A Lighting Interface to Wireless Network

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ABSTRACT

The wireless communication may help to make a step over the lighting systems limitation, in the inter operability and poor connectivity to the external world. There is a potential in CoAP that is an effective protocol, based on the HTTP. Synergy in the OS Contiky has significant drive for implementation of the heterogeneous communication from one world to the other. Using the IPv6 and its benefits goes to a new generation of smart things.

1. Introduction

Common lighting network uses wired connections. Different standards have been evolved over time, however, characteristics remain the same. Major systems are KNX, DALI and DMX512. Our project uses the DALI standard [1] based on the IEC 60929/1 and IEC 62386 [2]. Communication system consists of a single DALI control module and up to 63 devices. DALI modules can be connected to the external worlds via a gateway [3].

Optimized IPv6 for a wireless system is 6LoWPAN [4]. For lighting and building automation application, there is an important factor, namely easy to use, install and maintenance the product. From this point of view, automatic network discovery and routing is useful. When RPL comes to the uIPv6 [5] stack, the path to smart routing will be open. The uIPv6 is certified by the IPv6forum [6].This stack is included in the Contiki [7] operating system that has a vital community.

Radio channel bandwidth is limited, consequently the data rate is typically mid or low. For this reason, a compression or special effective protocol is important. Constrained Application Protocol (CoAP) [8] may save up to 95% of XML header ballast using the W3C EXI compression [9].

2. Frequency

The range and robustness are important features of a wireless system. Common application uses one of three ISM [10] frequency bands: 433 MHz, 869 MHz and 2.4 GHz. Signal propagation in a different band is a complex, however, typical value proven in practices equals 9 dB gain between 2.4 GHz and 869 MHz. The gain between 869 and 433 MHz it is about 6 dB. These values are close to the Friis transmission equation [11]. For example, typical radio has RF output of +10 dBm and the antenna gain is equals zero. Path lost for distance 20 meters and two walls in sight equals 117 dB on frequency of 2.4 GHz. It gives RSSI +10 - 117 = -107 dBm. At the 869 MHz, it gives -98 dBm, and for 433 MHz -92 dBm. It is apparent, that a lower band gives better communication range. Disadvantage of the 433 MHz band consist in a heavy interference in the background. Accordingly, we have chosen 869 MHz band.

Robustness is also an important feature. A number of radio chips are available in the market. The SoC (system on chip) is a typical solution for the low power. The long lasting Chipcon brand is under Texas

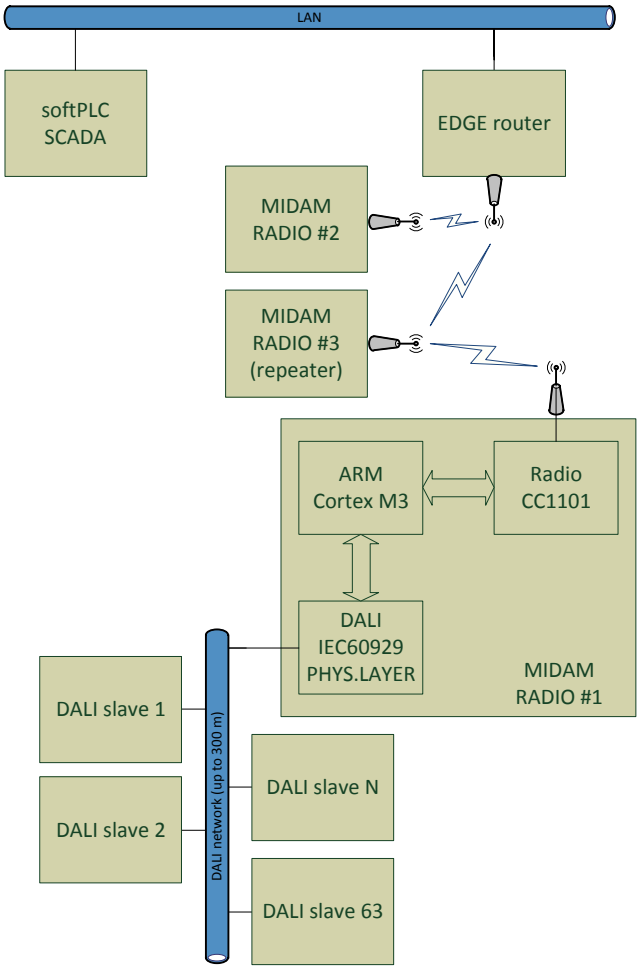
Instrument global company now. We are looking for a high sensitivity, narrow band SoC. The CC1101 chip [12] is the improved version of the CC1100 industry standard. Inside there is the DSP FSK transceiver up to 500 kbps, sensitivity of -112 dBm and output RF power of +12 dBm. Excellent receiver selectivity and blocking performance did not require an external preselector, e.g. SAW filter.

3. DALI to CoAP IPV6 gateway

The DALI network has fast timing, from the narrow band radio point of view. The GW (gateway) is the only chance to connect from the rest of world. The second side of the GW must use a standard, robust and safe protocol. This type of protocol consist in the CoAP, a securing layer may be added by the DTLS [13]. The middleware is a process database, where an environment image from DALI network is placed. It is advantageous that there is no configuration required.

4. Implementation

Regarding a Comparative Study on Available IPv6 Platforms for Wireless Sensor Network [14], where authors compare available platforms, we have chosen the Contiki system running on the ARM Cortex M3 platform with the CC1101 radio chip by Texas Instrument. The DALI implementation is based on the MIDAM standard [15]. Power is provided by the building 24 VAC line system, or a standard 230 VAC power cord. Edge routers are powered by the PoE. The SCADA server is based on the softPLC system. Considerable property of this system is its compatibility with the PLC (power line communication) system based on the 6LoWPAN system [16].



5. Conclusion

Discovering the IPv6 wireless world makes big space for ideas, which are not possible yet. The system has huge scalability. The communication platform convergence is easier, using the heterogeneous WAN. New protocols help with the reliability, compression or security. A modern operating system, like Contiki enables a fast FOTA (update firmware over the air) using a partial upgrade or multicast.

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