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Route Discovery Overhead Aware Routing Protocol for IoT to Enhance QoS

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ABSTRACT

IoT is a backboneless network, due tomobility nature of the nodes, network is dynamic. The nodes are self-organized and two nodes can transfer data directly when they are within the transmission range. Due to limited radio waves propagation, the transmission range is also limited and the intermediate nodes are involved to build a network as Multi-hop network. A Reactive (on-demand) routing is most commonly used for wireless routing. The proposed work is to reduce the routing overhead, by reducing the propagation of control packets.

Keywords: IoT routing, Overhead, Packet delivery ratio, QoS, LOAD, Reactive routing.

1. INTRODUCTION

Generally, the routing protocol calculates the shortest path, based on hop count between the sender and the receiver and the time delay between the source and destination. The energy also considered to increase the QoS by choosing the energy efficient path [1]. There are many energy efficient algorithms available. But, they choose the path with sufficient energy. If the shortest path has no sufficient energy, then the path is rejected and the next shortest path is selected [2][3]. QoS routing need to fulfill QoS requirements like bandwidth, energy and minimum delay. The widely used QoS constraints are bandwidth, energy, overhead, Packet delivery ratio and delay requirements. LOAD and OLSR-V2 [4] are pure on-demand routing protocol and uses a broadcast (i.e. flooding) route discovery mechanism. The reason for selecting LOAD is that its route discovery mechanism matches the bandwidth calculation scheme very well and is suitable for bandwidth constrained routing. This protocol maintains the end-to-end state information at every node for every possible destination[5].

2. RELATED WORKS

The topology of IoT Network is dynamic, due to variable network structure and heterogeneous [6]. IoT Oana Iovaet at.,[7]introduced the Context Manager, a background component providing context-aware adaptation to the IMPReSS platform. It simplifies context recognition and management providing features such as sensor data fusion, modelling of smart entities, context reasoning and sending commands to actuators to adapt system's behaviour. This Context Manager is based on object-oriented context modelling and rule-based context reasoning. In order to assess the suitability of the Context Manager for energy efficiency management in public buildings, the author built a case study representing a scenario of a university classroom. The author developed a prototype for this scenario, where the Context Manager automatically controls lighting and temperature, and displays power consumption.

Ehsan, S.et al.,[8]proposed energy-efficient probabilistic routing (EEPR) algorithm, which controls the transmission of the routing request packets stochastically so as to extend the network lifespan and reduce the packet loss beneath the flooding algorithmic rule.Machado, K et al.,[9] presents a future-driven routing architecture

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for Internet of Things (IoT). Things with a similar routing and service polices, denoted by an autonomous system of things (ASoT). The author explicitly classify and explain the ultimate requirements, called 6A connectivity, of the Internet of Things (IoT) paradigm European project cluster for IoT (CERP-IoT) has brought up. Then, a novel component of the Internet of Things (IoT), named an autonomous system of things is introduced. The ASoT is able to accommodate many phases of IoT interoperability property. In addition, ASoT's interoperability to either other ASoTs or traditional autonomous systems (ASs) brings up new challenges on inter-domain routing because they show a wide variety of features regarding interconnectivity.

Yang, T et al.,[10]proposed the cross-layer Link quality-aware Geographical Opportunistic routing protocol for video transmission in mobile multimedia IoT applications, called LinGO. This protocol finds reliable routes to transmit video packets, and thus increases the video quality from the user's perspective. LinGO adopts a Dynamic Forwarding Delay (DFD)-based approach, and takes into account multiple metrics to compute the DFD, i.e. link quality, progress, and remaining energy. Hence, LinGO provides high progress together with reliable links. LinGO considers a Link Quality Estimation (LQEt), to compute the DFD function. The calculation of the Link Quality and LQEMax represents the maximum value for LQE. LinGO also supports mobile multimedia IoT applications with QoE support, and operational modes.

Radi, M et al.,[11]describes the deployment of IoT, in various domains as shown in table 1, uses different technology to connect the nodes. Most of the IoT environment is formed by WSN and MANET nodes, so the MANET and WSN routing protocol plays an important role in IoT.The role of protocols in various applications is tabulated in table 1.

