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Research Article

An Energy Efficient Routing for Wireless Human Area Networks in Private Cloud Using Near Field Coupling Algorithm

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Abstract: In this study, an efficient routing algorithm for WHAN in private cloud was proposed. Pervasive computing based facilities that are genuinely user-friendly to everyone will require technologies that enable communication between people and objects in close proximity. Since to the context of conventional technologies is “intra body” communication in which the whole human body serves as the transmission medium. The human body can transmit up to 10 mbps at a fraction of time. For these environments we need high transmission rate of scheduling the packets, reliability, integrity and security in packet delivery. Hence we proposed a new algorithm called near field coupling algorithm for packet scheduling, Routing and delivery within the Wireless Human Area Network. Our proposed algorithm reduces the energy consumption, packet routing and scheduling time which uses WHAN as basic framework for transmission. Here our communication channel is optimized through the cloud environment. Experimental results demonstrating our proposed methodology was also included.

Keywords: Body area networks, flooding, packet routing, packet scheduling, routing, wireless human area networks

INTRODUCTION

A wireless network (Ad-hoc, Infrastructure, Sensor Networks, WHAN and WBAN) consists of a collection of nodes that communicate with each other through wireless links without a pre-established networking infrastructure. It originated from home appliances up to defense field communication applications, where infrastructure networks are often impossible. Due to its tractability in distribution, there are many potential applications of a wireless network. For example, it may be used as a communication network for a rescue-team in an emergency, during this time period fixed node-stations may be damaged. It may also provide a communication system for vehicles in a city. Next focus towards application side where wireless communication plays a vital role in communication as well as information sharing. For example, WLAN (Haas and Pearlman, 1998) can be used widely in corporate sector in which wired circumstances is entirely reduced and freed. Another good example is, present working area where data’s are interchanged through wireless communication only (CC2430, 2007; STLC2500D, 2008; STLC4560D, 2008; Perkins and Bhagwat, 1994; Johnson *et al*., 1998; Perkins and Royer, 1998).

Wireless Human Area Network protocol relies with Cloud computing methodology for global interaction for communication and communication channel establishment (Heidemann, 2003; McDonagh *et al*., 2007) effectively utilizes the model by which it interacts with, on a demand network access to a shared environment of configurable computing resources (Ko and Vaidya, 1998) (for example networks, high end smart device protocols, storage application and models) that can be under rapid growth and released with nominal effort of manage mentor service provider interaction (http://www.slideshare.net/ vinayak.nandi/human-area- networking-technology-eport; http://www.medgadget.com/2005/02/redtacton_ a_hum.html; http://blog.infizeal com /2012/01/human-area-networks-introductory.html). The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units) (Akyildiz *et al*., 2006), our major deployment model for cloud environment is private cloud (i.e., it may be owned by an organization or by a third party vendors) (Haas and Halpern, 2006; Basagni *et al*., 1998; Dam and Langendoen, 2003; Lamprinos *et al*., 2005). The various characteristics of cloud is defined as follows.

Major characteristic of cloud:

Elasticity: Is a core feature of cloud systems and limits the capability of the underlying infrastructure to adapt to changes and challenges.

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Reliability: Denotes the ability to ensure continuous operation of the system without interruption, i.e., no loss of data, no code reset during execution etc. Reliability is classically achieved through terminated resource utilization.

Quality of service: Support is a relevant ability that is essential in many use cases where specific requirements have to be met by the subcontracted services and/or resources.

Agility and adaptability: Are core features of cloud systems that strongly relay to the elastic abilities. It includes on-time response to the particular changes in the amount of requests and amount of resources, but also adaptation to the changes in the environmental circumstances.

Availability: Denotes the basic need of services and data is an essential capability of cloud systems and was actually one of the essential aspects to give rise to cloud environment.

