Modelling Sustainable Systems and Semantic Web

Data and Information

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

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December 2021

The Internet as a World of Shortcuts

Data and information – a first approximation

Bit streams and **data packets**.

- There are no bit streams on the "Internet", but rather data packets that are sent and received at the devices. Data packets are generated and transformed back again from bit streams at the 4 lower levels of the OSI stack.
- Shortcut of speaking about the universally networked end devices and reality of the net failures.

The mouse phenomenon

- Tools and their use. The spoon.
- Internalisation and processual skills.
- Shortcuts of speaking in everyday life. **Discussion**.

The Internet as a World of Shortcuts

The Notion of Shortcut

Shortcut as socially supported, guaranteed and sustained *consensus* on an *abbreviated way of speaking* about a *social normality*.

- Shortcuts of speaking are a specific way of dealing with a increasing complexity of the world.
- Shortcuts in this sense are not a new phenomenon.
- Shortcuts are close related to systemic thinking.
- Shortcuts and Myths
  - A *myth* in its original meaning is a story. The religious myth links human existence with the world of gods or ghosts. Myths demand to be valid for the truth they claim. ... The ensemble of all myths of a nation, a culture, a religion is called *mythology*. (Wikipedia)

The Internet as a World of Shortcuts

Complexity and Clock Frequencies in a Society

- A clock (or timing) is used to impress a periodicity to a sequence or to synchronise processes. The system clock in a computer determines the working speed of many components. (Wikipedia)
- Timing is also essential for the coordination and synchronisation of social activities.
- Development of complexity and clock rates of computer chips see `https://arxiv.org/pdf/1803.00254.pdf`
- Moore's Law (1965) states that complexity of integrated circuits with minimal component costs doubles on a regular basis. Depending on the source, the period is 12 to 24 months.
- But the „human clock rate“ does not change ...

Theoretical Expansion of a Shortcut

Shortcut: universal end-to-end connectedness in the internet.

Theoretical reflection as a scale-free network

- $v(k) = c \cdot k^{-a}$ – proportion of nodes with k neighbors (v as valence).
- Example with $a = 3$: $v(1) = 0.832$, $v(2) = 0.104$, $v(3) = 0.031$, $v(4) = 0.013$, $v(5) = 0.007$, $v(6) = 0.004$, ...
- Compared to a random network (another model!) the proportion of nodes with many connections (hubs) decreases slower.
- Scale-free networks are robust against the failure of a larger number of randomly selected nodes, but not against failure of a small number of hubs.
- Robustness: Each node is embedded in a local socio-technical infrastructure, which takes care of its operation, maintains the "social normality" and thus reproduces the socio-technical conditions of this shortcut of speaking.

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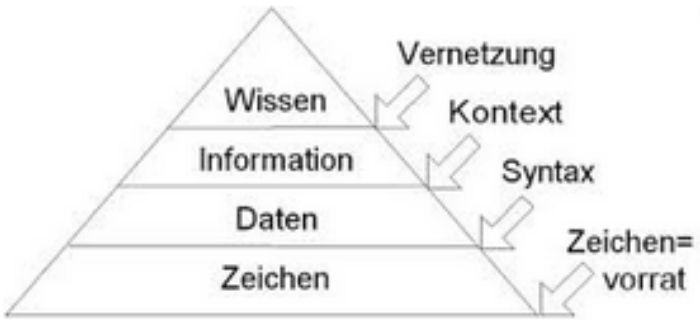

Data and Information

Syntax, Semantics, Pragmatics

Data and Information. A first definition

Information = interpreted data

Data = formalized information

Both (formalization and interpretation) are only "valid" in a special natural, technical or social *embedding* – a *context* (or pragmatics) – and thus **assume** the existence of a "working shortcut of speaking".

Compare this also with the concert example in the first lecture.

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Syntax, Semantics, Pragmatics in the OSI layer model

We consider such a *pragmatically* contextualized interplay of (formalized) *syntax* and (formalized) *semantics* on different levels at the example of the OSI stack.

- Each layer is based on a shortcut of speaking (i.e., social normality) and its language representation given as formalized syntax.
- This formalized syntax was practically produced on the previous layer as *components* within the newly emerging system.
- On this basis a further pragmatics is realised through language constructions as special way of speaking (semantics) about *relations* in the newly emerging system.
- This special way of speaking in turn is formalized for use on the next layer (the next system level).

