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Optimal Energy Efficient Mobility Management Routing Protocol for the Next Generation Networks

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Abstract

Connecting physical things *to the internet helps to use remote sensor data and it allows controlling the physical world from distance. Currently IoT is used for the diverse areas like industries and smart home etc. For efficient data transmission in such cases cluster head (CH) is selected from diverse IoT devices. In this paper the mobility is taken as the major problem. Thus to maintain proper mobility in WPAN environment a novel protocol called optimal energy efficient mobility management (ORPL) for 6LoWPAN is proposed. The proposed ORPL protocol is used in hard and soft hand-off. The major contributions of the proposed protocols are; initially the cluster is formed using artificial algae optimization algorithm. In the cluster formation the cluster member will move in the cluster domain. In this case within the cluster domain the mobility handover is performed also the control messages are only transferred between nearby nodes. This will reduce mobility handover cost, delay and energy consumption. The second contribution is the CH selection using Hunting search based decision making algorithms. For selecting the CH the location information based on the destination address of the routing path that connecting destination CH which automatically built without routing discovery. Third contribution is to find the congestion prediction and selection of optimal links in order to control user mobility, for this purpose back track searching algorithm is used. The proposed ORPL protocol is implemented in Network simulator (NS2) tool. The analysis is performed for the parameters like hand-off delay, packet delivery rate, overhead and energy consumption. For the analysis purpose grid deployment of 12 APs and a root node are considered. The data generated by the MN is collected by root node and it is deployed in 8 m × 20 m room size. By using the optimal link the data is transmitted. The speed of the Mobile Node (MN) is constrained to the scope of human walk speed: from 0.5 m/s to a 2 m/s.*

Keywords : *WPAN, IoT, Hard Handoff, Soft Handoff, Cluster Head*

1. INTRODUCTION

The cutting edge Internet, called Internet of Things [1, 2], is depicted as confounding structure for every remote contraption. The reactions for this issue in a gigantic piece of inside drives is gotten from internet engineering task force (IETF) which is filling in as a social gathering under IPV6 over low power wireless personal area networks (6LoWPAN). Precisely when individuals move away from their workplaces or concentrate lounge areas the adaptable learning is an essential idea for the correspondence. Adaptable learning isn't utilized for correspondence yet what's more it is utilized for hearing music, sports program and news when individuals' moves over the long haul from schools or office. In any case, coming to fruition to arriving at home the need changes and they utilizes DVD/CD Players, tapes, PCs gave getting programming or PCs with fast access to the Internet for e-learning [3]. In like manner PDAs are utilized for modifying furthermore as correspondence. Generally the PDAs join purpose of control and little memory and this fragment of beyond what many would consider possible the utilization of tabs or various windows, the opening of affiliations and length of messages [4]. In current calculating an area adaptability is considered quickly making and a huge estimation. A silly improvement in the PDAs like PDA, GPS

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Navigation, Smartphone and PCs solidifying with assortment of security drives, structures alliance and adaptable enlisting [5][6]. Verifiable remote advances like WIFI, Ad Hoc Network and WiMax the social requesting can get to the web acceptably rather than relationship starting at now. Other than the telephones are evidently not difficult to work and it licenses focal access of a wide level of beguilement [7] which make it saw by more clients. As showed by the evaluation from Juniper, the adaptable programming and application subject to coursed arranging are relied upon to increase 88% constantly from 2009 to 2014, and such improvement can make US 9.5 billion dollars in 2014 [8], [9]. Various issues and pesters are there in versatile figuring system. The standard issues are security, low figuring point of confinement, constrained control, signal instigating effect and hand-off deferral.

The structure adaptability is reliably utilized in the correspondence and internet providers in any case these media transmission shows are not reasonable for the internet of things (IOT)[11]. IoT or what's more suggested as IP-enabled wireless sensor network (IP-WSN) has become a rich locale of research. The shows for low power sensors have been considered and developed, while the size of these applications is enormous, gadget limits, especially to the degree battery life and centrality attainability are limited. In tinier media transmission contraptions are equipped with battery-filled batteries and it may be satisfactorily reestablished. A basic piece of the sensors in IOT are not effectively battery-filled or available. Controlling protocol for low power/lossy networks [12] is an IPv6-based sifting through show unequivocally anticipated lossy conditions and asset obliged displayed gadgets. RPL drives a bundle vector sifting through check. To disseminate the hugeness of contraption focus focuses, the sifting through show first wholes gadgets into packs subject to various highlights, for example, excellent ways from base station, information/message length and information saw from the earth in the present epoch.Due to RPL its presentation become uncovered against within perils. During trap on sensor focus focuses it might make un-improved ways, much consistently overhead, and more pack crashes [13].

CORPL is Cognitive and Opportunistic Routing Protocol for Low power and Lossy Networks on a basic level Radio condition. It's a rising technique and in not removed future academic radio anticipates that an essential movement in machine should machine correspondence [14]. It uses a deft sending approach that guarantees security to Pus likewise as satisfies the utility necessities of the optional system. An expansive estimation is done on TCP over RPL in an IPv6 and IEEE 802.15.4-based LLN [15]. CORPL have the upside of keeping up the beginning forwarder set, to pick the going with weave, so as to lessen the power use during the range seeing and insistence of ricochets. The focal make in RPL is a destination oriented directed acyclic graph (DODAG). RPL is group vector controlling show; it was drafted by IETF (Internet Engineering Task Force) with a decisive target of low power and lossy networks (LLNs). The control messages are utilized to keep up a structure in RPL. The standard Linux TCP have trade information with different presented TCP has through a LLN of multi-weave tree topology worked by RPL [16].The Internet Engineering Task Force (IETF) has systematized the Internet Protocol translation 6 (IPv6) over IEEE 802.15.4 for low power a remote individual zone plan (LoWPAN) as 6LoWPAN show. The 6LoWPAN sensor focus focuses are considered as short range correspondence explicit territory sort out pieces with low power use. The IOT course of action will be snappy and solid. The domain based flexibility structure will fortify for 6LoWPAN WSN used to reduce the deferral and pack hardship [17]. In 6LoWPAN, the low preparing most extreme sensor focus point or Reduced Function Device (RFD) needs to send information get-togethers, it from the earliest starting point sends the gatherings to Full Function Device (FFD). The FFD goes about as switch, it will push the information bundles ricochet by impact to the section. The 6LoWPAN passage will drive the information packs to the target IP connected with contraption by utilizing the IP address. Co-RPL is an improvement of RPL [18] subject to the crown part that supports the flexibility to squash the issue. The X-Machiavel show is utilized for a fixed sensor foundation [19]. MoMoRo liberally assembles neighborhood data and use a estimator to make interface quality estimations. This estimator dependably reconfigures its edges, and permitting MoMoRo to feasibly acclimate to changing channel conditions [20]. The key responsibilities are:

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ORPL brings opportunistic routing to RPL, focusing on low-latency, reliable communication in duty-cycled networks. ORPL centers around giving a low-power work that underpins any-to-any traffic with discretionary examples. The choice of the following bounce is finished during the transmission. The bunch hubs will moves with a group area, the control messages are just can traded between neighbor hubs. It decreases the energy consumption, mobility, cost and delay.

