

Full Stack Web Development

WS2019 - BSA5 Ausgewählte Kapitel

Alija Sobic

sabic@technikum-wien.at

Smart Homes and Assistive Systems

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Outline

1 TCP/IP

- 1.1 History
- 1.2 Protocol Suite
- 1.3 Internet Layer
- 1.4 Transport Layer
- 1.5 Application Layer

2 Appendix

TCP/IP - History I [1]

- 1969: Advanced Research Projects Agency (ARPA) funded a research and development project to create an experimental packet-switching network, the ARPAnet.
- 1975: Operational network under the responsibility of Defense Communications Agency (DCA).
- 1983: TCP/IP protocols become adopted as Military Standards (MIL STD) and implemented in BSD Unix. The term Internet appeared as a term for the network consisting of ARPAnet, MILNET and the unclassified part of the Defense Data Network (DDN).
- 1985: National Science Foundation (NSF) creates NSFNet and connected it to the Internet.



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TCP/IP - History II [1]

- 1987: NSF creates a new, faster backbone and a three-tiered network topology.
- 1990: ARPAnet formally passes out of existence.
- 1995: NSFNet ceases its role as a primary Internet backbone network.
- Today's Internet is built by commercial providers. National network providers, called tier-one providers, and regional network providers create the infrastructure. *Internet Service Providers* (ISPs) provide local access and user services.



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TCP/IP - ARPAnet

ARPAnet [2]

- Named after *Advanced Research Projects Agency (ARPA)* of the *U.S. Department of Defense (DoD)*
- Results of the efforts in 1970s to develop a *network architecture* that is
 - open
 - common
 - distributed
 - decentralized
- Avoid problems resulting from typical networks of that time
 - Single point of failure (centralized)
 - Incompatibility (proprietary)



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TCP/IP - ARPAnet



Single point of failure [2]

Foremost design goal was establishing a *decentralized, distributed network topology*. To achieve this goal, **ARPAnet** employed a *packet-switching* technology, where each “message” is split into packets, each of which might take different routes over the network and still be reassembled and understood by the recipient.

Incompatibility [2]

To promote *interoperability*, the *Internet Working Group (INWG)* was formed to examine the issues associated with connecting heterogeneous networks in an open, uniform manner, providing an open platform for proposing, debating, and approving protocols.

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TCP/IP - Internet Working Group

The Internet Working Group evolved into other bodies, over time [2].

- *Internet Assigned Numbers Authority (IANA)*
- *Internet Engineering Task Force (IETF)*
- *Internet Engineering Steering Group (IESG)*

Proposals for new and updates of existing protocols are provided in the form of *Requests for Comments (RFCs)*.



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TCP/IP - Request for Comments



Types

- *Standards (STD)*
- *Best Current Practices (BCP)*
- *For Your Information (FYI)*

Standards

- Required
- Recommended
- Elective

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TCP/IP - Communication Model

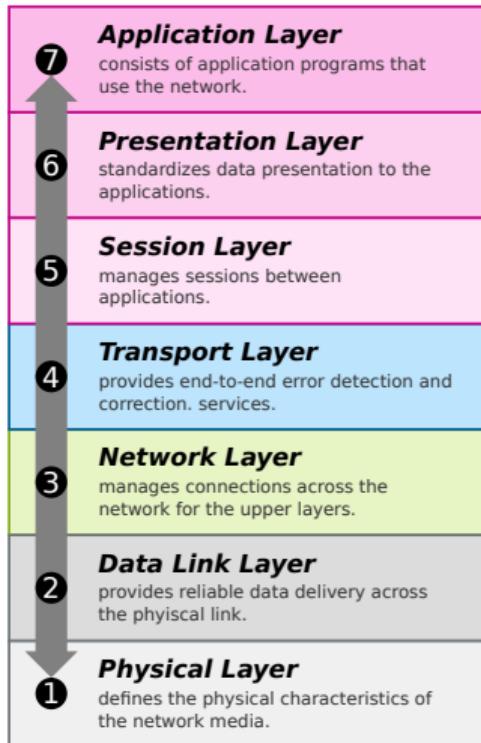


Figure 1: OSI Reference Model [1]

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TCP/IP - Communication Model

