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Basics of Information Technology
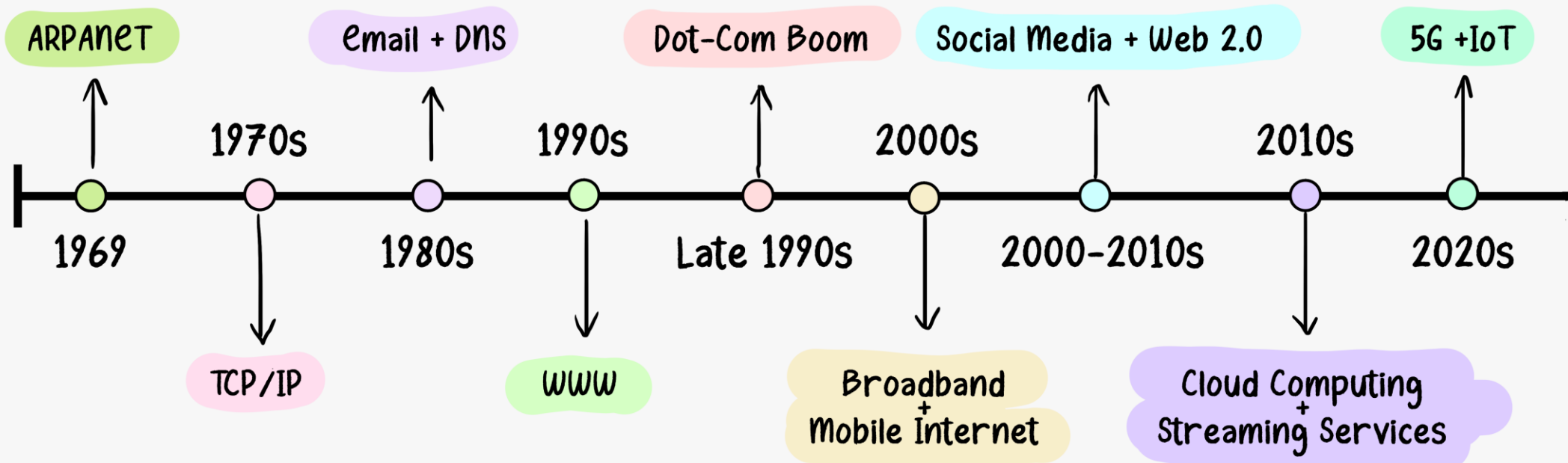Ing. Michal Radecký, Ph.D. MBA

Internet

What is the Internet

- The Internet is a set of technical means that enable the transportation of data in electronic form throughout the world, without restrictions on type and content.

- The Internet is a worldwide, publicly accessible set of interconnected computer networks that transmit data through "packet switching".

- The Internet is a "network of networks", where these internal networks do not have to be built on IP protocols (AppleTalk, IPX/SPX, etc.).