The cluster head (CH) process was done by hunting search based decision making algorithm. For group of nodes one node will be selected as CH with the help of energy efficiency basis and it includes the location information based on the destination address. The cluster head will change automatically based on node energy.

- In this we have proposed a ORPL protocol uses back track searching algorithm for congestion prediction and selection of optimal links to manage user mobility.
- The nodes will loss energy while transmitting packet from transmitter to receiver. Both sender and receiver node will have some losses in energy. To overcome this, we have choose the CH selection method.
- It will verify the node energy after each data transfer between sender and a receiver node.
- This was implemented in Network Simulator (NS2) tool and analyzes the performance as energy consumption, delay, overhead and packet delivery ratio.

The remaining part of the paper is sorted out into six sections. The related work is given in the second section. The major problem and the system model are given in the third section. The detailed study proposed protocol is given in the section four. The simulation result and the result analysis is given in the section five. The conclusion of the paper is given in the section six.

2. RECENT WORKS

Barcelo et al. [21] have proposed co-operative RPL-based structure (CPRL) to control monstrousness edge tradeoff. This sort of structure used a silly nature of center centers; it made an utility most uncommon that considers the tradeoff between inside point execution and its criticalness use. The game plan of the response for WSN supported effort issue is on a tremendously chairman level identifying with certain prisoner's trouble game.

Sanshi et al. [22] have proposed an Enhanced Mobility Routing Protocol for wireless sensor network (EM-RPL), it joins modules to connect with the minimization to center focus interests. EM-RPL will used to build up the structure lifetime and its centrality advantage by picking its course.

Shafique et al. [23] have proposed IETF it to be used for see an inside ambushes in IOT. The dangerous center point is enveloped by ambushes in sensor center point even it depends around low power use.

Sanshi et al. [24] have proposed an improved withdrawing through show up for LLNs (ERPL), it underpins Preferred Parent (PP) of the Mobile Node (MN) sharp and the MN move far from the past picked PP.

Barcelo et al. [25] have proposed a Kalman Positioning RPL (KP-RPL) for WSNs with both fixed and versatile centers, in setting on RPL. The KP-RPL is used to give ludicrously hot and solid controlling, mulling over the filtering through goofs and center point disengages make, truly, WSNs.

Kim et al. [26] have investigated the store changing and blockage issue of RPL. The social gathering burdens will happen just on basic traffic are a clever surrendered delayed result of blockage, and a considerable weight trading issue appears in RPL to the certificate planning watch support.

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Hashemi et al. [27] have indicated a Dynamic and Comprehensive Trust Model for IoT (DCTM-IoT) it used to get together with RPL (DCTM-RPL). This procedure is used in IoT, which has another estimation vision. It was endeavored and surveyed byCooja emulator over Contiki 3.0 OS and secluded and related shows. Goyal et al. [28] have proposed stream Algorithm and has been adjusted with achieve better power and centrality use. This check is used for code spread and upkeep in remote sensor structures. The stream check in RPL is used to lessen the control traffic overhead by limiting the time into between times. By using stream estimation it builds up its sending level of the control messages. It makes its sending level of the control messages if an inconsistency plainly picks it quickly else it decreases its sending degree by exponentially expanding its window size.

Bahramlou et al. [29] have present A-Timing model (A-RPL) is verified into a Distributed Computing technique (M-RPL) to attract the control plane traffic and control the stop up. A structure of remote sensor framework to help traffic preparing for both unicast and multicast traffic is an upsetting issue.

Sanmartin et al. [30] this used to execute the objective work in filtering through show RPL. RPL controlling discovering that makes and keeps up destination oriented directed acyclic graph (DODAGs).

3. PROBLEM AND SYSTEM MODEL

3.1 Problem Definition

Fotouhi et al. [31] have proposed a mobility management framework (mRPL+) it simplify two hand-off models are hard hand-off. The MN ought to consider sort out circumstance during and after a hand-off technique close by off models. Before looking through new affiliation the past reduced focus guide needs toward break an affiliation and need to pull back from the present one. The mRPL+ is united in the 6LoWPAN/RPL stack in a regressive faultless way. The mRPL+ is fast and solid flexibility support in RPL. The mobility approach, in context on a hand-off part, keeps the standard RPL show unaltered, while equipping in reverse resemblance with the standard execution. The outcome displays a structure with minimized focus focuses, pack development degree with mRPL+ is for all intents and purposes 100%, where RPL accomplishes 80% in best case.

In sharp city applications have phenomenal and dynamic adaptability conditions that merge a static and dynamic smaller focuses, these middle focuses can move in various way with different speed controls, this sort of mobility largy impacts directing and it would by and large have the option to isolate the presentation of the system. So as to fulfill the system necessities of livelihoods with such unprecedented adaptability lead, it is basic to have an incredible controlling show that can oblige this sort of transportability and fulfill the referencing prerequisites of these applications. The pass on depends upon estimation overhead structures direct with the measure of neighbors and the taking a gander at rehash. A couple of systems was proposed to help adaptable multi-jump remote structure to lessen a degree overhead. This makes mRPL+ particularly wasteful and possibly incredible in reduced conditions.

Contributions

This paper proposed, the system has proper execution of IOT in WPAN condition. To address the above issues, we have proposed an OPTIMAL ENERGY EFFICIENT IN MOBILITY MANAGEMENT (ORPL) show up for 6LoWPAN. The noteworthy inspiration driving the proposed structure in ORPL show is used to control the deferral and social event hardship. The proposed ORPL show joining two hand-off models are hard and soft hand-off.

