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SELF HEALING THERMAL AWARE RPL FOR BODY AREA NETWORKS

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Abstract: Objectives: In our modern society monitoring age old persons are gaining less importance. Any system for continuous monitoring is felt important and necessary. Implanted sensor nodes are the best way in monitoring the age old persons in their homes. Over heating of tissues is the major problem to be addressed on implanted sensor nodes. The main objective of the paper is to incorporate self healing in Thermal Aware RPL for body Area Networks to solve the problem of overheating in implanted sensor nodes.

Methods/Statistical analysis: Routing protocol for Low Power Lossy Networks is an apt protocol for implanted sensor networks. But enhancement of Routing protocol for Low Power Lossy Networks is needed with temperature metric and self healing capability. Each node in the human body are subjected to take decisions and with the DAG formation and should reach the destination node safely. It can be done by a new protocol of Self Healing Thermal Aware RPL For Body Area
Networks

Findings: Whenever a node is implanted there is a possibility of sudden temperature rise in the nodes and its corresponding tissues gets affected. Selfhealing Thermal Aware RpL solve the problem of overheating. This protocol helps in individual decision making of each nodes which is used for safe routing. Simultaneously providing flexibility, evolvability and correctness in routing is a basic requirement to be addressed. This paper gives a great solution of safe routing in body Area networks. In this paper we have analyzed the use of Self healing Thermal Aware RPL for Body Area Networks. In this paper we also study the problems involved in routing and the available various thermal Aware Routing protocols. The advantage and drawbacks are analyzed for the development of Self Healing Thermal Aware RPL For Body Area Networks. This protocol is analyzed for efficiency and message transmission. It is proved that data is not lost and the routing process is speedy than the available routing protocols. Each node decides it path independently and when the temperature increases in the nodes, itself repair the networks and reduce the routing complexities. The proposed system is based on Self Healing thermal aware RPL. The advantage of this system is that each node will automatically decide whether to send data or not beyond the threshold temperature and they decide their path on their own. Proposed algorithm is implemented in Cooja simulator.

Improvements: Other protocols in contiki cooja simulator can be analyzed with temperature metrics. Performance Analysis using various other tools of contiki can be done in future.
Keywords: Overheating, temperature, threshold, hotspots, routing, Body Area Networks, Routing Protocol for Low Power Lossy.

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1. Introduction

Wireless Body Area Network (WBAN) is a collection of wireless nodes of low-power, miniaturized in nature used to monitor body area networks[1]. This Figure1 shows the healthcare architecture of Body Area Networks[2]. It consists of Wireless Body Area Network (WBAN) and also explains how the notes are connected to the server. WBAN consists of several sensors that measure all types of data such as ECG, temperature, pressure etc. These sensors have radio interface and send their information to a central device called medical hub. Medical hub act as a gateway between WBAN and the external network.

The backend server securely handles huge amount of medical data of patients. This data can be observed and analyzed by doctors[2]. In addition it supports a number of interesting applications such as ubiquitous healthcare computing, entertainment, gaming and military applications[1]. Vivo sensor nodes supports the frequency of 403MHz and the range is 14 meters and for the frequency of 2.47GHz, the range is 4.8 meters [1].The ranges varies with distances. The problem of WBAN related to routing is Network Topology, Path-loss, Energy Efficiency and reliability. In implanted sensor nodes, the power generated by the node's could cause damage to the tissues and area surrounding to it. Therefore, in designing a routing protocol for WBANs, it is important to reduce the power consumption of nodes. Extending the Lifetime is the important challenge in implanted sensor nodes and it needs to be addressed. The need of choosing the best low power consuming protocol for Body Area Networks is the prime requirement of work. Real time implementation of implanted sensor node needs the low power consuming protocol. This paper helps in understanding the compatibility for choosing RPL in Body Area Networks. In real-time similar works of vivo sensor nodes are implemented in rats[9]. The remainder of the paper is organized as follows. Section 2, presents the related works of Thermal Aware routing protocols with their advantage and disadvantages. Section 3 deals with proposed methodology of self healing thermal aware RPL. Section 4 deals with the simulation results. Section 5 presents the Analysis of self healing thermal Aware RPL.