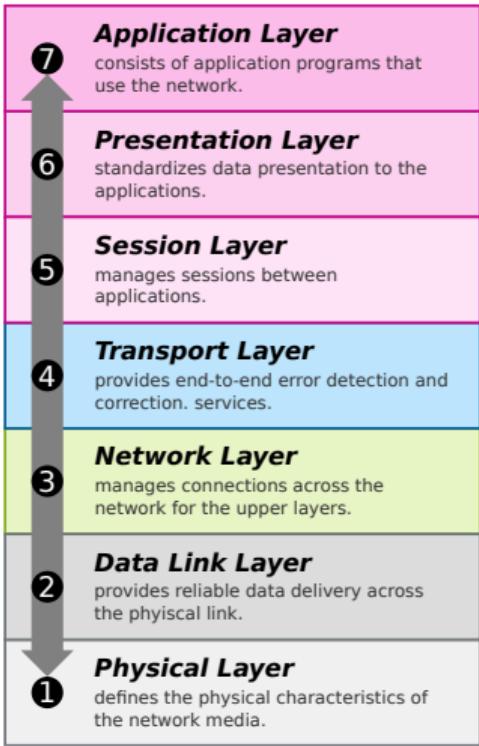


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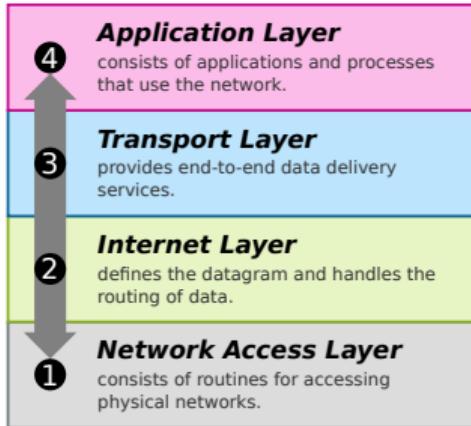


Figure 2: TCP/IP architecture [1]



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TCP/IP - Data Encapsulation

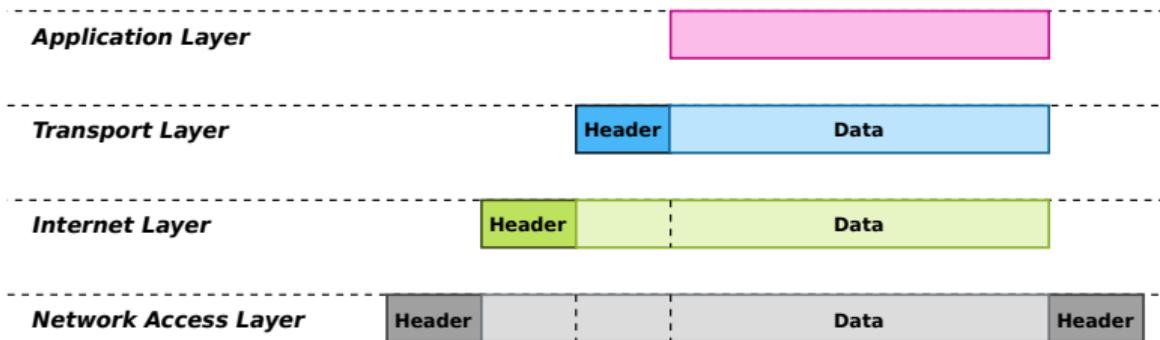


Figure 3: TCP/IP Data Encapsulation [1]