LITERATURE REVIEW

The similar applications of ad hoc network stance a challenge for equivalency and designing a single protocol that operates efficiently across a wide range of operational conditions and network configurations. Two ad-hoc routing methodology namely Pro-active and Reactive routing plays a vital role. Both proactive and reactive protocols described above perform well with certain limitations and in a certain limited region. Generally, reactive protocols are well suited for networks where the mobility ratio is relatively very low. While in Proactive routing protocols, are well suited for networks where mobility ratio is relatively high. Figure 1 show the basic network design space with node mobility and call rate as in the two dimensions and the general regions where each of these two kinds of protocols performs well. Since these protocol areas do not suites for inter body communication channel and the performance of both of the protocol classes degrades when they are applied to regions of ad hoc network space between the two extremes. Wireless Human Area Network protocol supports for inter body communication channel (Sensium™, 2008) and intra body communication channel (http://www.scribd.com/doc/50074166/ Redtacton-IEEE-Report). The data can be routed by means of nearby node or nearby poll which are in range to nearest save point (private cloud) (http: //www.scribd.com/doc/50074166/ Redtacton-IEEE-Report). When the mobility ratio is high in range the node keep on tracking for nearest node and establishes its request throughout the session. When the mobility range is very low then the nearest node is traversed and back tracked to perform its local routing strategy. Since the high quality local route information provided by save point (i.e., local routing point in private cloud) which can be used to provide a collection of new and enhanced services (Langendoen and Halkes, 2005). Services based on local field information, connectivity, telecast circumstance can be identified by overlaps in local connectivity, broadcast messages in corresponding node which can be distributed or established to all nodes more efficiently (CC2520, 2007). Moreover, local packet exchange of route information can be further abused to provide a multicasting based query distribution service, in which only a subset of the interconnected nearest nodes are needed to be queried. Such a service can be applied to global route discovery, path focuses, name-address translation and general database traverse etc., (http: //www.slideshare. net/vinayak.nandi/human-area-networking-technology-report; http://www.medgadget.com/2005/02/redtacton_ a_hum.html;http://blog.infizeal. com/2012/01/human-area-networks-introductory.html. (Bauman, 2006; Hamilton, 2002)).

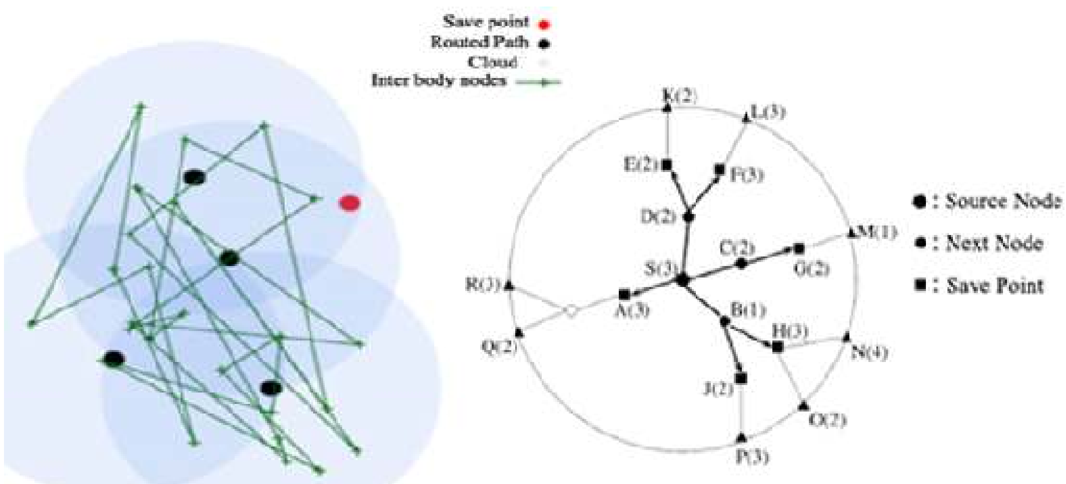

Fig. 1: Basic architecture near field coupling algorithm

METHODOLOGY

Implementation details: The motivation behind near field coupling based routing is to provide a framework that can be configured to match the network's operational condition and characteristics. Therefore, an integral component of the framework is a tuning mechanism in private cloud. In particular, the three basic ingredients for tuning are: a means for measuring relevant Wireless Human Area Network characteristics, mapping values onto the framework's configuration and a structure to upgrade the configuration of transmission nodes.