- The first commitment of proposed ORPL show is to familiarize the get-together subject with fake green headway improvement count. A get-together part moves inside a pack space, the adaptability

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handover is performed inside the gathering zone and the control messages are simply swapped between neighbor center core interests. It diminishes the centrality usage and convenience handover cost, delay.

- Second, we present the Hunting look based fundamental position mean CLUSTER HEAD (CH) figuring process. CH address consolidates the zone information reliant on the objective zone the sorting out course landing at the objective CH can be thusly worked without organizing revelation.
- Moreover, proposed ORPL show uses back track filtering estimation for stop up need and affirmation of perfect accomplices with supervise customer transportability.
- Finally, the proposed ORPL show is done in NETWORK SIMULATOR (NS2) mechanical assembling and analyzes the presentation as essentialness use, hand-off deferral, overhead and pack transport rate.

Simulation setup: We consider lattice sending of 12 APs and a root hub. The root hub gathers the information created by the MN, sent in 8 m × 20 m room size, and the information is sent through processed ideal connection. The speed of the MN is constrained to the scope of human walk speed: from 0.5 m/s to a 2 m/s.

3.2 System Model

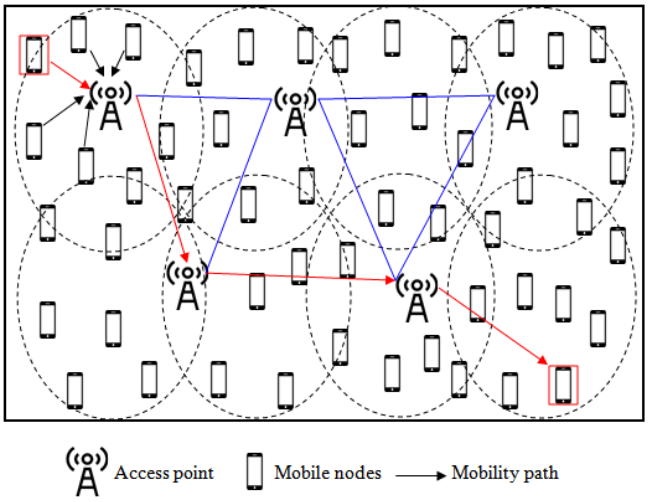

FIGURE 1: SYSTEM MODEL

The Figure 1 shows the system model. The IoT based WPAN is given the Figure 1. The network consists of clusters and in each cluster there are cluster head. The network consists of access point, mobile nodes and the mobility path. The data are transmitted through the optimal path. Versatile hubs should move unreservedly, while keeping up their availability by means of a fixed infra structure through hand-off.

4. PROPOSED ALGORITHM

4.1 Artificial Algae Optimization Algorithm for Clustering Process

4.1.1 Clustering Process

Different parameters are used to perform bundling. The usually used parameters are bundle between within centers, holding up giganticness of a center point and accessibility. The proportion of neighbors and remaining centrality of a center are two parameters used here. Thusly evidently the social event is incorporated using two parameters called number of neighbors. Subordinate upon the degree of transmission stretch out and the near centers the neighbor center is picked. The neighbor center point is requested ward upon the SNR regard satisfied by the reference point. The gathering kept subject to sift through achieves the course of action of center concentrations in the get-together which are various ricochets limited; still it shapes a social gathering. In any case, this is obviously not a suitable response for the gathering movement as the multi ricochet get-together will exhaust progressively significant

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criticalness. Starting now and into the foreseeable future rather than incorporating multi ricochet the better outline is the single skip neighbor and structure a pack. Another parameter that impacts the get-together is the holding up essentialness. A bit of the time within with high extra centrality is considered as a get-together head. In any case, the pack head isn't picked as subject to the holding on centrality for keeping up criticalness weighty correspondence. By and large if the rest of the imperativeness is high, by then the transmission range and SNR with respect to various centers will be more and along these lines the probability of breaker of such center concentrations in the gathering is more. Consequently unmistakably the holding up imperativeness is a standard factor for picking number of neighbor centers.

The computational oddness can be decreased by convincing the proportion of pack heads which are talking with the IoT contraptions in upper layer. The proportion of neighbor center centers is agreed to each sensor center I is given by:

$$N_c(i)=\sum_{j=1}^{k} X_j \tag{1}$$

where $X_j=1$, if node j is within the radius of transmission range with desirable SNR and $X_j=0$, otherwise. The power loss is equal to the d^2 in the free space and d^4 in the case of multipath fading and d indicate the distance. For sending m bits message over distance d is calculated by:

$$T_{ex}=m\times\left(E_{ele}+\varepsilon_{fs}+d^2\right) \text{ if free space} \tag{2}$$

$$T_{ex}=m\times\left(E_{ele}+\varepsilon_{amp}+d^4\right) \text{ if multipath} \tag{3}$$

The radio expends for receiving m bits of information is given by:

$$R_{ex}=m\times E_{ele} \tag{4}$$

For sensor node i the residual energy is given by:

$$RE(i)=E_0(i)-\left(T_{ex}(i)+R_{ex}(i)+E_{com}(i)\right) \tag{5}$$

where E_0 is starting energy of the node and E_{com} is the amount of energy consumption in local processing while running cluster head selection algorithm on separate nodes.

4.1.2 Algae algorithm

Algae: generally the term green advancement suggest an alternate get-together of photosynthetic eucaryotes. Green advancement incorporate a discrete focus, and chlorophyll, this will assist them with joining their own unique sustenance material from CO2 and H2O. Phytoplanktons are the unicellular green improvement (microalgae). Notwithstanding, the multicellular green advancement (macroalgae) references kelp with 1m length. Marine, freshwater and normal natural systems are nature in which green improvement leave. They can in like way get by in the marvelous conditions likes ordinary springs and saline course of action lakes. Green photosynthetic concealing called chlorophyll is open in the Algae. This green photosynthetic concealing is available in chloroplasts and a part of the time disguised or for the most part spread by different shades. It is encompassed in the existences of light consolidate CO2 and H2O to shape starch or related substance and at the same time discharge oxygen.