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TCP/IP - Data Structures

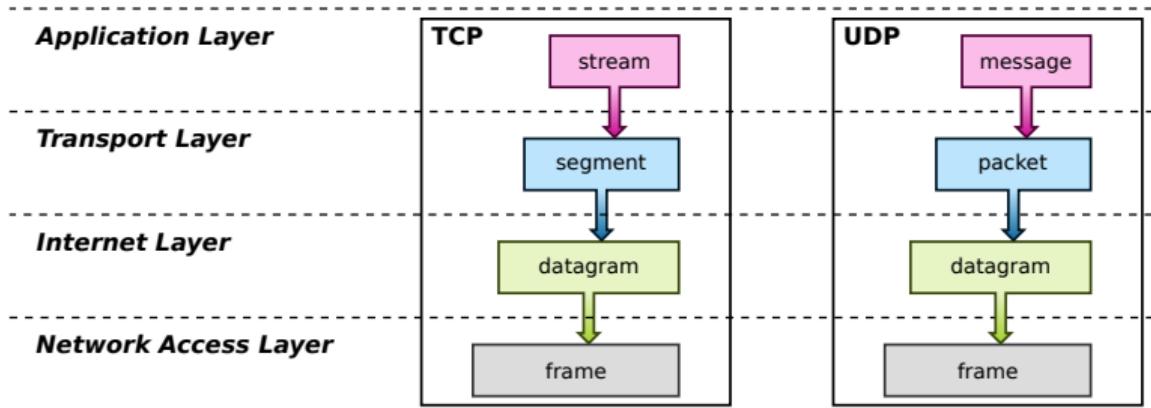


Figure 4: TCP/IP Data Structures [1]



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TCP/IP - Internet Protocol Suite [2, 3]



Application Layer Protocols

DHCP, DNS, FTP, NTP, POP, HTTP, RTP, SIP, SMTP, SSH, Telnet, TLS/SSL

Transport Layer Protocols

TCP, UDP, DCCP

Internet Layer Protocols

IP (IPv4, IPv6), ICMP, ICMPv6, IGMP, IPsec

Network Interface Layer Protocols

ARP, NDP, OSPF, PPP, MAC (Ethernet, Wi-Fi, DSL, ISDN, FDDI)

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TCP/IP - Internet Protocol Suite [2, 3]



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TCP/IP - Internet Protocol



Internet Protocol (IP)

The current version IPv4 is defined in [RFC 791](#).

Characteristics

- Connectionless
- Unreliable
- Media Independent

Functions

- Defining the datagram, the basic unit of transmission in the Internet
- Defining the Internet addressing scheme
- Moving data between the Network Access and the Transport Layer
- Routing datagrams to remote hosts
- Performing fragmentation and re-assembly

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TCP/IP - Internet Protocol



Internet Protocol (IP)

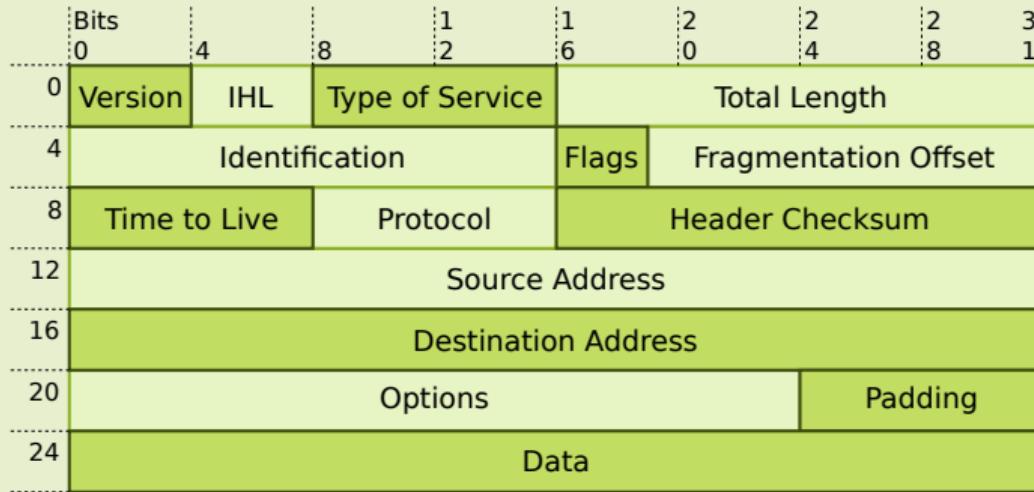


Figure 5: IP [1]