Protocol initialization and configuration: Human Area networks (http://www.scribd.com/doc/50074 166/Redtacton-IEEE-Report) naturally provide themselves to active reconfiguration. Through the progress of normal operation; nodes directly measure its local network characteristics. Each node may use its own local measurements for node independent self-configuration. For a cloud based environment the measurements could be relayed to a central configuration node or shared with surrounding nodes for a distributed configuration approach. At first glance, centralized dynamic reconfiguration may appear to prevent inconsistent configuration (Virtualized parameter), as is the case for centralized static configuration. Since the multi hop nature of Wireless Human Area Networks makes it impossible to reliably perform tightly synchronized configuration updates for all nodes. This means that, for some period of time, the network could be in an inconsistent state. As this also affects distributed and independent reconfiguration (Cloud), it is necessary that a dynamically routing framework (near field coupling) be able to deal with, support and possibly adventure the non-uniform node configurations. Since our algorithm supports the non-uniform node configurations.

Node discovery: The methods and strategies of node discovery initializes with one kernel node (primary kernel) in a known point (Position). The primary node is capable of determining the absolute positions of neighboring nodes and eventually other nodes in the network, since it establishes the communication channel to all the nodes in the private cloud.

Optimized flooding: In this section, we use optimized flooding protocol which counterparts pure flooding protocols in location and route discovery, keeping the number of transmissions far lesser and near optimal. Flooding attains the goal of location discovery by allowing all the nodes to receive the request and each of them to retransmits it again. The sensitivity behind our protocol is that in order to achieve the goal, there is no need for all nodes to transmit/retransmit the message. Instead, the goal can be achieved if only few strategically selected nodes retransmit the message. In our proposed system the node which was nearer to the save point (Private Cloud) have to retransmit the data for the request. From the response the node nearest to the save point can be located (http: //www. scribd.com/doc/50074166/Redtacton-IEEE-Report).

Fixing save points for mobility nodes: Here we are going to discuss about the save points are fixed in equal interval for Cloud environment. Although cloud is a Huge online storage area since the mobile node can traverse to any place, based on mobility here we assign the maximum range and minimum range for maximum range the node mobility is limited to the transmission ratio, for minimum range the node mobility is maximized to the transmission ratio. In cloud the save points are fixed based on the following result:

$$\text{Save point} = \text{Area} - (\text{range} + \text{nearest node distance} - \text{traversing node distance})$$

Algorithm for near field coupling routing algorithm:

Alg: Near field coupling Algorithm (N, S, R, Source, Dest)
N-next node
S-save point
R-Possible routes
Source-Source node
Dest-Destination node
Assign values for source node
Assign Destnode
Trace for all nearby node
Predict all possible nearest routes for nodes
    For each level at transmission stage
        Choose a save point in cloud
        If n save point violates its properties (missing nearest node or save point)
            Backtrack for next possible node
        If n save point traced back
            Apply fixing node
        Track the connectivity of nearest node
        Establish channel for each node
        Predict the first response from all nodes
        Check for the possible routes for the node (intermediate nodes)
        Couple the coordinate node (source traced node) with its response node
        Apply routing based on nearest field node within the savepoint
    Transfer data within the save point
    Locate the save point in cloud
End

EXPERIMENTAL RESULTS

Simulation prototype: We have developed a stimulant to evaluate the routine of our protocol. The results are compared to our routing algorithm with other routing algorithm. Wireless Human Area Network (WHAN) of different physical areas and different shapes with different number of nodes were simulated (denoted in