Table 1
The Role of Routing protocols

Application	*N/W size*	*Energy*	*N/W Technology*	*IoT Node*	*Routing protocol*	*author*
Smart home	Small	Re-chargeable battery	802.11, 3G,4G	RFID, WSN, MANET.	LOAD, AODV, RPL	Kidd et al.,[12]
Smart city	Medium	Re-chargeable battery / Energy harvesting	802.11, 3G, 4G	WSN, MANET.	LOAD, AODV	murty et al.,[13]
Smart agriculture	Medium/ Large	Energy harvesting	802.11, Satellite communication	SENSORS, RFID, MANET.	LOAD, RPL	Brainbridge et al., [14]
Smart transport	Large	Re-chargeable battery Energy harvesting	802.11, Satellite communication	SENSORS, NFC, VANET	AODV, LOAD	Yu et al., [15] Taylor et al., [16]

3. PROPOSED TECHNIQUE

The reactive protocols dose not maintains history of information about their neighbours. Whenever a need to communicate with other node, it initiates the route discovery process to identify the optimum to the destination. In network scenario 1 the source node S initiates Route discovery process by constructing the RREQ and forwards to its neighbour nodes. Whenever a node receives RREQ, it calculates the RREQ list and forward to the nodes present in the list. This process repeats till the destination occurs. The destination node constructs the RREP, and forward to the nodes in the RREP list. This process repeats till the source reached. The step by step process of route discovery is as fallows

Step 1: identify the N/W Topology.

Step 2: Source node initiates the Route Request (RREQ) to find the optimum path from source to destination.

Step 3: The neighbouring nodes receive RREQ and insert its neighbour information in the RREQ packet and forward the RREQ to its neighbouring nodes without saving the RREQ info.

Step 4: The step 3 iterated till the destination occur or till the Time To Live (TTL) expires, If TTL expires before destination identified, then increase the TTL value and continue the step 2.

Step 5: The destination node receives RREQ and construct the Route Replay (RREP) and forward to nodes present in the compliment list.

Step 6: Whenever a node receives RREP, it will runs the step 5.

Step 7: The source node receives the RREP from different paths, and choose the optimum path.

The route discovery process for Network scenario shown in figure 1 is manually calculated, and results are discussed below. The parameters and variables that are explained in table 2. The network topology contains 7 mobile nodes where S is the source node, D is the destination node and rest are intermediate nodes. The source node S begins the route discovery process to communicate with destination node D. The route discovery process is carried out as like the proposed technique, the existing protocols stores the control packet information. Whereas the proposed technique doesn't store the routing information so the memory isutilized, though there are merits in proposed technique also have its demerit also. The size of the RREQ is increased so the load overhead is increased but the overall routing overhead is minimized while comparing to the existing technique.

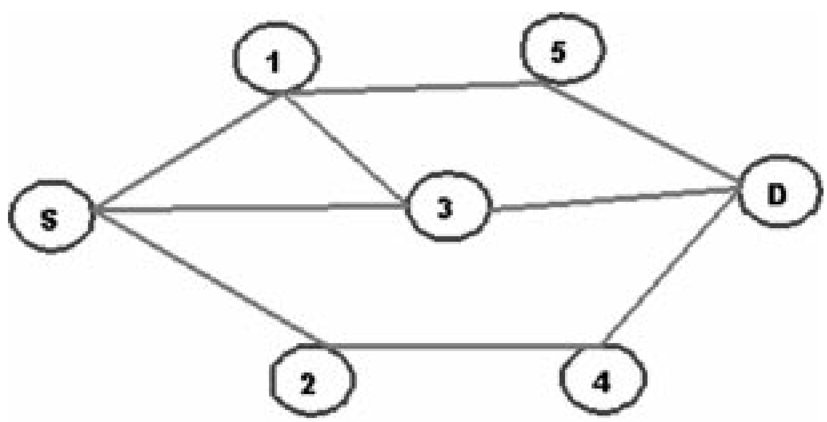

Figure 1: Network Scenario

The variables used are listed below,

Where,

S -source Node

D- Destination Node

{1,2,3,4,5} – Neighbouring nodes

Source Neighbour – {1,2,3}

1's Neighbour {S,3,5}

2's Neighbour {S,4}

3's Neighbour {S,1,D}

4's Neighbour {2,D}

5's Neighbour {1,D}

RREQ list = Neighbour list – RREQ hop list

Example

1's Neighbour list = {S,3,5}

RREQ hop list for 1 = {S,1,2,3}

RREQ list= {S,3,5}-{S,1,2,3}
= {5}

RREP list= {Neighbour list} n {D's RREQ hop list}

Example

1's Neighbour list = {S,3,5}

D's RREQ hop list for 1 = {S,1,2,3,5}

RREQ list= {S,3,5} n {S,1,2,3,5}
= {S,3}

The time delay k from node v1 to node vk is a non-empty graph P = (V, E) of the form