2. Related Works

Based on their routing decisions Thermal aware protocols are classified as per hop basics and end to end basics. Figure 2 shows that[3-7] LTRT uses End to End routing and TARA, LTR, ALTR, HPR, TSHR are based on per-hop basis of routing. Each Routing protocol has their own advantage and disadvantage. These protocols are analyzed and segregated into Routing decisions which include per hop basis and End to End basis.

3. PROPOSED METHODOLOGY

The Architecture of self healing Thermal Aware RPL for body area networks is shown in Figure 3.node 4 and node 8 are over heated nodes so the nodes itself decides the path and select the effective shortest distance path towards the destination. Nodes travel from source to destination via hotspots. When a hotspot i.e (nodes above the threshold level is reached) node stake an alternative path and route in an efficient manner. Each node decides the routing path and routing metrics of its own. Routing takes place by upward and downward path .It uses the concept of Self healing in RPL for routing with low power and temperature metrics. It leaves the hot spotted nodes and routing takes an alternative path. This proposed methodology deals with the enhancement of thermal Aware RPL (Routing protocol for low power and lossy networks) with self Healing in Body Area Networks, as it reduces the routing inconsistencies and is able to self- repair the network by itself.

3.1 Rpl

IPv6 Routing Protocol for Low Power and Lossy Networks (RPL) [8] is a routing protocol specifically designed for Low power and Lossy Networks (LLN) devices. IETF ROLL working group proposed RFC draft. This protocol aims to minimize memory requirement, low complexity in routing, data forwarding mechanisms, use compact routing algorithm and efficiently discover links and peers. RPL is more optimized for data acquistation network.

3.2 Control Messages

RPL control messages along with the sequence flow of control messages and their working is shown in Figure 4.[13]

- Destination Oriented Directed Acyclic graph Information Solicitation (DIS): The DIS is used to form a DODAG Information Object (DIO) from an RPL node.
- Destination Oriented Directed Acyclic graph Information Object (DIO): The DIO is used to sent in multicast through the DODAG structure construct a new Directed Acyclic Graph.
- Destination Advertisement Object (DAO): The DAO is used to propagate reverse route information to record the nodes visited along the path.

4. SIMULATION RESULTS

Simulation is done using Contiki OS [11]Cooja Simulator. Temperature and self healing is an additional attribute is added in the RPL (Low Power For Lossy Networks). Scenario of 6,12,18 nodes are analyzed and all the scenarios proves the thermal efficiency of self healing RPL. Table 1 shows the scenario properties of nodes.Figure 5 represents the Self healing thermal Aware RPL for body area networks. This scenario consists of 6 nodes where effective communication is possible in terms of self healing thermal Aware RPL.Incase of failure or presence of hotspotted node the network topology still remains and communication takes place. The node itself finds an alternative path for communication, and also helps in finding the shortest path towards the destination. Self healing include fastest recovery. This can be implemented in the area of body area networks. Figure 6 represents the Self healing thermal Aware RPL for body area networks .This scenario consists of 10 nodes where effective communication is possible in terms of self healing thermal Aware RPL. Incase of failure or presence of hotspotted example 3 in the network an alternative path excluding the node 3 with minimum distance to reach the destination is achieved Self healing include fastest recovery of the alternative path. This can be implemented in the area of body area networks. After some time the hotspotted node loses its temperature and cooling of nodes takes place.Figure 7 explains the communication of 20 nodes with temperature and self healing metrics. This result proves that Self healing thermal Aware RPL is suitable for Body Area Network. It explains the temperature attribute of each node with the server and client nodes. The temperatures value of each node increments itself in a natural sequence till it reaches 10 after which the temperature of the nodes gets reinitialized to 0. The node 1 is assigned as the router node which accepts the data from all the neighboring nodes. The node changes its path after threshold is reached. This shows that the transmission of nodes are accepted only if the temperature value is within the threshold, otherwise the path to the nodes are dropped and an alternative path is selected