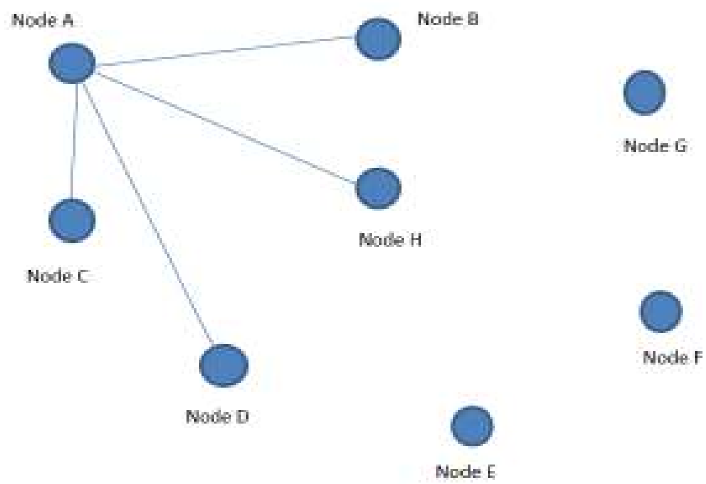

Fig. 2: Node discovery and flooding

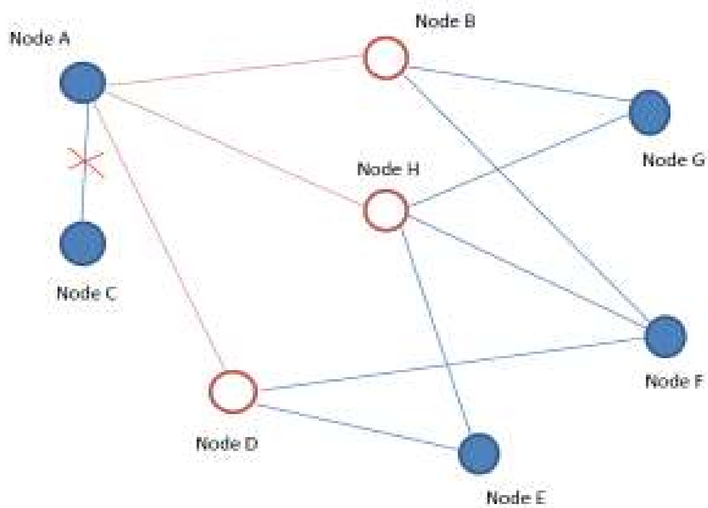

Fig. 3: Node discovery and flooding at level 0

Fig. 2 and 3). To be more specific in a private cloud of region ranging from 400 to 4000 m and square region of 400×400 m. The nodes were uniformly distributed all over the region with the density varying from 4 Nodes per 400×400 m region to 100 Nodes per 400×400 m region. By n2 Nodes per 400×400 m region, we mean to say that one node is randomly placed in every (400/n) × (400/n) m region. Also, the best case where some node always exists at the strategically located has also been simulated. We have simulated each case multiple times and the results presented are the average of all the simulations. Tables denote the route path order in the sequence. The sequence of path order is denoted and represented from Table 1 to 8.

Observed prototype: The best case is where some node always exists exactly at the strategically selected location.

Table 1: Routing index for source node and destination node during flooding at level 0

Node	Source node	Destination node
A	AC, AH, AD, AB	B, C, D, H
B	-	-
C	-	-
D	-	-
E	-	-
F	-	-
G	-	-
H	-	-

Table 2: Weight ratio for source node and destination node for level 0

Node	Weights (source node)	Weights (destination node)
A	8	4
B	0	0
C	0	0
D	0	0
E	0	0
F	0	0
G	0	0
H	0	0

Table 3: Routing index for source node and destination node during flooding at level 1

Node	Source node	Destination node
A	AD, AH, AB, AC	B, C, D, H
B	BG, BF	G, F
C	-	-
D	DE, DF	F, E
E	-	-
F	Destination	Destination
G	GH	-
H	HG, HF, HE	E, F, G

Table 4: Weight ratio for source node and destination node for level 1

Node	Weights (source node)	Weights (destination node)
A	6	4
B	4	2
C	0	0
D	4	2
E	0	0
F	1	1
G	2	0
H	6	3

Table 5: Routing index for source node and destination node during flooding at level 2

Node	Source node	Destination node
A	AH	H
B	B	-
C	-	-
D	D	-
E	E	-
F	F	-
G	-	-
H	HG, HF	F

The number of transmissions required to insure circular and square regions in the best case scenario are observed and presented in comparison table listed below in section 5 (conclusion). Initial level of flooding iteration predicts the node discovery whereas further level (0, 1, 2, …n) node and path discovery is analyzed by means of several flooding iterations (up to n) over nodes in the range (Cloud region).