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Algal growth characteristics: to know the growth rates of microbial biomass batch tests, i.e., the growth rate per unit of biomass is given by:

$$\frac{dx}{xt} = \mu x \qquad (6)$$

where dx/dt is the modification in biomass per unit time; x is biomass obsession, t is time, d; is express progress rate, 1/d. In the event that there ought to emerge an event of high event illuminance, the spiting of ordinary covering until all phones is kept up above light inundation. Absolutely when the cell obsession expands other than the light held perspectives 100% and relentless centrality pay of the lifestyle is reflected in a straight development in cell entire which shows dx/dt is obvious. Whatever the scene enlightening, the convincing light will over the long haul approach a value, a compensation point for advancement, and the extent of cells in the lifestyle will push toward a biggest. The trademark movement making is routinely portrayed by the Monod work which relates as a piece of substrate center:

$$\mu = \frac{\mu_{\max} S}{K_s + S} \qquad (7)$$

where max is the most astounding express improvement rate (1/time), and Ks is the substrate submersion pushing ahead (mass/volume). Under conditions, where fulfilling light and nitrogen are available, the progression pace of green improvement will be obliged by the level of inorganic carbon (firm inorganic carbon or constrained CO2) open.

Light and Algae: Light is customarily studied as irradiance passed on as the level of photons, or the level of centrality, per unit zone per unit oftime. Green advancement, being photosynthetic, have gigantic degrees of shades, which in like way square light attack. Algal biomass creation is usually bound by light and progress of microalgae is looked with issues of light diminishing and the light collecting most remote point. In very much blended thick social ideas of microalgae, where light fixing happens a few centimeters underneath the way of life surface and light dissipating inside the reactor isn't homogeneous, standard light force must be considered, as the green improvement change. As light enters the fluid surface, its capacity is diminished exponentially with centrality. This exponential nature guarantees that, even incredibly central groupings in the irradiance will have little effect on the importance of light interference. In like way, light-obliged improvement rate will be normally picked per unit surface.

Artificial Algae Algorithm (AAA): Artificial green advancement identify with every system in the issue space by romanticizing the characteristics of green development. Like the guaranteed green advancement, fake green improvement can push around the wellspring of light to photosynthesize with helical swimming, and they can adaptto the earth, can change the general species and can repeat by mitotic division. Everything considered, the lack of regard was made of 3 key parts called "Developmental Process", "Change" and "Helical Movement". In the estimation, green improvement are the key genera. Accurately when a particular algal cell is coursed to pass on two new algal cells, they live adjoiningly, and when these two are separated, the new four cells live uninhibitedly, etc. Algal settlement acts like a particular cell, moves together, and cells in the state may hang wretchedly under denied life conditions. An outside force like a shear power or some messed up conditions may spread the state, and each dispersed area a little while later become another district as life continues. The state existing at the ideal point is named as the settlement of required states and it is made out of the ideal algal cells.

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$$P_c = \begin{bmatrix} X_1^I & \cdots & X_1^D \\ \vdots & \ddots & \vdots \\ X_N^I & \cdots & X_N^D \end{bmatrix} \quad (8)$$

$$P_{c_i} = \begin{bmatrix} X_i^1 & X_1^2 & \cdots & X_i^D \end{bmatrix} \quad (9)$$

The algal cell in j[th] dimension of the i[th] algal colony is given by X_i^j .

The size of i[th] algal colony in time t + 1 in Monod equation is given in the following equation:

$$G_i^{t+1} = \mu_i^t G_i^t \quad (10)$$

where i = 1, 2, ……N, G_i^t is the size of i[th] algal colony in time t, N is the number of algal colonies in the system.

$$B^t = \max G_i^t \quad (11)$$

$$S^t = \min G_i^t \quad (12)$$

$$S_m^t = B_m^t \quad (13)$$

where i = 1, 2,… ..N and m = 1, 2,… … .D and D show issue measurement in greatest is the greatest algal settlement and littlest is the littlest one. Algal states are arranged by their sizes in time t. In any haphazardly chosen measurement, algal cell of the littlest algal province kicks the bucket and algal cell of the greatest settlement repeats itself.

Adaptation Algal: The artificial alga having the most noteworthy starvation esteem has adjusted.

$$ST^t = \max A_i^t \quad (14)$$

$$ST^{t+1} = ST^t + (B^t - ST^t) \times rand \quad (15)$$

Where A_i^t is the starvation (ST) value of i[th] algal colony in time t, ST[t] is the algal colony with the more starvation value in time t.

Helical movement:

Algal cells and settlements all around swim and attempt to stay close by to the water surface in setting on lovely light for continuation is open there. They swim helically in the liquid with their flagella which give progress ahead that is constrained by gravity and the thick drag. Developments of algal cell waver. The improvement of an algal cell is helical everything considered actually. In AAA, the gravity keeping the development is appeared as 0 and gooey drag is appeared as shear control, which is standing out from the

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size of algal cell. It is fit as a fiddle and its size is its volume in the model. Thusly, pulverizing surface changes into the surface zone of the side of the equator.

$$\tau(x_i) = 2\pi r^2 \tag{16}$$

$$\tau(x_i) = 2\pi\left(\sqrt[3]{\frac{3G_i}{4\pi}}\right) \tag{17}$$

where (x_i) is the friction surface. Three dimensions for the helical movement of the algal cell are determined randomly.

Algorithm 1 Artificial Algae Algorithm for Cluster Process

Input	Energy loss, adaptive parameter, distance
Output	Clustering Process
1	Objective function $f(x) = x_1, x_2, \ldots\ldots x_d$
2	Initially the algal colonies consist of n population and calculate size(G) of n algal colonies.
3	Parameters like loss of energy and adaptation parameters are initialized.
4	While(t < Max_Calculation)
5	Calculate the energy(E) and friction surface (τ)
6	For i = 1:n ST is true
7	While ($E(x_i) > 0$) Select j for all the solutions. Select randomly three dimensions to helical movement k, l and m. Use the equations 18, 19, 20
8	α, β are the random angles and its range is given by [0, 2π] and ρ is the random value ranges from [-1, 1]
9	New solution is calculated by: $E(x_i) = E(x_i) - \frac{\varepsilon}{2}$ energy loss caused by movement
10	If $E(x_i)$ is better the update algal colony I and ST is false
11	else $E(x_i) = E(x_i) - \frac{\varepsilon}{2}$ energy loss caused by metabolism end if
12	end while
13	if ST is true, increase ST $A(x_i)$ end if
14	end for
15	Evaluate size (G) of population Reproduce r by using one dimension
16	$S_n^t = B_n^t$
17	If rand < A_g $ST^{t+1} = ST^t + (BT^t - ST^t) \times rand$
18	End
Return	Clustering Process