- **The Internet is a communication space for the exchange, acquisition and publication of information, regardless of its origin, form or language.**
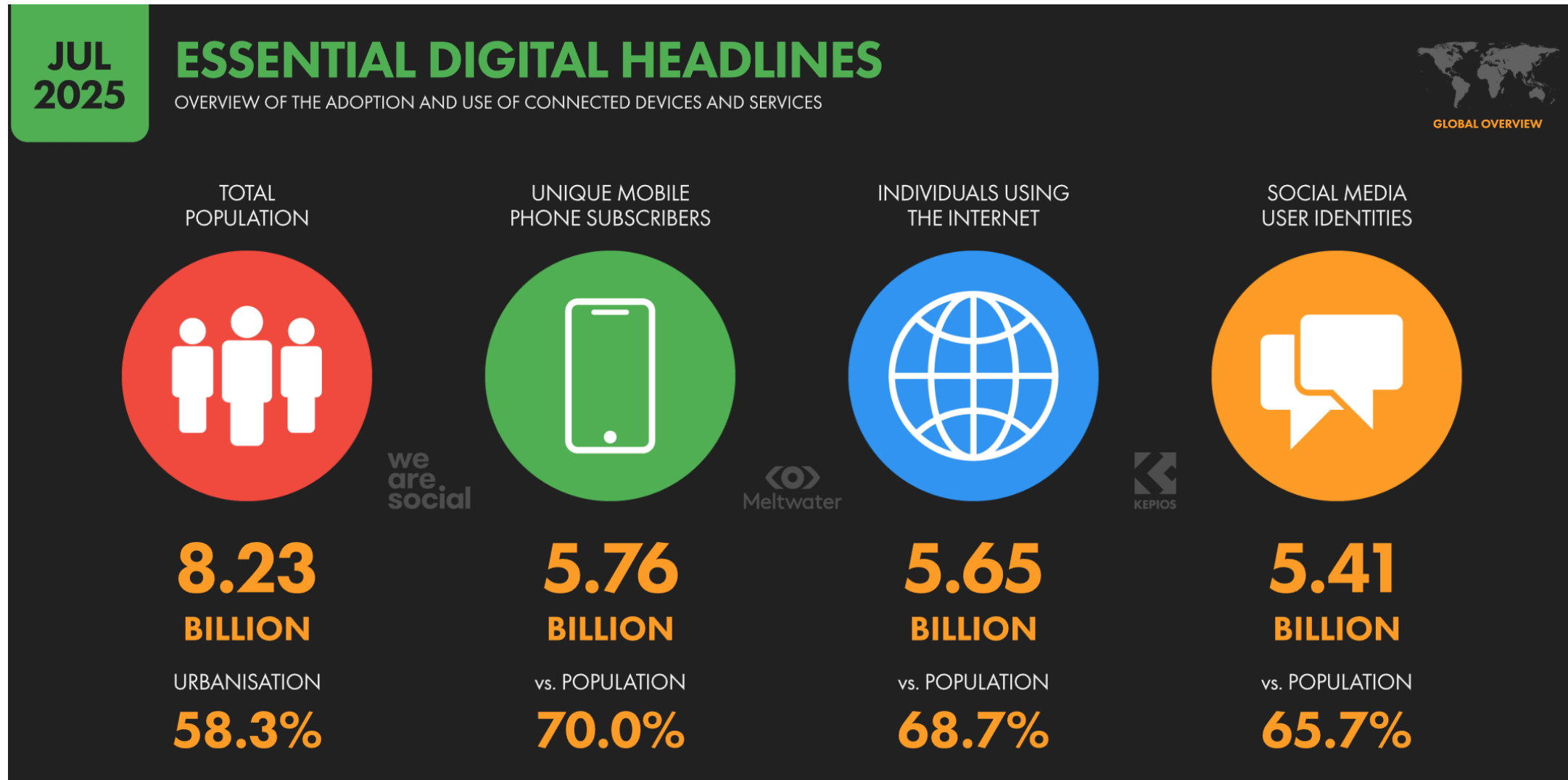
- Internet vs. Web

History of the Internet

https://www.youtube.com/watch?v=9hIQjrMHTv4, https://www.youtube.com/watch?v=VPToE8vwKew

Today's Internet

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Concepts and technologies

IP address

- identification of a node in a computer network (within the network layer (3) of the OSI model, IP protocol)

- IPv4 (32 bit), IPv6 (128 bit)

- Public vs. private address

- DHCP (Dynamic Host Configuration Protocol)

- Special address types (network/gateway address, broadcast, localhost, reserved addresses, etc.)

MAC address (Media Access Control adresa)

- Unique identifier of the network device on the link layer (2) of the OSI model

- For routing within a local area network (LAN)

- 48-bit (manufacturer identifier + device serial number)

Router

- Connects different networks using IP addresses, layer 3

- Directs traffic between networks

Switch

- Connects different devices within a local area network (LAN), layer 2

- Directs network traffic to specific devices

IPv4 vs. IPv6

IPv4	IPv6
Deployed 1981	Deployed 1998
32-bit IP address	128-bit IP address
4.3 billion addresses Addresses must be reused and masked	**7.9x10²⁸ addresses** Every device can have a unique address
Numeric dot-decimal notation **192.168.5.18**	Alphanumeric hexadecimal notation **50b2:6400:0000:0000:6c3a:b17d:0000:10a9** (Simplified - 50b2:6400::6c3a:b17d:0:10a9)
DHCP or manual configuration	Supports autoconfiguration

IP Address vs. MAC Address

Feature	IP Address	MAC Address
Definition	Unique identifier for network devices	Unique identifier for NICs
Purpose	Routes data between networks	Identifies local network devices
Format	IPv4: 192.168.1.1 IPv6: 2001:db8::1	00:1A:2B:3C:4D:5E
Assignment	By DHCP or manual	By manufacturer
Scope	Public or private	Local network only
Changeability	Dynamic or static	Permanent (hardware-based)
OSI Layer	Network Layer (Layer 3)	Data Link Layer (Layer 2)