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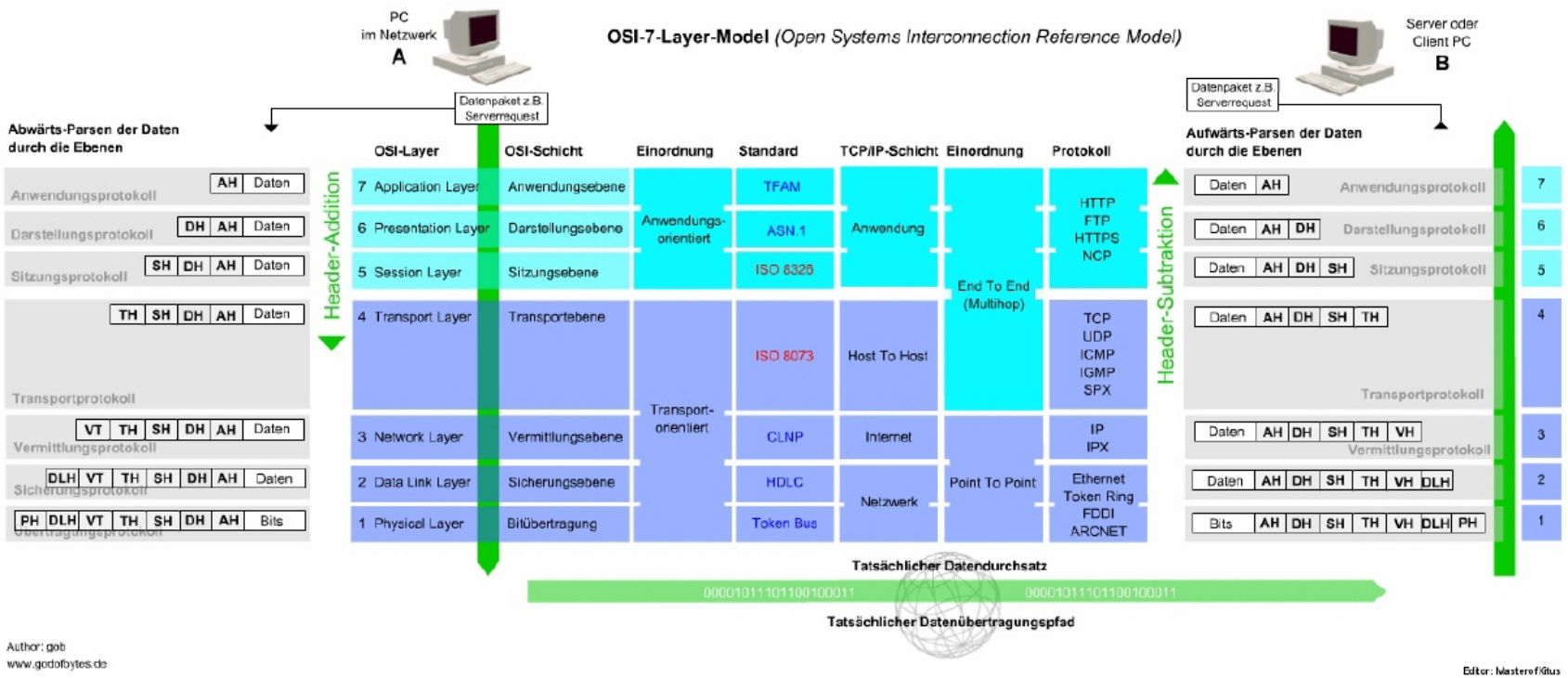

Source: Wikipedia,
`http://prima-it.de/images/osi7layermodell.jpg`

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Syntax, Semantics, Pragmatics in the OSI layer model

Explanation of this idea:

Layer 1:

- Syntax = modulated waves,
- Semantics = bit sequences (first shortcut of speaking),
- Pragmatics = diversity of transmission media

Layer 2:

- Syntax = bit sequences,
- Semantics = frames (second shortcut of speaking),
- Pragmatics = control of the transmission speed of the bit sequences, addition of checksums for error detection

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Syntax, Semantics, Pragmatics in the OSI layer model

Layer 3:

- Syntax = frames,
- Semantics = data packets (third shortcut of speaking),
- Pragmatics = routing and organization of forwarding of packets across multiple nodes

Etc.