Table 6: Weight ratio for source node and destination node for level 2

Node	Weights (source node)	Weights (destination node)
A	2	1
B	1	0
C	0	0
D	1	0
E	1	0
F	1	0
G	0	0
H	4	1

Table 7: Routing index for source node and destination node during flooding at level 3

Node	Source node	Destination node
A	AB, AC, AH	H
B	BF, BG, BH	-
C	CH, CD	-
D	DF, DH, DE	-
E	EF	-
F	Destination	Destination
G	GF	-
H	HF	F

Table 8: Weight ratio for source node and destination node for level 3

Node	Weights (source node)	Weights (destination node)
A	6	1
B	6	0
C	4	0
D	6	0
E	2	0
F	1	1
G	2	0
H	2	1

Figure 3 to 5 states, to be more specific in a private cloud of circular region ranging from 400 to 4000 m and square region of 400×400 m (Table 9 clearly defines the transmission range for various regions in private clouds). The nodes were uniformly distributed all over the region with the density varying from 4 Nodes per 400×400 m region to 100 Nodes per 400×400 m region. By n2 Nodes per 400×400 m region, we mean to say that one node is randomly placed in every (400/n) × (400/n) m region.

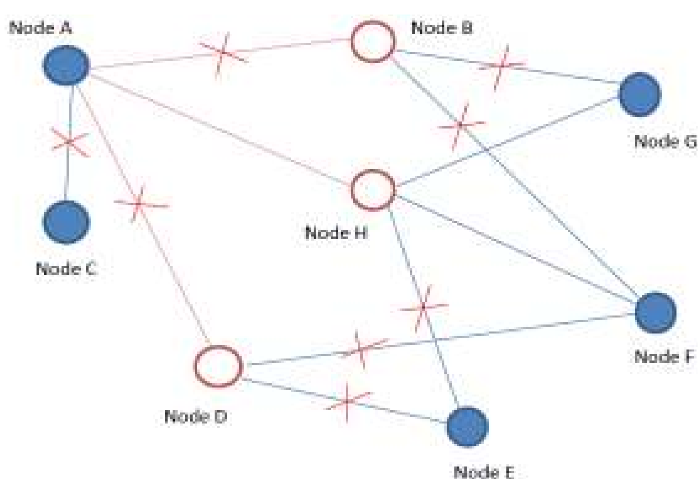

Fig. 4: Node discovery and flooding at level 1

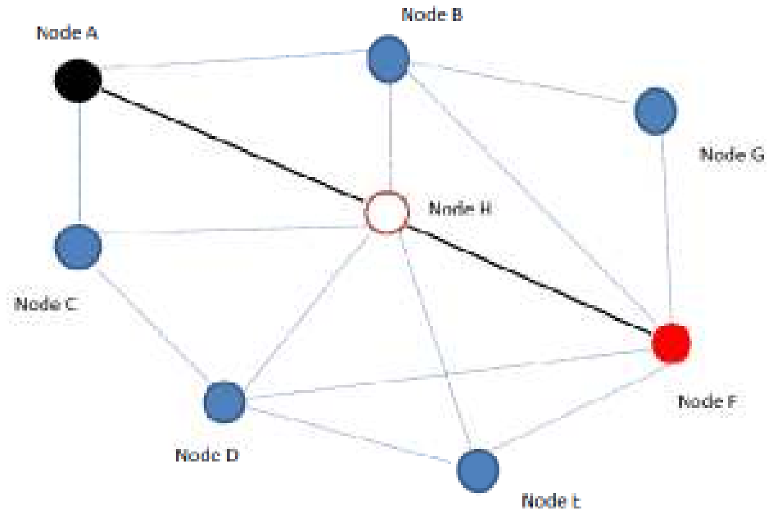

Fig. 5: Denotes the routing path of the nodes (source-destination)