The algorithm 1 shows the artificial algae algorithm. The equations are given below:

$$X_{im}^{t+1} = X_{im}^{t} + \left(X_{jm}^{t} + X_{im}^{t}\right)\left(\Delta - \tau^t(x_i)\right)p \tag{18}$$

$$X_{ik}^{t+1} = X_{ik}^{t} + \left(X_{jk}^{t} + X_{ik}^{t}\right)\left(\Delta - \tau^t(x_i)\right)\cos\alpha \tag{19}$$

$$X_{il}^{t+1} = X_{il}^{t} + \left(X_{jl}^{t} - X_{il}^{t}\right)\left(\Delta - \tau^t(x_i)\right)\sin\beta \tag{20}$$

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4.2 Hunting Algorithm used for Cluster Head Selection

4.2.1 Cluster Head

IoT based arrangement every sensor place is related with discrete IoT contraptions. Since the WSN joins different focus communities, the IoT plan should meld number of IoT contraptions. The advancement of the sensor community point is to watch and send the data to the concerned IoT gadget, which by then offers it to the IoT base station. The basic estimation build up that the contraption can change the data is inside Lm and Ln in meters. Right now, pack head ought to be picked among three get-togethers that contain a couple IoT gadgets. As necessities be, the three picked contraptions are tended to as A, B, and C, which assembles data from different gadgets and move the data to the IoT base station IB. For the most part talking, right now, stores of the structure are tended to as CIn and the social affair head is tended to as HIn. More to the point, Dmn signs the section between the mth gadgets to the nth contraption and DHIB proposes the separation between the party head and the base station.

Get-together Head Selection: when all is said in done, the pack leader of the WSN is picked subordinate upon the parameters, for instance, fragment, deferral, and criticalness. As opposed to in IoT engineer, it is key to think about the parameter of the IoT contraptions. Since, the WSN is associated with the IoT contraptions; it is required to consider both the store and temperature of thedevices. With everything considered, bunch head affirmation process depends on the parameters, for instance, division, delay, criticalness, weight, and temperature of the IoT contraptions. Truth be told, the package, deferral, weight, and temperature of the contraptions should be low and the significance should be more. The objective uttermost ranges of the major relies on the acceleration work that is showed up in Eq. (21), Eq. (22), and Eq. (23), where (β, γ) is the persisting that appoints the fixed worth (0.9, 0.3).

$$OF_1 = O_f^E \frac{1}{O_f^L} + O_f^E \frac{1}{O_f^{temp}} \tag{21}$$

$$OF_2 = \beta \frac{1}{O_f^d} + (1-\beta) OF_1 \tag{22}$$

$$OF_3 = \gamma OF_2 + (1-\gamma) \frac{1}{O_f^{delay}} \tag{23}$$

In Eq. (24), the numerator esteem speaks to the quantity of group heads in a specific system and the denominator means the complete number of IoT gadgets.

$$f_d = \frac{Max_{q=1}^{Hin}\left(H_I^q\right)}{N} \tag{24}$$

4.2.2 Hunting Search Based GSA for Cluster Head Selection

The proposed figuring used in pack head affirmation techniques of the IoT sort out is a blend of GSA and ABC estimations. The standard GSA figuring reestablishes the position and speed of the directors until it lands at the ending constraint. Of course, the proposed count applies update framework for used bumble bee time of ABC figuring. The speed revived using the likelihood of ABC estimation is given in Eq. (25),

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where $V_m^d(t)$ represents the current velocity of the particular agent, $V_n^d(t)$ represents the velocity of the neighborhood agent, and φ_m represents a random number between [-1, 1].

$$V_m^d(t+1)=V_m^d(t)+\varphi_m\left(V_m^d(t)-V_n^d(t)\right)+A_m^d \quad (25)$$

The algorithm 2 shows the pseudo code for the hunting algorithm. the hunting algorithm is used find the cluster head.

Algorithm 2 Hunting Algorithm for Cluster Head selection

Input	Energy loss, adaptive parameter, distance
Output	Cluster Head
1	Generate the population of the agents m ¼ 1; 2.....N
2	For all m, Calculate mass M, g(t), B(t) and W(t)
3	Compute the initial position $z_m^d(t)$ and velocity $v_m^d(t)$ of all agent
4	Compute the fitness function of all agent
5	Identify the k_{best} agent
6	For each agent the force is calculated using the equation $F_m^d(t)=\sum_{ne k_{best}, n\neq m} rand_n F_{mn}^d(t)$
7	Calculate acceleration $A_m^d=\frac{F_m^d(t)}{M_{mm}(t)}$
8	Update velocity of the agent using the equation (25)
9	The position of the agent is updated using $Z_m^d(t+1)=Z_m^d(t)+V_m^d(t+1)$
10	Compare upto best solution is obtained
Return Cluster Head	

4.3 Back Tracking Search Algorithm for Mobility Management

4.3.1 Congestion Control and Prediction

Congestion Prediction: Right now, applied exponential smoothing, which is one of the most strong time-course of action figure models. Its key favorable position over shorter mprediction was suitably utilized for WSNs to help in way choice to keep away from clog in thought ofbuffer inhabitance. Conditions (3) to (5) show the exponential smoothing determination:

$$\hat{Z}_t(i)=\frac{S_t}{W_t} \quad (26)$$

$$S_t=\sum_{\gamma=0}^{t-1}\alpha_\gamma Z_{t-\gamma} \quad (27)$$

$$\hat{Z}_{t-\gamma}=(1-\alpha)Z_t+\alpha\hat{Z}_{t-1} \quad (28)$$

Where $\hat{Z}_t$ is the anticipated an incentive at time t (support), Wt indicates a geometric arrangement, and α is a given consistent (smoothing factor) in the scope of 0.02 and 0.3. Condition (6) tells the best way to infer the anticipated cushion, in particular, BO over $\hat{Z}_t$.

