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PROTOCOL FOR ADVANCED WIRELESS SENSOR NETWORKS

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ABSTRACT

The Wireless Sensor Network (WSN) comprises of the nodes with the low power processors having very limited resources and is deployed in field to sense and analyze the data. The protocols used in the sensor network must be simple. The data collected by the node is transmitted over the sensor network is encapsulated with the IP satisfying the requirements of 6LoWPAN [3]. The computation overhead on the sensor node must be less in order to increase the life of a Sensor Node. The Simple Data Transmission (SDT) Protocol is used to encapsulate the data collected by the node. The SDT protocol has the provision of choosing the type of data to be collected by the node at various instances. The SDT protocol is developed to collect the data from the various sensors on the board to frame the data and to actuate a sensor on the board according to the requirement of the application.

Keywords: *WSN, 6LowPAN, SDT, Protocol, Computation Overhead*

1. INTRODUCTION:

WSNs have a range of applications in various fields [2]. The WSNs are developed with the devices consuming low power, operating at a low data rate, comprises of many individual nodes which perform a specific task and the data is collected by the coordinator. Each node can work independently and in combination with the neighbors to fulfill the requirements like increasing the overall performance of the network. The traditional and proprietary Sensor Networks has limitations in terms of network scalability and interoperability among the nodes with a different communication standard. The 6LoWPAN network is shown in Figure 1indicates various types of Networks according to the field of application. The 6LoWPAN specification has called for the standardization on some of the critical issues of WSNs [3]. To solve these issues a new protocol must be developed to extend the livability of a WSN in the future. This requires a unique global identity to enhance the global connectivity of the node for transferring the data. The following work provides a solution for the limitations of traditional WSN nodes and makes compliant to IPv6 and the later communication standards.

6LoWPAN finds its scope in various areas like Industry Automation, Transport, Health monitoring, Home Automation etc. thus forming internet of objects. The application of Sensor Network is dependent on the area its going to be deployed. The protocols used in the WSN must be designed to satisfy the requirement where the Sensor Network is designed for an application. The SDT is designed to encapsulate the data with the IP. The SDT was tested with C-DAC's Ubimotes.

Section 2 explains the SDT, its Scope and Command base. Section 3 explains the implementation of SDT on Ubimotes.

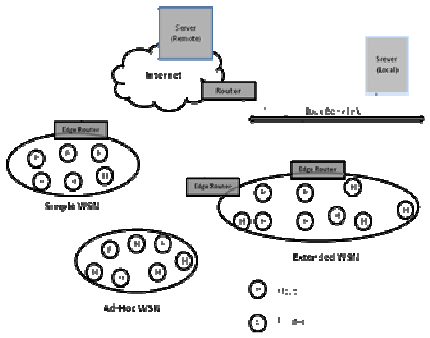

Figure 1: 6LoWPAN

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2. SIMPLE DATA TRANSMISSION PROTOCOL:

2.1. Scope of SDT:

The Simple Data Transmission protocol is developed for the low power applications which suit the WSNs. The SDT protocol has a set of commands to transmit the data to and fro the node and edge router of the sensor network. The SDT protocol is based on the client server architecture in which a command is sent to the sensor node from the coordinator or edge router and the reply is sent in the same fashion from the node to the coordinator. The request and reply comprises of a command indicating the type of data and mode of collection. The type of data collected is dependent on the type of sensor attached to the sensor node and the mode is the way the data is collected by the node from the sensor i.e the communication interface the sensor is connected. The SDT protocol is designed to work on layer 3 networking protocols such as TCP/IP or any other low power IP standard like Berkeley Low power IP (BLIP).

The Simple Data Transmission Protocol lies in the Application Layer of the Sensor Node Architecture. The Network layer comprises of BLIP which supports UDP/IP and the bottom layer is based on 802.15.4.

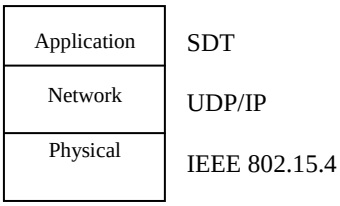


Figure 2: Scope of SDT

2.2. Structure of SDT:

The first field is protocol byte which indicates that the packet belonging to the Sensor Network.

The second and third fields indicate the length of payload and CRC respectively. The fourth and fifth fields indicate the source and destination address of the nodes. The sixth field holds the command and data to be transmitted from the coordinator to node and vice versa. The last field has the CRC code to check for the errors.

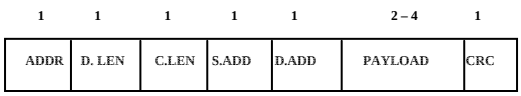


Figure 3: Structure of SDT

The command messages used by SDT have been optimized for the sensor information that a node can gather.

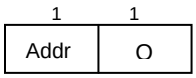
Command	Description	Direction
Q	Query	C → N
R	Reply with Sensor Info	N → C
S	Sensor Data query	C→ N
D	Reply with Sensor Data	N → C
A	Actuate Sensor	C→ N
B	Sensor Actuated	N → C
E	Error	N ←→ C

C – Coordinator, N – End Device

Table 1: Command Base

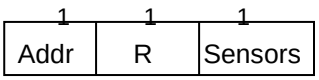
The SDT commands combined with the possible other fields. Here is seen the 'Payload' part only.