Table 9: Analysis ratio of range of parameters and routing index

Circular region	Square region	Transmission range for circular region	Transmission range for square region	Routing index (circle)	Index index (square)
400*4000	400*400	4*24 = 96	4*4 = 16	Fair	Fair
1200*200	200*200	6*2 = 12	2*2 = 4	Average	Average
1500*500	500*500	9*5 = 45	5*5 = 25	Fair	Average
2400*200	400*400	15*2 = 30	4*4 = 16	Average	High
3600*500	500*500	21*5 = 105	5*5 = 25	Good	Fair
4000*400	400*400	24*4 = 96	4*4 = 16	Excellent	Excellent

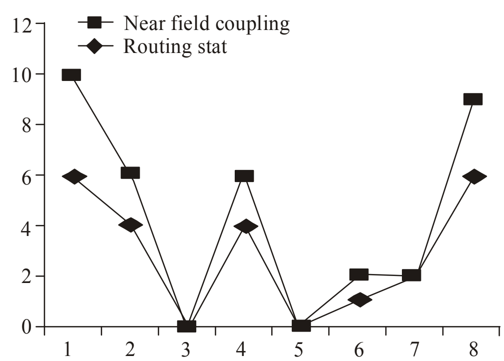

Fig. 6: Load and store comparison with routing stat and NFC algorithm

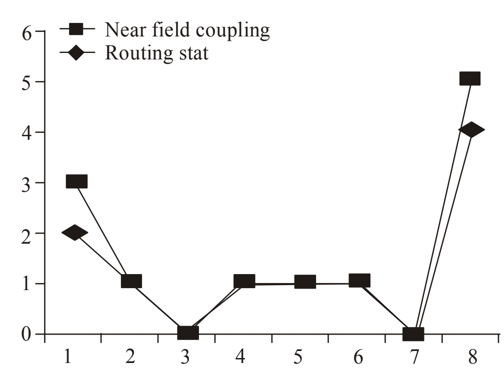

Fig. 7: Path analysis between routing stat and NFC algorithm

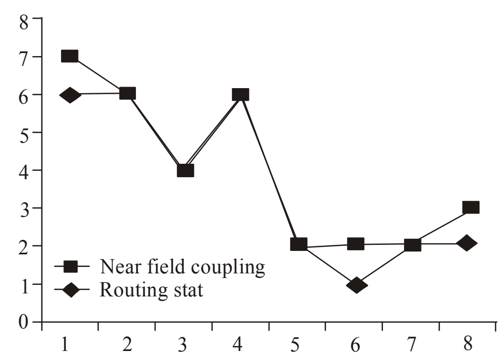

Fig. 8: Graph denotes the performance metrics about near field coupling algorithm and routing stat

The performance analysis of the Near Field Coupling (NFC) algorithm is given. Here NFC algorithm routes the packet through the optimal route using store and forward method where the mobile nodes communicate through cloud environment. The proposed algorithm built a new routing strategy for packet forwarding and rendering. Routing stat is denoted for experimental algorithm i.e., Hybrid routing (Proactive + Reactive). Figure 5 denotes the load and store comparison between routing stat and Near Field Coupling algorithm. Figure 6 denotes the path analysis between routing stat and Near field coupling algorithm by means of local threshold value (path cost). Figure 7 clearly defines the performance analysis of the routing stat and near field coupling algorithm. Figure 8 denotes the comparison result shows that NFC algorithm is better than existing hybrid algorithms.

CONCLUSION

In this study, we have proposed and built an all-inclusive credential system called near field coupling algorithm for human area networking, Our proposed method near field coupling algorithm gives the promising results as stated in Fig. 5, since Wireless Human Area Network protocol is used to transfer data between human bodies and to establish communication within human area network was in reliable and novelty was in increased rate. NFC algorithm built a new routing for packet transferring and storing the data in private cloud within the intra HAN. Results show the optimality of data transmission from one node to another node through private cloud.

RECOMMENDATIONS

We extend our work on optimal routing in cloud for Wireless Human Area Network at low range. Also, the best case where some node always exists at the strategically location has also been simulated. We have simulated each case, multiple times and the results presented here are the average of all the simulations. Since in low range, routing is not possible at the optimal rate hence future enhancement is fully based on augmenting the routing methods in low range for Wireless Human Area Network based mobile nodes.

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