V = {v0, v1, . . . , vk}

E = {(v0, v1), . . . ,(vk—1, vk)}

edge j connects nodes j — 1 and j (i.e. |V| = |E| + 1).

The result for proposed technique is calculated and the results are shown in figure 2 and figure 3. Figure 2 shows the number of RREQ, and figure 3 shows the total route discovery delay in bits.

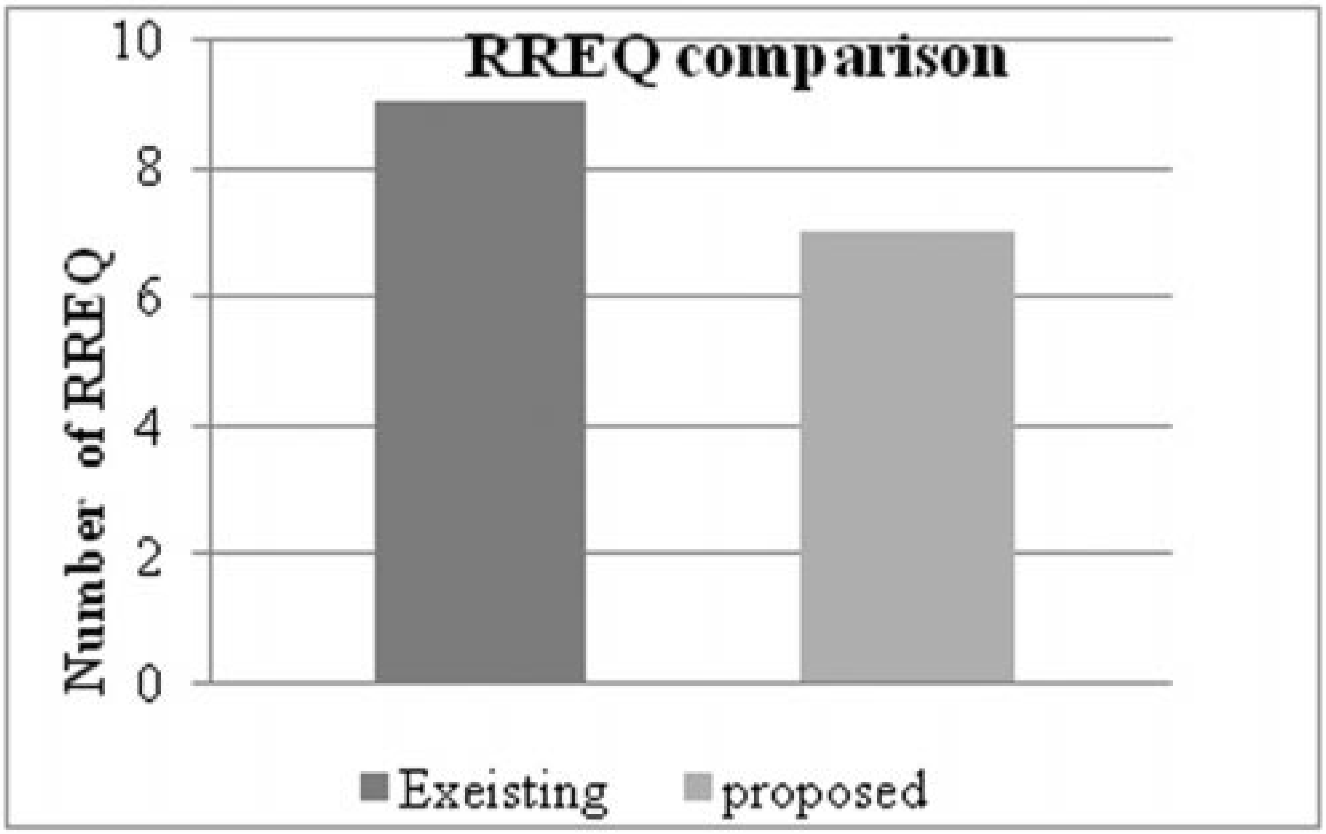

Figure 2: RREQ Comparison

Algorithm Find To order of path

d := 0; p0 := G;

while E v — Gt : din(v) = 0 do

Gt + 1 := Gt/{v}; order(v) : = d + 1; d : = d + +;

end while if d = n then p is acyclic;

else if d < n then G has a cycle;

end if

Routing overhead is computed by the ratio of control packets and data packets received.