5. ANALYSIS OF SELF HEALING THERMAL AWARE RPL

Figure 8 explains the communication of Nodes 6,2,20 nodes, self healing with temperature metrics is implemented. Self healing Thermal aware is analysed. This analyzed study proves that packet delivery ratio is 100% and there is no packet loss in the network. The radio of packets sent per second is higher in self healing thermal aware rpl than traditional and thermal aware rpl.This proves the efficiency of self healing thermal Aware RPLTable2 explains the values of figure8 and this proves that there is no delay in the packet sent and reciving.The delay has been rectified.

6. Conclusion

Our contribution to this paper is the Self healing thermal aware RPLprotocol. This protocol takes into the consideration of heat and self heal the path and route the data packets to minimize the heating effects on the body .Self healing Thermal Aware RPL shows 100%

throughput and less packet drop in the network under different scenarios which indicates that the Self healing thermal aware RPL is enhanced to be a safe routing solution.

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Annexure-I figures and Tables

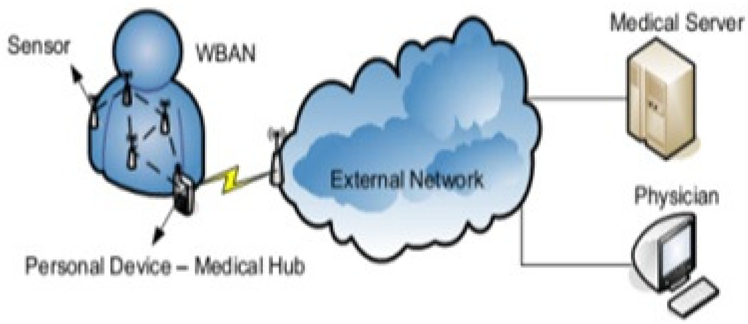

Figure 1: Healthcare Architecture

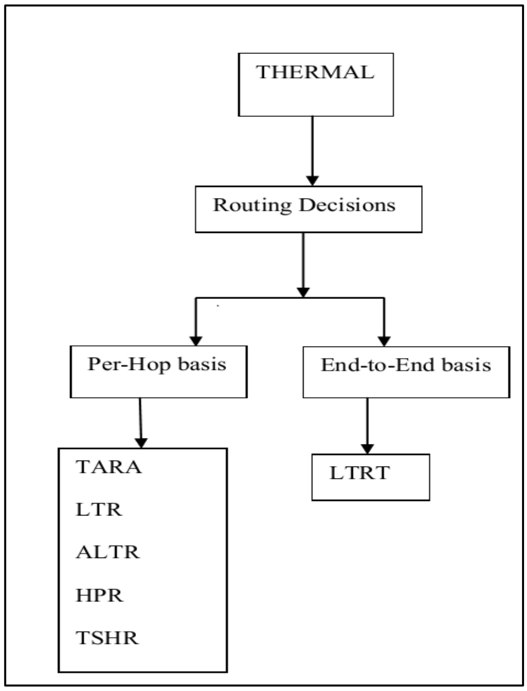

Figure 2. Classifications of Thermal Protocols.