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TCP/IP - Routing

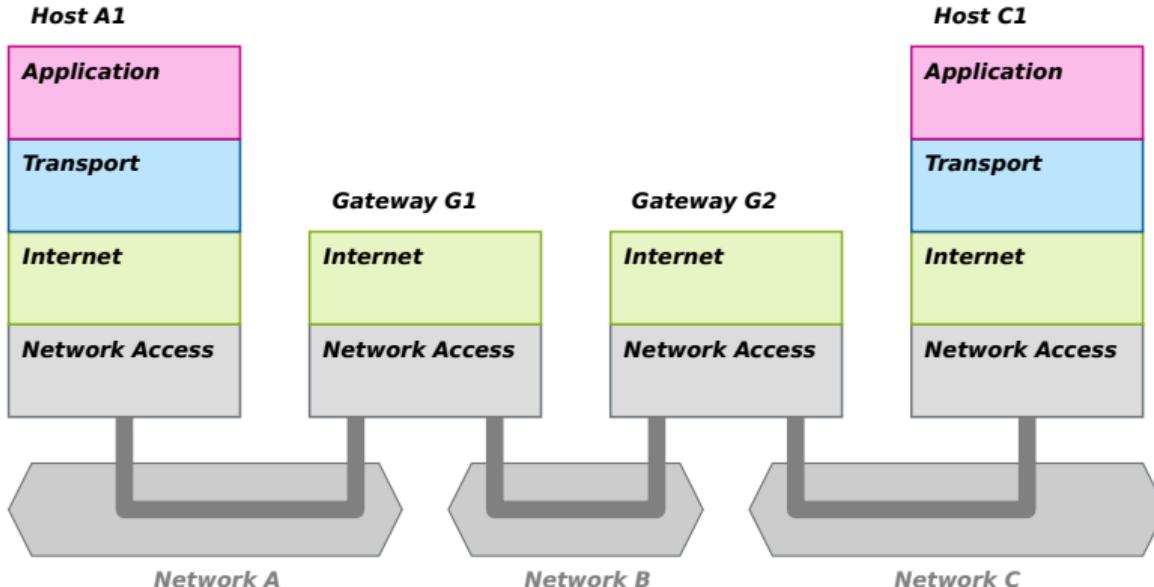


Figure 6: TCP/IP Routing through gateways [1]



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TCP/IP - User Datagram Protocol

User Datagram Protocol (UDP)

The current version of UDP is defined in [RFC 768](#).

Characteristics

- Connectionless
- Unreliable
- Minimal overhead

Functions

- Delivering data to the correct application process



Figure 7: UDP [1]



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TCP/IP - Transmission Control Protocol



Transmission Control Protocol (TCP)

The current version of [TCP](#) is defined in [RFC 793](#).

Characteristics

- Connection-oriented
- Reliable
- Byte-stream

Functions

- Delivering data to the correct application process
- Retransmission of lost data
- In-order delivery
- Congestion control and avoidance
- Data integrity

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TCP/IP - Transmission Control Protocol

Transmission Control Protocol (TCP)

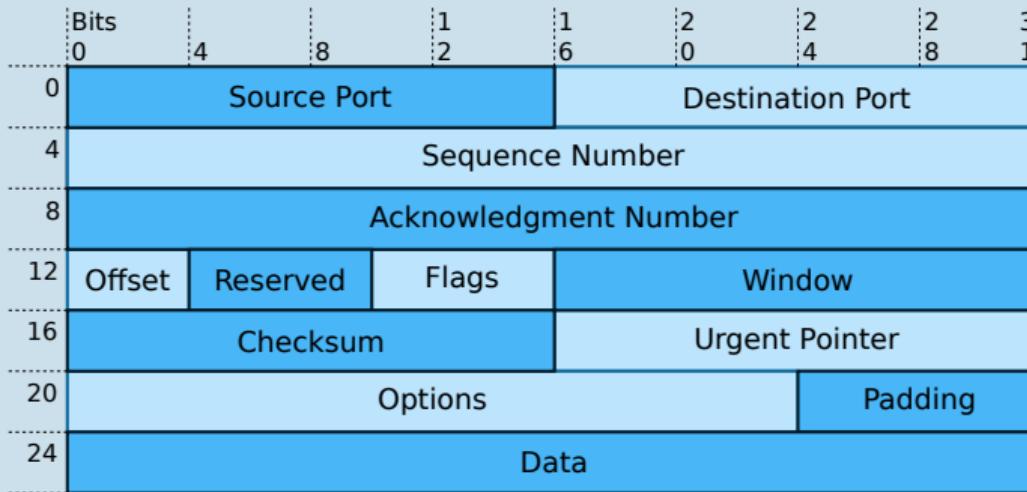


Figure 8: TCP [1]



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TCP/IP - Connection Establishment

