Zurich University
of Applied Sciences

**School of
Engineering**

InES Institute of
Embedded Systems

Communication for energy utilities over IP

Due to the continuous modernization of the communication, the old infrastructures have been replaced by new ones. This trend brings a lot of advantages but also disadvantages. Continuous increasing bandwidth, everywhere wireless internet access and shorter delays are only a few of the advantages. Disused technologies such as analogue phone lines were adapted to newer ones. Setting the analogue phone lines out of order, causes energy concerns many new problems, because they control their transformer stations with E&M. But what happens with such systems, which cannot easily be replaced?

The aim of this bachelor thesis is to develop a converter from E&M to Ethernet. Because Ethernet is a worldwide networking technology, the future of this network is guaranteed. The further processing of the data is not a problem; Ethernet works with a lot of transmitting pathways.

The technology E&M is a data transfer standard similar to the modem ones. Digital data were transmitted in terms of modulated tones over a four wire cable. There were also four more wires used to transmit status information.

For the realization of this E&M converter, the software package RL-ARM from Keil has been used. This package includes a real time operating system, a complete IP-stack and a lot more. The hardware for this project consists of a given development board from Stellaris. The analogue audio signals will be transmitted with a sampling rate of 48 kHz and a resolution of 16 bit. The processing of the data is divided in several autonomous tasks and interrupt handlers. The sampled data is packed in UDP protocol to be transmitted over Ethernet. Further information is written in the protocol header. To achieve an accurate and ordered regeneration of the audio signal, every data packet becomes a sequence number.

The main focus of this bachelor thesis was the development of the firmware for E&M over Ethernet transmission. The evaluation and the development of the firmware have both beeen made with a common development board.
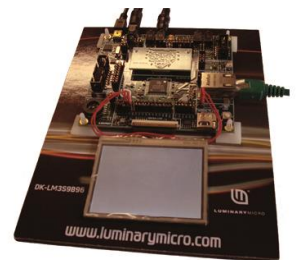
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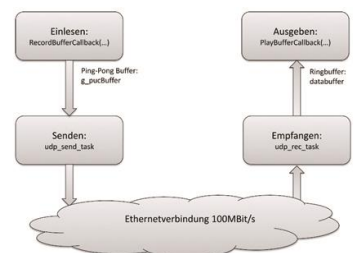Peter Tönz
Oliver Walch

Dozent
Hans-Joachim Gelke

The development kit LM3S9B96, a product out of the Luminary Micro factory, consists of a 80 MHz Cortex-M3 Controller with 256 KB Flash and 96 KB SRAM, as well as a Ethernet connection and an audio codec.

The block diagram shows the main data path in one direction. Due to the bidirectionally implemented connection, it is possible to send and receive date in both directions.