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$$BO_{t+1}=(1-\alpha)BO_t+(\alpha)BO_{t-1} \tag{29}$$

4.3.2 Backtrack Search Algorithm

The weighted graph is given by (V, E) where $V = \{1, 2, 3, \ldots, n\}$ is the vertex set, $E = \{e_{ij} = (i, j) \mid i, j \in V, i \neq j\}$ /is the edge set. d_{ij} $(i, j \in V, i \neq j)$/is the weight of vertexes i to j, where $d_{ij} > 0$ and $d_{ij} \neq \infty$; while d_{ij} and d_{ji} may be unequal, $V' = \{1', 2', \ldots\ldots n'\} \in V$. The next step is to find the sequence $A = \{a_1, a_2, a_3, \ldots, n\}$ within a given time, where s is beginning point and t is the goal, s, $t \in V$ and s, t do not belong to V', all of the elements in V' must show up in arrangement A, making the total of the loads of all edges of the way framed in grouping A insignificant, and circle isn't permitted in any way. The scientific model of the issue is characterized as follows. Under the state of Time = t, solve $\min C = \sum_{i \neq j} d_{ij}$, in request to characterize the starting point s and the objective t and ensure that there's just one in-edge and out-edge on every vertex with the exception of the edges of starting point and the objective ways; we make the accompanying conditions:

$$X_{ij} = \begin{cases} 1, edgee_{ij}\ is\ along\ the\ result\ path \\ 0, edgee_{ij}\ is\ out\ the\ result\ path \end{cases} \tag{30}$$

where X_{ij} is an integer of 0 or 1, 1 represents edge e_{ij} on the result path, and 0 represents edge e_{ij} out of the result path, and $X_{ij}$is used to calculate the weight of the outcome way.

$$\sum_{i \neq j} X_{ij} = 1\ j \in V' \tag{31}$$

where $i \neq j$ implies that the outcome way can't contain the edges that the beginning hub and the end hub are a similar hub, which implies the point in the moderate hub set on the outcome way can just happen once and must happen once.

$$\sum X_{sj} = 1, j \in V, j \neq s \tag{32}$$

The equation characterizes an edge that starts with the beginning hubs which ought to show up in the outcome way, and the beginning hub in the edge can't be the end hub.

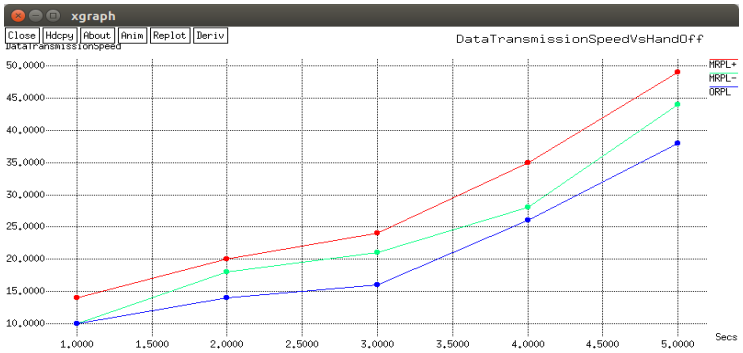
$$\sum X_{js} = 0, j \in V, j \neq s \tag{33}$$

The recipe limits that the beginning hub s must be the beginning hub in an edge, and it can't be some other sort of hubs, for example, end hub or middle of the road hubs.

$$\sum X_{it} = 1, i \in V, i \neq t \tag{34}$$

The recipe limits that the outcome way should have an edge finished with the end hub t, which implies the edge can't begin with the last point t.

$$\sum X_{ti} = 0, i \in V, i \neq t \tag{35}$$



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The equation limits that the subsequent way can't contain the edge starting with the end hub t; that is, the end hub t must be utilized as the last hub on the subsequent way.

$$\sum_{i,\, j \notin V} X_{ij} = |A| \tag{36}$$

This equation characterizes the quantity of edges on the subsequent way which can be the quantity of hubs short one; that is, the subsequent way can't show up with irrelevant edges and circles.

Algorithm 3 Advanced Backtracking Algorithm for Mobility Control

Input	Energy loss, adaptive parameter, distance
Output	Clustering Process
1	node = start
2	while usedtime < t && (node! = end &&!A' ε node)
3	nodes.add(node)
4	record information include route and weights
5	for i = 1 to children.length
6	add search rule
7	improvedackrack(children[i])
8	if result! = null - B
9	return result and weigh
10	else return NA

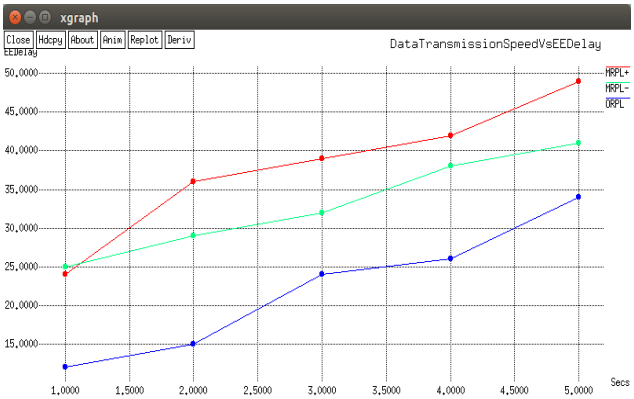
Return Mobility Control

5. RESULTS and DISCUSSION

The simulations are performed using NS2 simulation environment. The analysis is performed for the parameters like hand-off delay, packet delivery rate, and overhead and energy consumption. For the analysis purpose grid deployment of 12 APs and a root node are considered. The data generated by the MN is collected by root node and it is deployed in 8 m × 20 m room size. By using the optimal link the data is transmitted. The speed of the Mobile Node (MN) is constrained to the scope of human walk speed: from 0.5 m/s to a 2 m/s. The simulations are carried out with metrics for both proposed protocol and existing.