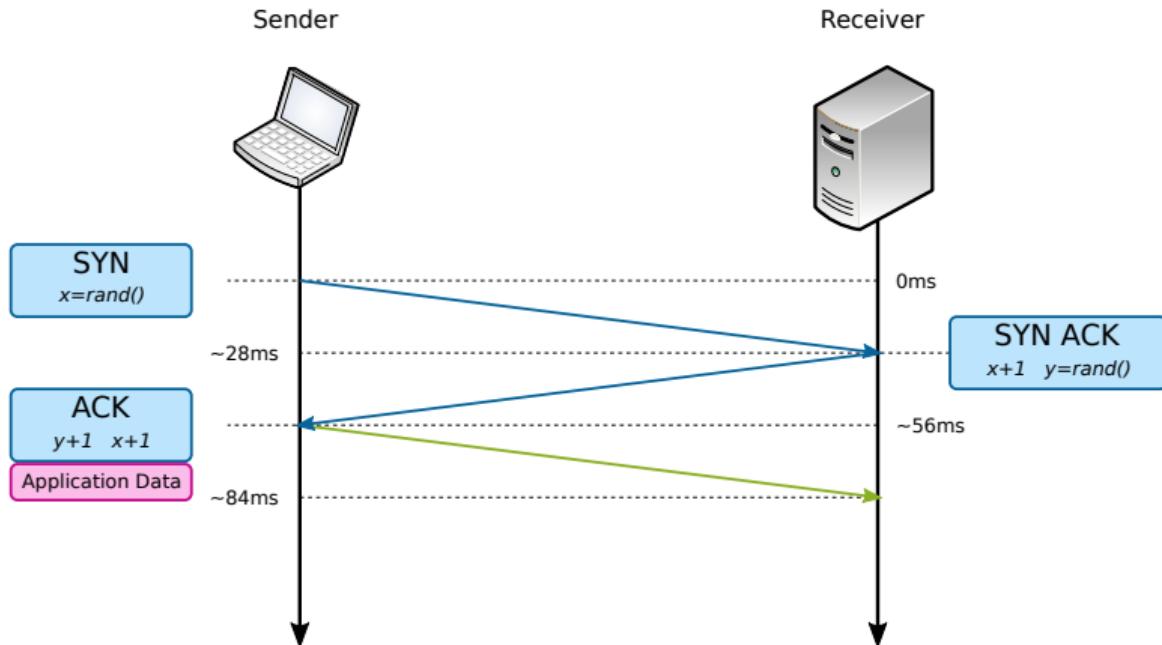


Figure 9: TCP Three-Way Handshake [1]



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TCP/IP - Simple Mail Transfer Protocol



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TCP/IP - File Transfer Protocol



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TCP/IP - Hypertext Transfer Protocol



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Acronyms I

- ARP Address Resolution Protocol
- ARPA Advanced Research Projects Agency
- ARPAnet Advanced Research Projects Agency Network
- BCP Best Current Practices
- BSD Berkley Software Distribution
- DCA Defense Communications Agency
- DCCP Datagram Congestion Control Protocol
- DDN Defense Data Network
- DHCP Dynamic Host Configuration Protocol
- DNS Domain Name System
- DoD Department of Defense



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Acronyms

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Acronyms II

DSL Digital Subscriber Line

FDDI Fiber Distributed Data Interface

FTP File Transfer Protocol

FYI For Your Information

HTTP Hypertext Transfer Protocol

IANA Internet Assigned Numbers Authority

ICMP Internet Control Message Protocol

IESG Internet Engineering Steering Group

IETF Internet Engineering Task Force

IGMP Internet Group Management Protocol

INWG Internet Working Group



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Acronyms

References

Acronyms III

- IP Internet Protocol
- IPsec Internet Protocol Security
- ISDN Integrated Services Digital Network
- ISP Internet Service Provider
- MAC Media Access Control
- MILNET Military Network
- MIL STD Military Standards
- NDP Neighbor Discovery Protocol
- NSF National Science Foundation
- NSFNet National Science Foundation Network
- NTP Network Time Protocol



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Acronyms

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Acronyms IV

OSPF Open Shortest Path First

POP Post Office Protocol

PPP Point-to-Point Protocol

RFC Request for Comments

RTP Real-Time Transport Protocol

SIP Session Initiation Protocol

SMTP Simple Mail Transfer Protocol

SSH Secure Shell

SSL Secure Socket Layer

STD Standards

TCP Transmission Control Protocol



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Acronyms

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Acronyms V

TCP/IP Transmission Control Protocol/Internet Protocol, Internet protocol suite

TLS Transport Layer Security

UDP User Datagram Protocol

U.S. United States

Wi-Fi Wireless Fidelity



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