Modelling Sustainable Systems and Semantic Web

Internet Basics

Lecture in the Module 10-202-2309
for Master Computer Science

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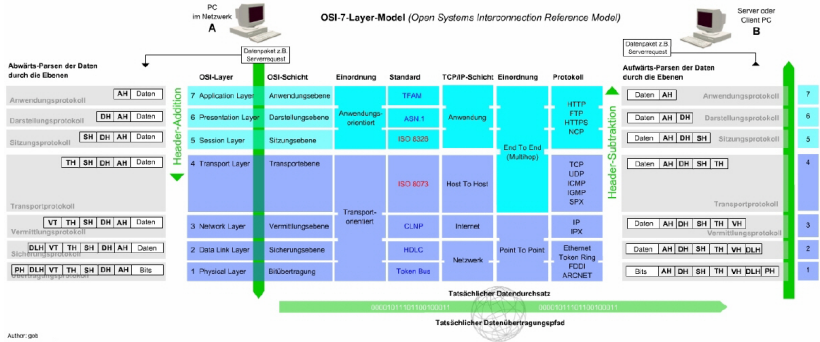`http://www.informatik.uni-leipzig.de/~graebe`

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Internet Basics

In the following, we will use the concept of *role* as partial identity as basis when looking at the technical basics of the operation of digital identities (more precisely: *as* digital identities).

▶ On the internet descriptions are exchanged.

Images, for example, are also descriptions that instruct the computer how to render the image.

▶ Descriptions are exchanged between computers by breaking them down into packets of a given structure and size.

Packet transmission on the internet, the OSI 7-layer model

▶ http://de.wikipedia.org/wiki/OSI-Modell
▶ Layers and protocols
▶ Protocols and language

Source: Wikipedia,
http://prima-it.de/images/osi7layermodell.jpg

Internet Basics. The OSI Layer Model

Source: http://www.hbernstaedt.de/knowhow/ether/osi.jpg
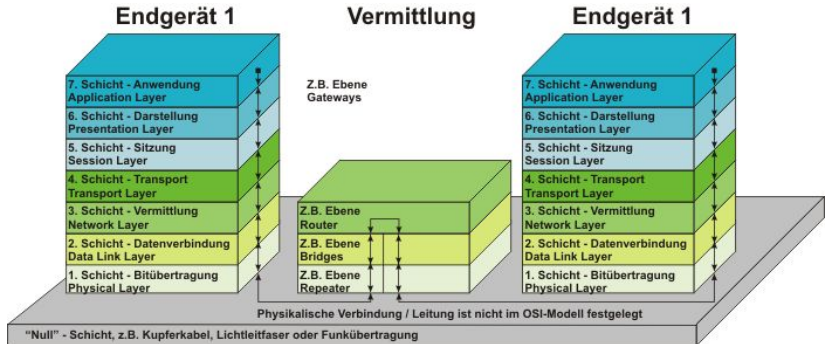
Internet Basics. How It Works

Texts consist of characters (letters, numbers, etc.)

- ▶ Bits and Bytes.
- ▶ Reduction to standardised bit sequences and thus numbers.
  - ▶ First permanent alphabet: ASCII (7 bits) = 0..127
  - ▶ 0..31 – control characters.
  - ▶ 32..127 – numbers and letters of the English alphabet.
- ▶ Several waves of standardisation for further alphabets and character systems (latin-1, Windows character set).
- ▶ Need to agree → Unicode.
  - ▶ Efforts begin around 1988.
  - ▶ First standard in 1991 contained 2^{16} = 65 536 characters.

Internet Basics. Unicode

International standard in which (in the long term) a digital code is defined for every meaningful character or text element of all known writing cultures and character systems in order to standardise the exchange of textual information worldwide.

- ▶ Unicode is constantly being supplemented with characters from other. writing systems.
    - ▶ Hexadecimal representation, e.g. U+01FA (2 bytes).
- ▶ UTF-8 as an evolving de-facto standard.
    - ▶ Encoding of characters in up to 4 bytes (variable length).
    - ▶ Encoding of ASCII characters in 1 byte.

Internet Basics. Data transmission

▶ Serial transmission as a bit sequence, for human-readable purposes usually represented in the octal or (more frequently) hexadecimal system (base 16) (x1FA = 0001.1111.1010).

▶ Bit stream is divided into packets of constant length and sent off with sender/receiver information (routing).

▶ Packets are forwarded from computer to computer until they reach their recipient.

▶ Integrity check with a hash function.

▶ Receiver reassembles the bit stream from the packets.