5.1 Analysis Based on Data Transmission Speed

Figure 2: Data Transmission Speed with HandOff



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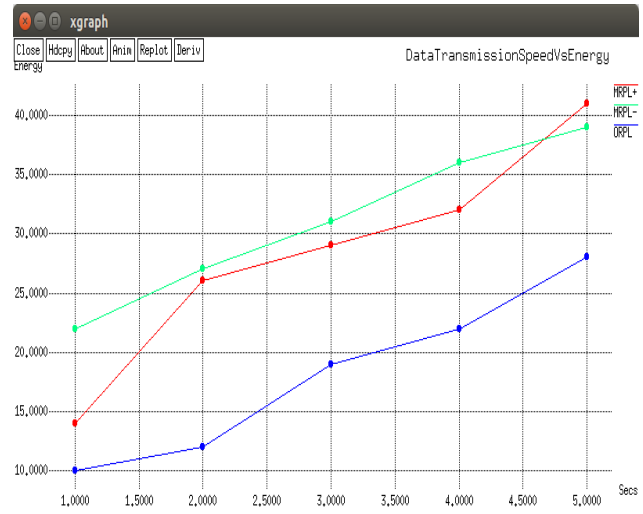
The analysis of the parameters like delay, energy, handoff, overhead and delivery ratio with data transmission speed is described. The Figure 2 shows the delay analysis. It is found that the proposed ORPL is having low delay as compared to the MRPL+ and MRPL-. The Figure 3 shows the energy analysis with the data transmission speed. The energy consumption of the proposed protocol is low as compare to the existing protocols. The Figure 4 shows the handoff delay variation with respect to the data transmission speed. The proposed ORPL protocol is having low handoff delay as compared to the existing protocol. This will increase the data transmission speed. The Figure 5 shows the overhead analysis with respect to the data transmission speed. The proposed ORPL has low overhead which allows the smooth transmission of data. The Figure 6 shows the delivery ratio analysis with data transmission speed. From the analysis it is clear that the delivery ratio is high for the proposed ORPL protocol. As the delivery ratio is high then the maximum packet will properly have delivered.