Ex **Examples.com**

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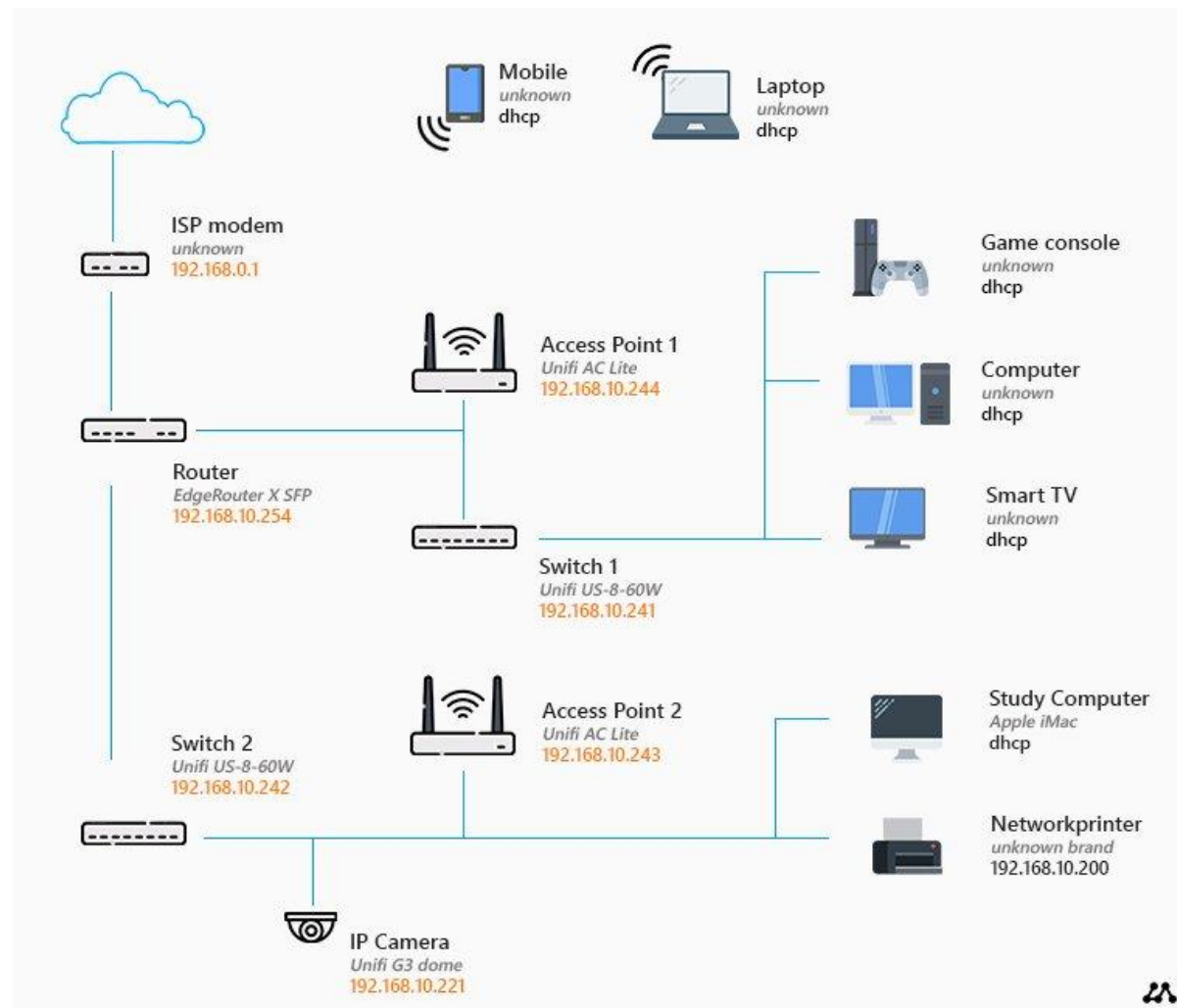# Concepts and technologies

ISP (Internet Service Provider)

- Commercial-based Internet Service Provider

- It uses various technologies (optics, radio signal, satellites, etc.)

- Provides an IP address (may/may not be public)

Firewall

- Security element within computer networks

- It can be standalone (SW, HW) or part of other network elements

- The task is to monitor and block dangerous activities based on rules or traffic analysis

Wifi MESH network

- A system of multiple access points (APs) that work together and create one common Wi-Fi (SSID - Service Set Identifier) with smooth covering the entire space.

- Better coverage and roaming

- Part of complex systems (Unifi, OneMesh, etc.)

- Possibility of wireless connection between APs

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Concepts and technologies

Domain

- A legible and understandable address on the Internet, which corresponds to an IP address (not only)

- TLD (Top Level Domain), Domain Administrators, Registrars

DNS (Domain Name System)

- A global system that converts domains to IP addresses (and vice versa)

- DNS resolver (ISP, 8.8.8.8), TLD servers, Authoritative servers, DNS cache

URL (Uniform Resource Locator)

- The address of the location of a specific resource on the Internet

What is a domain name?