Overhead = control packets / Data packets received;

Control packets = RREQ + RREP+HELLO;

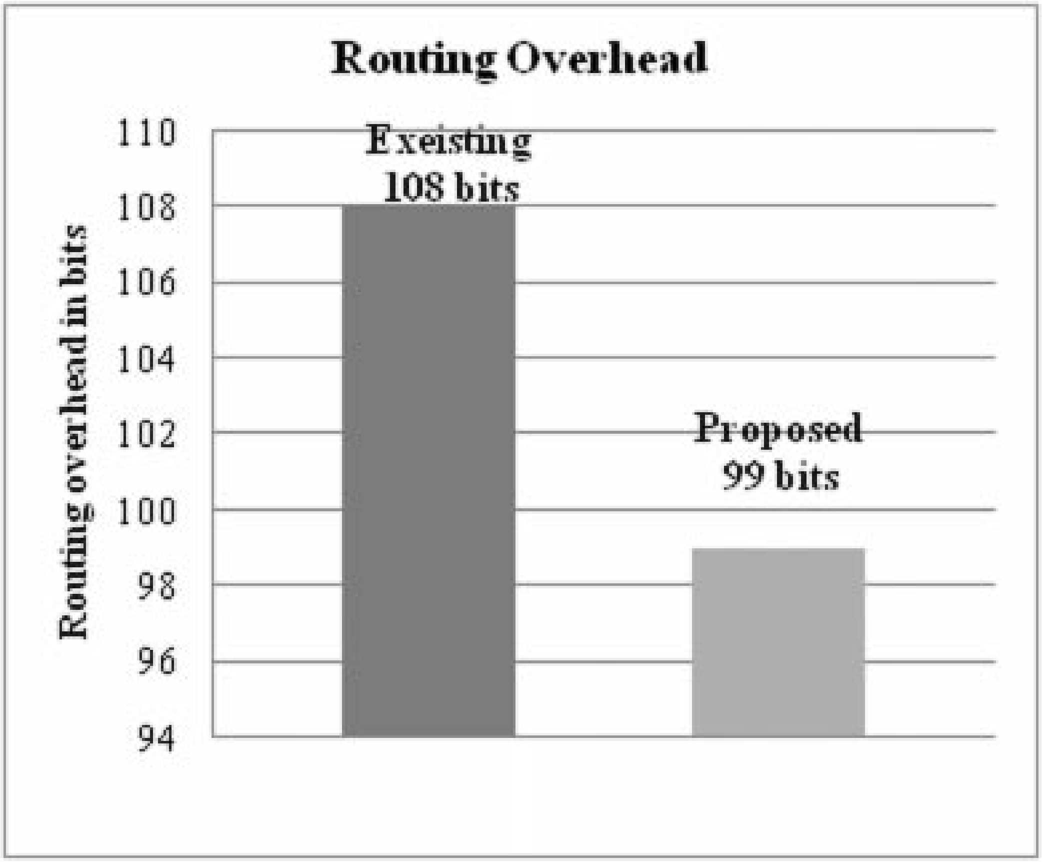

Figure 3: Route discovery overhead

4. CONCLUSION

IoT routing is a challenging task, the mobility in IoT nodes are managed MANET protocols. The IoT nodes are energy efficient, so MANET protocols are enhanced to manage energy alone but fail to overcome other QoS parameters like bandwidth, delay, PDR etc. The proposed technique enhances the MANET protocol LOAD with respect to route discovery delay and routing overhead. The result for proposed technique is manually calculated. In future the proposed technique needs to simulate using IoT simulator. The manual calculation proves that the proposed technique enhances the PDR and route discovery delay in various network scenarios with different kinds of IoT nodes.

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