▶ Standardised protocols are used so that this is transparent for the user.

Internet Basics

Function	OSI Layer	Protocols
Anwendung	Anwendungsschicht	HTTP
	Darstellungsschicht	HTTPS
	Sitzungsschicht	SSH
Netzübertragung	Transportschicht	TCP/IP
	Vermittlungsschicht	SSH/SSL
Netzzugang	Sicherungsschicht	WLAN, PPP
	Übertragungsschicht	Ethernet

What Computers Talk About with each Other

Example: `http://www.inspirata.de`

- ▶ Web pages are composed of different parts that can come from different sources.
- ▶ Parts in different languages (HTML, graphic formats, programme code, ...), the languages determine the form of presentation.
- ▶ Rendering web pages therefore (usually) means bringing together heterogeneous information from different sources.

Internet as World of Fictions

Two dimensions of language: description and instruction.

- ▶ HTML (HyperText Markup Language) – the language of the internet?
- ▶ HTTP – HyperText Transfer Protocol.

The Internet as a **World of Iterated Fictions**:

- ▶ Interpretation of modulated electromagnetic waves as sequences of 0-1-bitstreams.
- ▶ Intermediate: frames (OSI level 2), packets (OSI level 3)
- ▶ Interpretation of bit streams as "digital content".
- ▶ Interpretation of digital content as text, pictures, code etc. for rendering.
- ▶ Interpretation of rendered content by humans.

On the Assignment of Digital Identities

Digital identity = *authenticated* and *authorised* within a session real-world civic subject, who performs actions in the digital universe for a limited period of time.

Such digital identities do not fall from the sky, but must be embedded in the civil legal order for the purpose of private assignment of the consequences of actions.

▶ Market economy: Regulatory framework and contractual arrangements in a hierarchical socio-technical system.

Who authenticates and authorises?

▶ Computers, computer networks, computer names.
▶ Registrar, provider, host.

Computer and Computer Names

de.wikipedia.org.
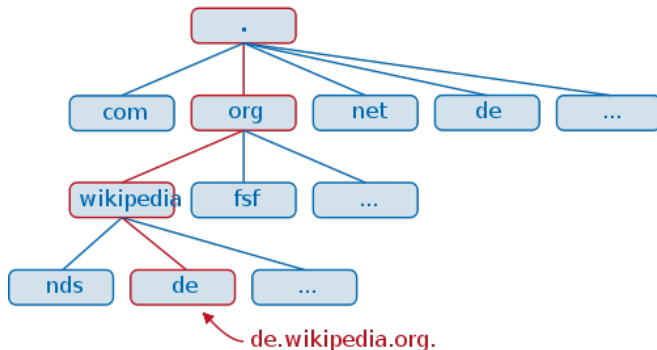
- ▶ IPv4 (32 bit) and IPv6 (128 bit) – `ping` and `ifconfig`
- ▶ On the structure of computer names, domain names and top level domains.
- ▶ Converting names into addresses – the Domain Name Service System.

Registrar, Provider, Host

- **Registrar:** Administrator of computer names
  - Denic.de – The administrator of the TLD .de is DENIC e.G.
  - Citation Imprint: Registered under No. 770 in the Register of Cooperatives, Frankfurt/Main Local Court.
  - Notes on the legal form
  - URZ administers `uni-leipzig.de` and subdomains
- Which domain names?
  - Ownership of a domain as a legal title
  - Computer names as a commodity: `https://sedo.com/de/wissen/markt-trends/`
- **Provider:** Maintains computers with IP addresses (**Hosts**) and takes care of converting domain names into IP addresses as well as forwarding (routing) data packets.

Allocation of IP Addresses

- ▶ IP addresses are allocated hierarchically: Users get IP addresses from the ISP (internet service provider), ISPs from a local Internet registry (LIR) or National Internet Registry (NIR) or Regional Internet Registry (RIR – RIPE NCC for Europe, the Middle East, and Central Asia) and these from the Internet Assigned Numbers Authority (IANA).

- ▶ IANA is a department of ICANN responsible for coordinating some of the key elements that keep the Internet running smoothly. Whilst the Internet is . . . free from central coordination, there is a technical need for some key parts of the Internet to be globally coordinated, and this coordination role is undertaken by IANA. IANA is one of the Internet's oldest institutions, with its activities dating back to the 1970s. → `https://www.iana.org/numbers`

- ▶ *Question:* Can I buy IP addresses from the RIPE NCC?

  Answer: No. Internet number resources are a shared public resource and do not have a value. Members are charged fees based on the services that they receive from the RIPE NCC.