Main working fields

High-speed wireline and optical communication systems are gaining importance in short and medium range data transmission.

In those systems, high data rates have to be handled while taking care of robustness as well as electromagnetic immunity and low emissions.

In addition overall system costs play a major role and have strong impact on the choice of the wireline or optical communication link for a dedicated application.

In this field Fraunhofer IIS focuses on:

- Analog and digital integrated circuit design for high-speed data transmission systems
- Dedicated solutions for wireline and optical data transmission applications
- Implementation in nanometer IC technologies

High-speed IC-Design

At present, high bit rate transmission systems with data rates from 1 Gbit/s to 10 Gbit/s and over are developed; even 100 Gbit/s Ethernet is already in sight. Therefore, an important working area for Fraunhofer IIS is the design of high-speed and ultra high-speed integrated circuits.

For circuit design, access to a variety of nanometer ASIC technologies and providers is already available. The technology can be chosen appropriately to the intended application. Designs for industrial and automotive customers are mostly implemented in CMOS, BiCMOS, SiGe-HBT or GaAs-MESFET technologies. Moreover, in research projects InP-HBT and InP-mHEMT technologies have been used to develop components for an 80 Gbit/s electrical receiver.
Modulation and equalization techniques
Due to the ever-growing number of data demanding applications like video and multimedia services, transmission links have to cope with rapidly increasing data rates. Additionally, transmission links based on copper cable or even on multimode optical fiber have limited available bandwidth and signal to noise ratio. Therefore, sophisticated line coding, modulation and/or equalization schemes have to be applied to allow for high-bit rate transmission while consuming moderate power, being cost-effective and offering ease of use.

At Fraunhofer IIS we use several equalization schemes including:

- Linear, controlled analog high pass filters
- FIR-Filters for pre-emphasis in the transmitter and as Feed-Forward-Equalizers (FFE) in the receiver
- Decision Feedback Equalizers (DFE) in the receiver
- Control algorithms for blind adaptation of the equalizer without the need for a training sequence

Digital Signal Processing
In addition to line coding and equalization, application specific algorithms can be adopted to the data transmission. Examples are dedicated channel coding like Forward Error Correction (FEC), encryption or source coding with lossless or lossy data compression.

Project examples IC Design

- 4 x 10 GBit/s Pseudorandom Bit Sequence (PRBS) generator
- 4 x 10 GBit/s to 16 x 2.5 GBit/s demultiplexer
- 11 GBit/s transceiver for capacitive slipring
- APIX2 transceiver chipset (customer: Inova Semiconductors) with 3 Gbit/s downlink and 187.5 MBit/s uplink over shielded twisted pair cable
- Equalizer chips for 1.25 Gbit/s and 3.3 Gbit/s for optical data transmission over Polymer Optical Fiber (POF)

Solutions for Optical Short-Range Transmission
Fraunhofer IIS is working on new applications of optical short-range transmission in LANs, in-house communication, automotive and medical technology. Here, several options for the communication medium are available:

The well-known multimode glass fibers as well as cost effective and robust alternatives like Hard Clad Silica (HCS) and Polymer Optical Fibers (POF).

We are working on design of optical, optoelectronic and electronic components as well as on concepts and implementation of optical links. Technologies for optical short-range transmission can be applied both in analog and in digital transmission systems.