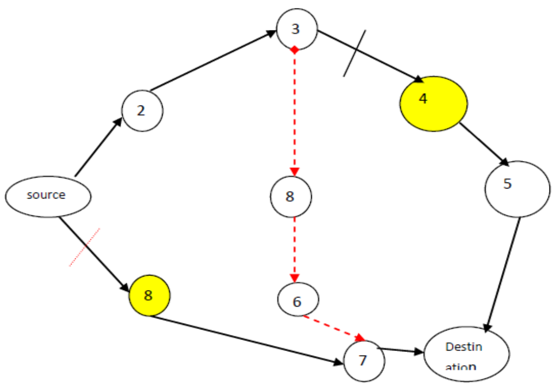

Figure 3. Architecture of Self Healing thermal Aware Rpl

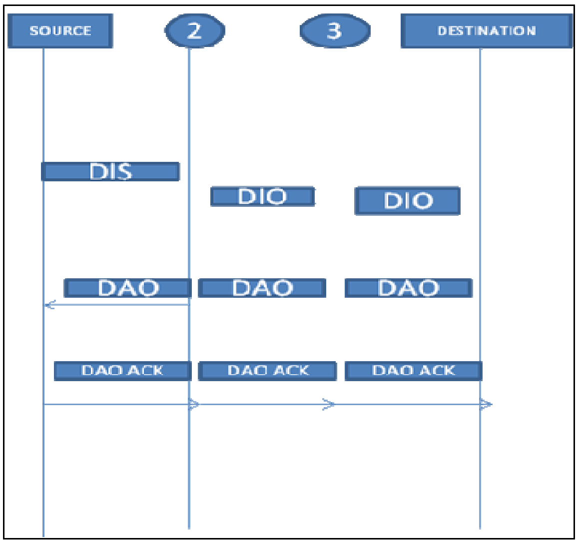

Figure 4. Working of Control Messages

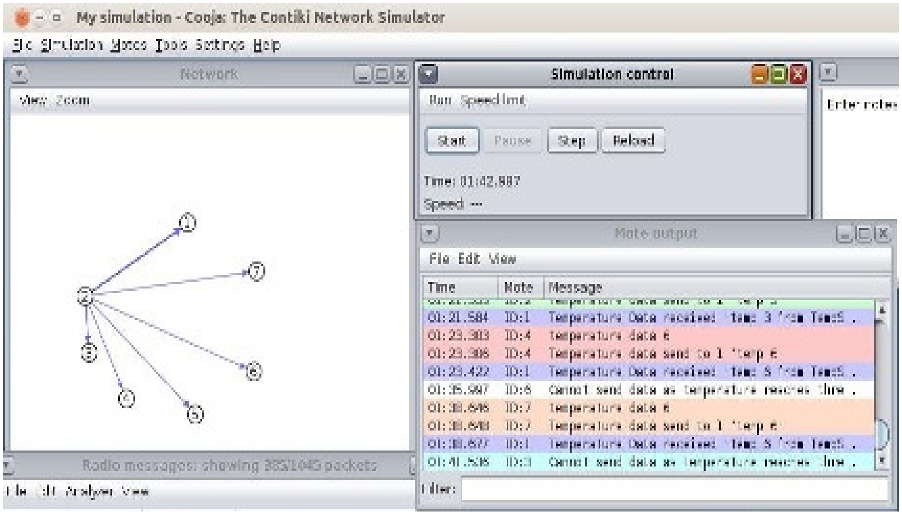

Figure 5. 6Nodes Communication on Self healing RPL

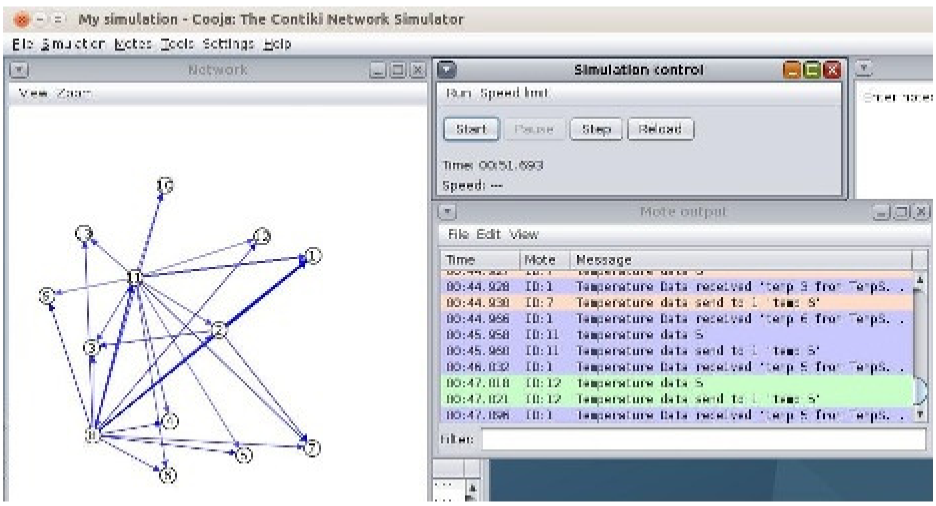

Figure.6 10 Nodes Communication on Self healing RPL

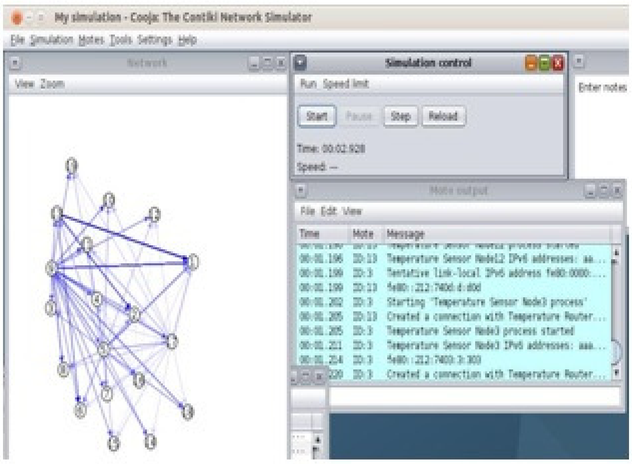

Figure.7 20 Nodes Communication on Self healing RPL

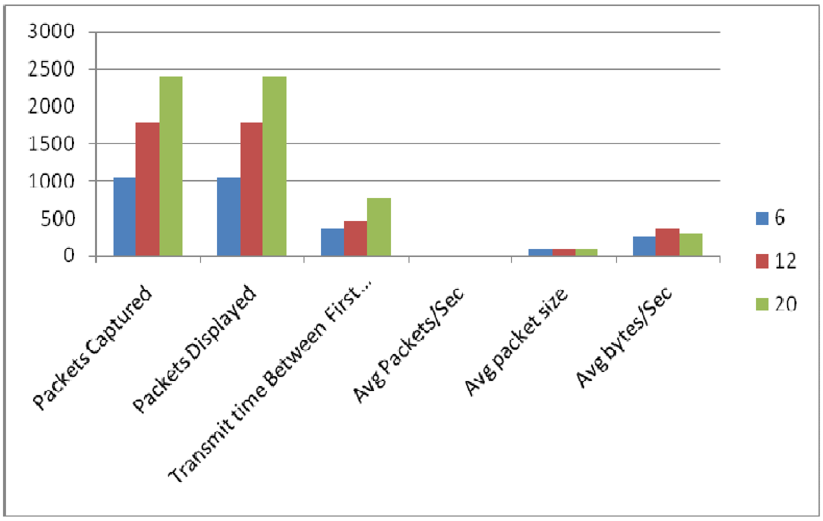

Figure 8. Analysis of Self Healing Thermal Aware RPL

Table 1. Scenario Properties

Nodes	6,12,20
Simulation Time	20.23 min
Terrain	10*10m²
MAC	CSMA Contiki MAC
Channel	26
Transmission Range	10 m(range selected for implanted sensors)

Table 2. Analysis of Self healing Thermal Aware RPL

Nodes	Packet Captured	Packets displayed	TransmitTime b/w First and LastPacket /Sec	Avg Packets/Sec	Avg packet size	Avg bytes/sec
6	1045	1045	358.34	2.916	90.997	265.367
12	1779	1779	465.55	3.835	91.338	349.783
20	2404	2404	762.93	3.151	91.564	288.52