The adress of your website

https://www.nicewebsite.com

| prefix | sub-domain | name | extension |

domain name

📄 **DNS Record Types – Quick Reference Table**

Record Type	Purpose	Example	Usage in 2025	TTL Range
A	Maps to IPv4	example.com → 192.0.2.1	Hosting	300–86400
AAAA	Maps to IPv6	example.com → 2001:db8::1	Future-proof hosting	300–86400
CNAME	Alias	www → example.com	Subdomain pointing	300–43200
MX	Mail	10 mail.zoho.com	Email routing	600–86400
TXT	Security	SPF, DKIM, DMARC	Verification	300–86400
NS	DNS authority	ns1.namecheap.com	Domain control	86400
SOA	Metadata	N/A	DNS replication	3600–86400
SRV	Services	_sip._tcp SRV	VoIP	300–43200
PTR	Reverse DNS	IP → domain	Email trust	Set by host
CAA	SSL authority	letsencrypt.org	SSL control	86400
DNSKEY / DS	DNSSEC	Auto-managed	Security	3600
NAPTR	Regex	Telecom ENUM	VoIP	3600
TLSA	TLS binding	With DANE	Cert validation	300–3600

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Concepts and technologies

Protocols TCP, UDP

- Data transfer protocols on the transport layer (4) layer

- TCP: reliable and connecting (HTTP, FTP, SMTP, POP3, etc.)

- UDP: Unreliable and Seamless (Stream, Online Games, DNS)

Protocols HTTP, FTP, SSH

- Protocols for service-specific communication at the application (7) layer

- HTTP (HyperText Transfer Protocol): data transfer for the web, HTTP/3 (QUIC/UDP)

- FTP (File Transfer Protocol): file transfer

- SSH (Secure Shell): remote connection

Protocol HTTPS

- Secure variant of HTTP (port 443 vs. 80)

- Today, it is basically a standard within the requirements of browsers

- Data encryption, server authentication, integrity (SSL, TLS protocols)

Pojmy a technologie

RFC Document (Request For Comment)

- Documents that define standards, protocols, and technologies for the Internet and computer networks.

- Each RFC document has a unique number (e.g. RFC 791 = IPv4, RFC 8446 = TLS 1.3, RFC 3339 = date format) and are freely available (https://www.rfc-editor.org). Today, more than 9000 documents.

- There is not always a standard – some RFCs are just suggestions, recommendations, information, some will become official Internet standards.

- RFCs are issued by the Internet Engineering Task Force (IETF).

Organization IETF (Internet Engineering Task Force)

- Development and standardization of Internet protocols and technologies (HTTP, TCP/IP, DNS, TLS, IPv6, etc.).

- A non-profit, open community of technical experts and volunteers.

Organization ICANN/IANA (Internet Corporation for Assigned Names and Numbers/Internet Assigned Numbers Authority)

- Domain name management (DNS) and top-level domain (TLD) assignment, identifier assignment (ports), root DNS record management

IAB (Internet Architecture Board)

- Overseeing the Internet architecture and directing the development of standards, provides guidance and recommendations to the IETF and other technical working groups.

- It assesses technical designs and standards (RFCs) from the point of view of Internet architecture, formally issues RFC documents.

W3C (World Wide Web Consortium)

- Development and standardization of technologies for the web (HTML, CSS, XML, SVG, JavaScript API, DOM...).

- It ensures the interoperability of web browsers and applications.

- Independent international organization.

- https://w3schools.com

Problems of today's Internet

- **Lack of IPv4 IP addresses**
  - 32-bit = 4 billion public IP addresses
  - Dividing addresses into classes, wasting in allocation
  - CIDR (Classless Allocation), NAT (Address Translation to Private Address Spaces)

- **Internet management, maintenance and architecture**
  - Interoperability and standardisation, compliance with standards

- **Insufficient domain name (DNS) options**
  - national character sets, more TLDs

- **Speed, quality and availability of the Internet connection**

- **Multimedia data and its transmission** (data volume, speed, quality of service)

Problems of today's Internet

- **Searching for information**
  - How we search
  - Credibility and quality, sources of information

- **Content and its freedom vs. censorship**

- **Security and authorization**
  - Technical connection itself
  - Data transfer
  - Services provided (MFA)

- **SPAM, advertising, unsolicited information**

- **Laws, Law and Intellectual Property**

- **User privacy, anonymity and identity protection**

- **"Internet" ethics and social aspects**

- **Cybercrime**

https://www.ted.com/talks/mikko_hypponen_fighting_viruses_defending_the_net

https://www.netflix.com/cz/title/81254224
(The Social Dilemma)

The Future of the Internet

- **Fiber optic networking and fast mobile internet**

- **IP Unification Protocol**

- **Embedded systems and devices with connectivity (IoT), integration into "lay" life**

- **Mobile app (not necessarily native), mobile internet**

- **Focus on safety**

- **Multimedia data transfer**

- **Semantic Web, Web x.0 (Website?)**

- **Social networks**

- **Artificial Intelligence (AI)**

- **Content Management, Regulation and Net Neutrality (?)**

- **Ecosystems, cloud solutions and services**

- **Blockchain**

- **Generational development (Z, Alpha)**