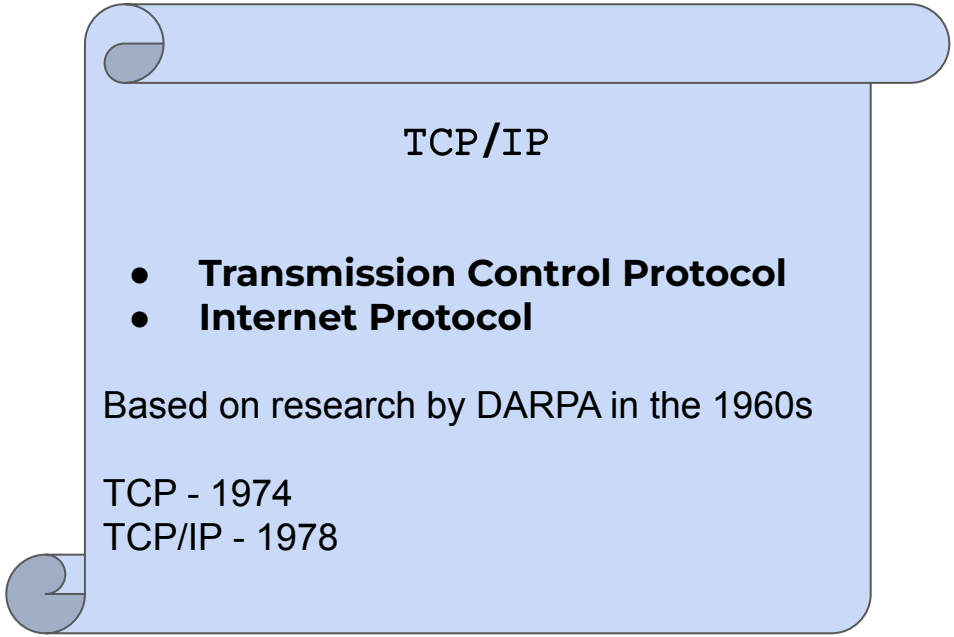
To enable computers to communicate, a shared protocol exists.

This protocol defines the standards that ensure that computers understand each other globally.

The set of protocols that powers the Internet is called the Internet protocol suite.

It is also commonly known as TCP/IP.

The protocol defines exactly how sent data looks like.



TCP vs UDP

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TCP , UDP

Data is sent as small packets using two different kinds communication:

TCP Connected

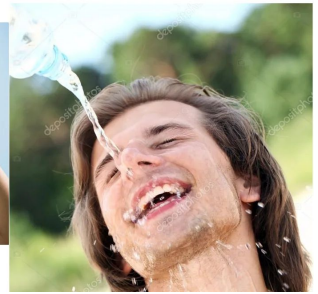
- like a telephone 📞
    - a connection is created and information sent
    - possible to confirm information was received
    - in case of error, information resent / retried
- used when all data is needed, no error tolerance
- **EG**. Web browsing, Email, File Transfer Protocol(FTP)

UDP Connectionless

- like radio transmissions📨
    - no connection made
    - messages sent and *hopefully* received
    - no error checking
- faster and simpler
- voice and video streaming
- **EG**. live Streaming, Online Gaming

TCP

UDP



IP addresses

To send data using TCP/IP, computers & smartphones need an address! **An IP address!**

IPv4 ➡️ **192.168.1.1**

This one *127.0.0.1* points to your local device

0.0.0.0 - 255.255.255.255 = ~3400 million addresses

We are running out of IPv4 addresses! 😨 But things like IPv6 are helping!

They can change OR be static (you can buy static IP addresses)
Some are Public (used on the internet) addresses
Some are Private (used in local networks) addresses

IPv6 ➡️ **2001:db8::8a2e:370:1123** (0:0:0:0:0:0:0:1 or ::1 for your local device)

These are *slowly* becoming popular. They are static, nearly endless and ❤️𝒞𝑜𝑜𝓁❤️. Also complex.

Help me DNS, you are my only hope

The Internet sure would be terrible if we had to remember the IP address of every website...

Tell me, was Facebook
2a03:2880:f10c:83:face:b00c:0:25de

Or was it
2a03:2880:f10c:83:face:b00c:0:25df

?

DNS

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Thankfully, we have nicer addresses for websites.

DNS is a global database of domain-to-IP records

They look like this: https://www.mytricksntips.com/cat/python/

That's better. That's an URL. **Universal Resource Locator**

The web (maybe you have heard of it?) uses URLs instead of IP addresses to make addresses easy to remember and recognize.

URLS are made up of multiple different parts ....

DNS / URL

The anatomy of an URL

Protocol **Port** **Query string**

https://**test.example.org**:**443**/**dogs/poodle**?**color=white&puppy=false**#**first**

Domain
(subdomain: test)
(domain name: example)
(TLD / top level domain: org)

Resource path

Hash

Common ports

80 - normal web traffic (http)
443 - encrypted web traffic (https)
22 - SSH access: Secure Shell
21 - FTP: File transfer protocol

DNS

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DNS (Domain Name System) is the phone book of the internet, translating IP addresses to Domains and pointing Domains to IP addresses.

When you type in an address, your computer does a DNS query to find the IP to connect to.

DNS is a layered system, where you have different kinds of DNS servers

- DNS Root servers know where TLD domains (.com, .de) are stored
- DNS TLD Servers know where specific domains are stored
- DNS Authoritative servers know which domain points to which IP address

...by the way, web sites can work without domains http://216.58.192.78/

To sum up

When you type in a website address

1. Your computer gets the website server IP address from DNS
2. Your computer connects to the target server and requests a website
3. The server responds and sends the data for the website
4. The data transmitted to you can travel through many servers on the internet
5. And all the communicating happens using the TCP/IP protocols

The Internet is awesome.

At the core of the lesson

Computers use standardized communication protocols

Computers have IP addresses for communication

IP Addresses are mapped to human readable domain addresses with DNS

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Self Study

- Different Types of IP addresses
- Group the different protocols under TCP and UDP

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Documentation

TCP vs UDP: https://www.freecodecamp.org/news/tcp-vs-udp/

IP Address: https://www.techtarget.com/whatis/definition/IP-address-Internet-Protocol-Address

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