

Networks and Digital Communication

In the specialization area “Networks and Digital Communication” a focus is on wired and wireless digital information transmission as well as on the architectures and protocols on higher layers of communication systems. Examples are the Internet as a worldwide communication network, mobile communications with its various generations, connected embedded systems (also known as “Internet-of-Things”, “Cyber-Physical Systems”), vehicular communications, industrial communications (as a building block of “Industrie4.0”), connected smart energy systems (“Smart Grid”) and many more. Despite this diversity there are often common aspects, such as:

- Design of protocols: typically, a separation in layers is applied. In doing so, it must for instance be decided where to put mechanisms for error, flow, congestion control. Virtualization of network functions is another important issue here.
- Dimensioning of communication systems: selection of the topology and number of devices, choice of protocol parameters. This is for instance needed, when for a random access protocol in wireless communications parameters have to be determined. For doing so, analytical methods and simulation are often used.
- Quality-of-Service (QoS) of communication systems: typical QoS attributes focus on system performance, such as are data rate, latency, and loss. Dependability, real-time behavior, energy demand, and security are further important attributes.
- Tools: for all issues tool are required to support modeling, analysis, simulation, optimization, monitoring, testing, documentation, and managing communication systems and their protocols.

On the physical layer digital transmission technologies are in focus. This includes an advantageous design of signals for information transmission and optimal detection at the receiver. Central are furthermore properties of transmission media and their use for information transmission and storage. The combination of such transmission systems to communication networks and the organization of the different tasks by suitable communication protocols are further important topics here. Relevant examples are the coordinated use of shared wireless media, such as between end users and base stations in mobile communications. This area includes also knowledge in implementing digital transmission systems with microelectronic components, both analogue circuits for the antenna system and digital circuits for signal processing. Therefore also basic skills in building electronic circuits will be conveyed.

To summarize, the specialization area “Networks and Digital Communication” offers a wide area of topics including analog and digital electronics, from information, signal and coding theory to design and realization of large communication networks with many mobile and fixed devices.