Query – 'Q'



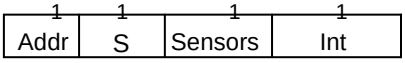
Addr – Address of the
Q – Query command

Reply with Sensor info – 'R'



R – Reply

Sensor Data Query – 'S'



S – Query Sensor Data
Int – Sample Interval

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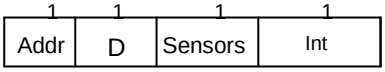
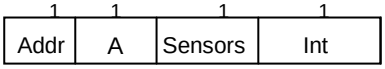
Reply with Sensor – 'D'



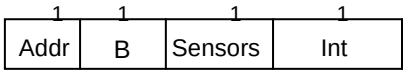
D – Reply Sensor Data

Actuate Sensor – 'A'



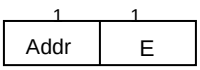
A – Actuate Sensor

Sensor Actuated – 'B'



B – Actuated Sensor

Error – 'E'



E – Error

The Coordinator transmits query messages to the Nodes. Nodes will reply accordingly to the coordinator. if any mismatch between the query and corresponding reply the Error message will be transmitted from the coordinator and if the query is not available then error will be transmitted to the coordinator.

3. IMPLEMENTATION:

The Simple Data Transmission protocol is developed on the Hardware Independent Layer of TinyOS. The underlying two layers are following the functionality of the BLIP to access the Hardware Abstraction and Hardware Presentation Layers.

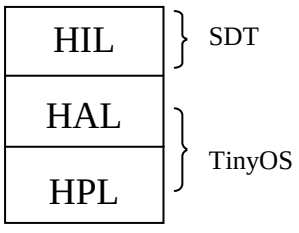


Figure 4: Scope of SDT in TinyOS

The typical packet of SDT has 7 fields which consist of various data to transmit to the coordinator. The coordinator which collects the data maps the data payload with the original IP standard and transmits to the network administrator where he can collect the sensor data and can manipulate according to the requirement.

The Simple Data Transmission Protocol is implemented on the motes comprising of MSP430f1611 and CC2520 radio. The SDT protocol is merged with BLIP on TinyOS [5] such that it satisfies the application standard of 6LoWPAN. The BLIP stack has been modified in order to reduce the memory over head created by unnecessary applications running along with SDT.

The Sensor Board has various sensors to measure the physical parameter and has onboard ADC to choose a particular Sensor. The Sensor Board is connected to the Node with many communication standards like UART, I2C so that the programmer can choose the way the Sensor Board need to be connected to the Wireless Sensor Node.

The interfaces for the sensor board have been developed in TinyOS. The TinyOS 2.1.1 has been modified such that it will work for MSP430F1611 and CC2520.

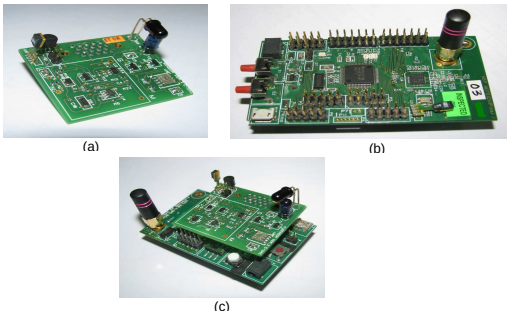


Figure 5: (a) Sensor Board (b) Processor Board

(c) Sensor Node

4. CONCLUSIONS:

The SDT is compared with the other application protocols like SNMP [1], SIP. The protocols SNMP, SIP are for network management and Session Initiation in the Sensor Networks and not for Data framing. The Simple Data Transmission Protocol has been tested on the Sensor Node with MSP430 and CC2520 radio and

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the Data has been transferred from the End Device to the Coordinator.

5. CITATIONS:

This is a part of research project on Developing Protocols for Advanced WSNs in UCHR, C-DAC Bangalore.

REFERENCES:

[1] Haksoo Choi, Nakyoung Kim, Hojung Cha, "6LoWPAN-SNMP: Simple Network Management Protocol for 6LoWPAN": 2009 11th IEEE International Conference on High Performance Computing and Communications.

[2] Waltenegous Dargie and Christian Poellabauer: First Edition, Fundamentals of Wireless Sensor Networks - Theory and Practice.

[3] Zach Shelby and Carsten Bormann: First Edition, 6lowpan the Wireless Embedded Internet.

[4] TinyOS programming Manual http://csl.stanford.edu/~pal/pubs/tinyos-programming.pdf

[5] NesC- A Reference Manual http://nescc.sourceforge.net/papers/nesc-ref.pdf

[6] TI's 2.4 GHZ IEEE 802.15.4/ZIGBEE® RF Transceiver, CC 2520 Data Sheet

[7] TI's Mixed Signal Microcontroller, MSP430F1611 Data Sheet.