Poster Abstract: Collecting Sensor Data using Compressed IPFIX

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ABSTRACT

During the last years the application areas and corresponding requirements for Wireless Sensor Networks (WSN) raised due to limited resources of devices and requirements of the application. The scenarios (e.g. home networks) call for an integration of a WSN into an existing IP-based infrastructure which is realized by 6LoWPAN. To save resources and to ensure a long life time of the WSN resource consuming tasks such as transmissions must be reduced. Therefore, we present a Compressed IPFIX protocol. It optimizes the transmission by reducing the packet size and the transmission amount by separation between meta information and data. Additional tasks can be performed on top of IPFIX to optimize the efficient usage of the limited resources.

Keywords

WSN, Autonomic Home Network, Data Transmission, Compressed IPFIX

1. INTRODUCTION

Today in home and health monitoring scenarios most tasks need manual input for control and management issues. To reduce those inputs an autonomic network would be desirable. Common monitoring networks are Wireless Sensor Networks (WSNs) where most components are battery powered and have limited resources such as memory and computational capacities. Most resources are needed during transmission therefore the question concerning efficient data transmissions occur to ensure a long life time for the whole system. Our work aims to address this challenge by implementing an efficient data transmission protocol based on IPFIX [2]. In our approach we implemented a Compressed IPFIX protocol to reduce the transmissions additionally and to save more power. We built an autonomic home infrastructure using IRIS motes from Crossbow [3] as shown in Figure 1 to test our implementation.

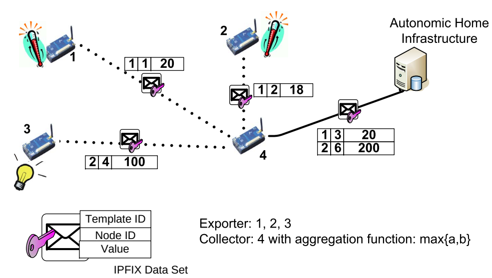

Figure 1: Overview of the application scenario

2. DESIGN AND IMPLEMENTATION

First, we decided to connect the WSN components to an existing IP-based home network infrastructure. Thus, we had to bring IP-communication to the IRIS motes. The IRIS motes have only 8kb RAM and to avoid collisions during transmissions the programming code should be under this threshold all together with the other upcoming program code. Normally ZigBee is used for communication tasks but it requires 8 kb RAM [6]. Thus, we decided to implement 6LoWPAN [4] on the motes which needs only 4 kb RAM and also offers the opportunity of both-way addressing between WSN and IP-based home infrastructure. Additionally it offers a fragmentation mechanism to handle packets of 1024 byte size. Second, we decided to implement a protocol which reduces data transmission within the network to save resources. In a common WSN the motes report autonomous and therefore a PUSH-protocol would be ideal for those networks. It should be an efficient protocol which distinguish between meta information and data itself. In the field of monitoring networks the IP Flow Information Export (IPFIX) protocol offers those possibilities. It uses a template based design where *Templates Records* carry the meta information and *Data Sets* the data itself. To adapt this protocol to the requirements of WSNs several modifications were essential and implemented in the so called Compressed IPFIX protocol as described in detail in [5]. The advantages of Compressed IPFIX protocol are: (1) a simple implementation, (2) use of less run-time-memory, (3) a simple data transmission and (4) transmission amount is reduced. Additionally, motes within the WSN can transmit different sensor data which can be transmitted in IPFIX format without causing complexity.

3. EVALUATION AND FUTURE WORK

Due to limited resources like memory, computational capacity and power among others the implemented protocols should work efficient. The implementation of modified 6LoWPAN together with adapted IPFIX protocol requires 5083 bytes RAM with 102 bytes payload and 1024 bytes IPFIX message size. Both protocols offer header compression techniques to obtain the application payload size. Additionally 6LoWPAN offers fragmentation to handle normal IPv6 packets within the network. With our implementation we require less memory than 8 kb which is available.

With our Compressed IPFIX approach we are able to distinguish between meta information and data itself. If a mote boots up the meta information is transmitted once followed by many small data packets which results in saving resources during transmission. In comparison a common Type-Length-Value-approach (TLV) needs to transmit every meta information within each packet together with the data. This results in bigger packets which need more resources for transmission. Finally, the decoding mechanism of Compressed IPFIX packets is easy, just pointers are needed, and thus computational capacities are reduced.

To optimize the efficiency of our approach different tasks should be faced. First, the transmission lost should be minimized which might be critical in some applications. If a Template is lost, Data which refer to this lost Template can not be decoded any more. Thus, we want a reliable transmission of Templates which can be achieved by an ACK-mechanism. Every time when a Template is transmitted, the sender has to wait for an ACK until the Data can be transmitted. Second, sleeping and wake up phases should be specified to optimize the power requirements. For example, a mote must be awake until the ACK is received than it can fall asleep until it must collect data and transmit them. Third, data aggregation should be integrated to reduce the data amount within the network and the amount of transmissions. Aggregation can be performed in different ways: (1) combine several messages in one message or (2) using aggregation functions such as MAX or AVG on several Collector motes. Currently our WSN is a star topology, thus we perform aggregation (1). Where several data which refer to the same template can be combined in one message. Aggregation (2) should be integrated in multi hop networks which will be very interesting for future scenarios. In this case routing task must kept in mind also. As it can be seen depending of the scenarios and the network structure different other tasks occur that must be faced to use the resources of the devices efficiently.

4. CONCLUSION

Here we present an integration of WSN into an existing IP-based home network infrastructure which uses Compressed IPFIX for transmissions to save resources of the WSN components. 6LoWPAN is used to bring IP-communication to the WSN. The efficiency of data transmission is achieved by adapting the well-known IPFIX protocol to the requirements of a WSN component. The presented Compressed IPFIX protocol is a PUSH-protocol which separates meta information and data that results in smaller packets which reduces transmissions. This possibility also offers simple decoding mechanisms to save resources again. On top of Compressed IPFIX different mechanisms can be adapted such as aggregation as shown in Section 3 to optimize transmissions and to save resources. The whole project is integrated into the EUREKA CELTIC initiative concerning Autonomic Home Networks [1].

5. REFERENCES

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