Figure 3: Data Transmission Speed with Delay



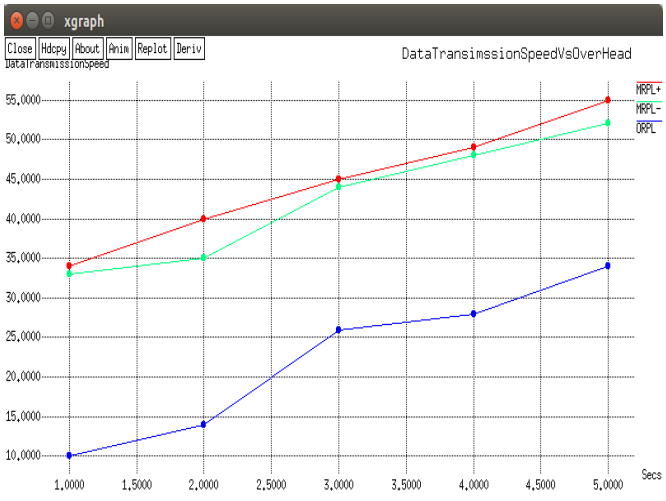


Figure 4: Data Transmission Speed with Energy

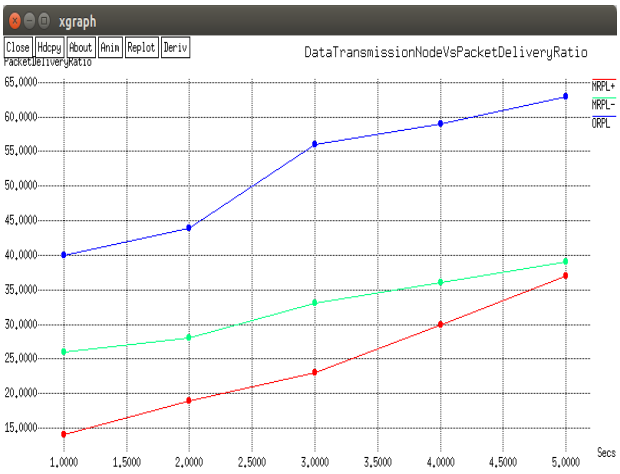


Figure 5: Data Transmission Speed with Overhead

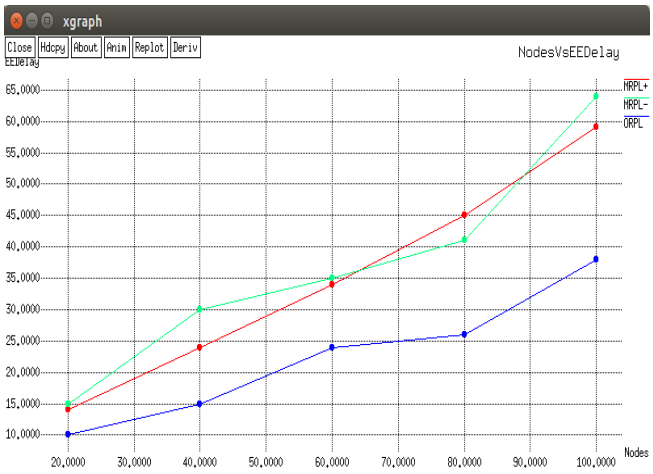


Figure 6: Data Transmission Speed with Deliver Ratio

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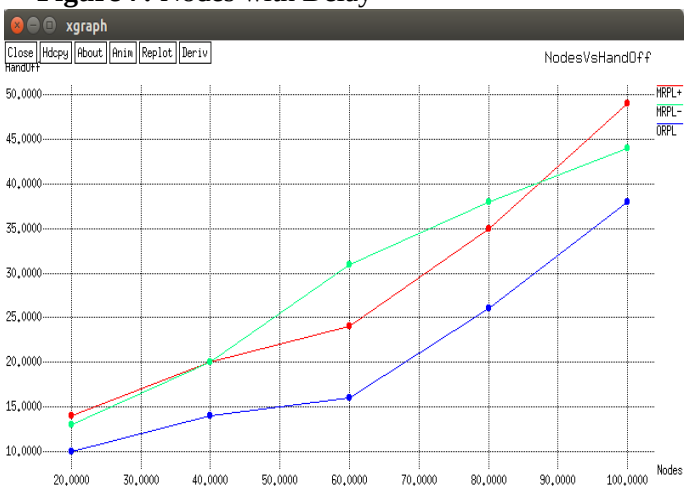
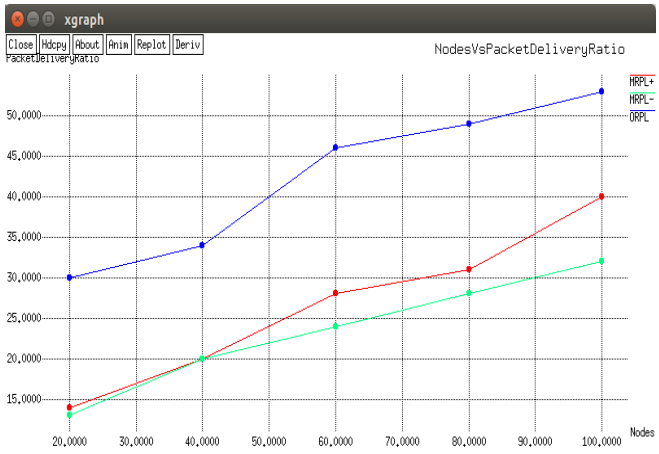
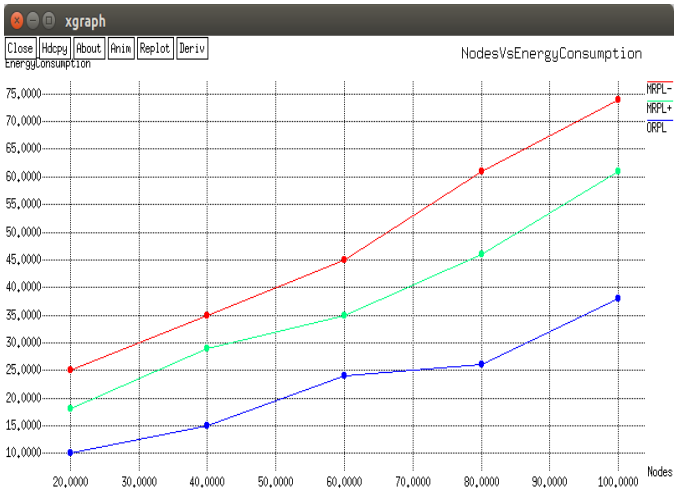
5.2 Analysis Based on Node Analysis

The analysis of the parameter by varying the number of node is given here. The Figure 7 shows the analysis of delay with number of node. The delay in the proposed ORPL protocol is low as compare to the existing protocol. The Figure 8 shows the analysis of energy consumption with number of node. The energy consumption for the proposed ORPL protocol is low which will helps increase the life time of the network. The Figure 9 shows the analysis of the handoff delay by varies the number of node. The handoff delay is low for the proposed protocol. As the handoff delay is low it will improve the data transmission speed. The Figure 10 shows the over head analysis regarding the quantity of node. The proposed ORPL protocol is having low overhead value. This will improve the performance. The Figure 11 shows the analysis of the pack delivery ratio. The packet delivery ratio is high for the proposed ORPL protocol. Then the transmitted packet will properly receive at the destination node.

Figure 7: Nodes with Delay







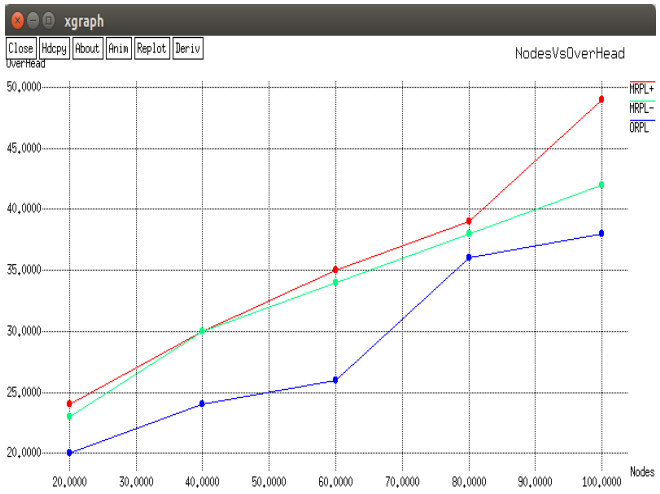


Figure 8: Nodes with Energy Consumptions

Figure 9: Nodes with Handoff

Figure 10: Nodes with Delivery Ratio

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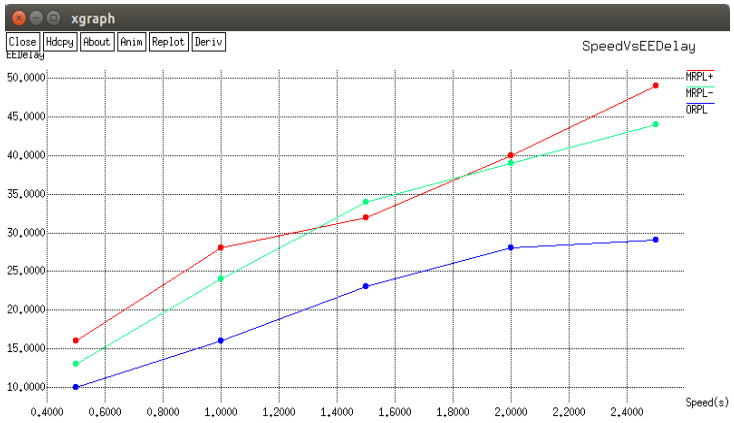
Figure 11: Nodes with Overhead

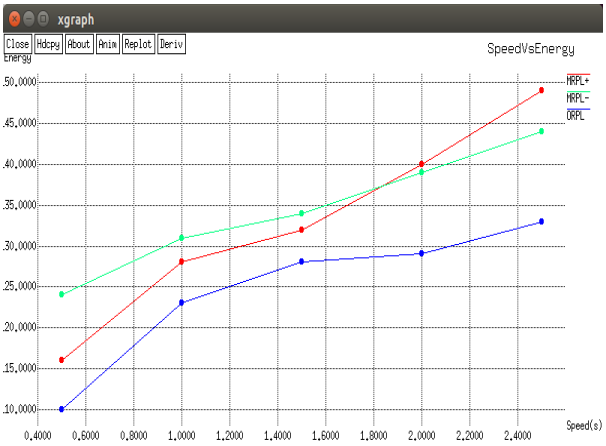


5.3 Analysis based on the Speed

The parameters are varied with respect to the speed. The Figure 12 shows the analysis of delay in the network with speed. The delay in the proposed ORPL is low when contrasted with the existing protocol. The Figure 13 shows the energy consumption analysis of the system with speed. The energy consumption is low for the proposed protocol. The Figure 14 shows the analysis of handoff delay variation with speed. The handoff delay is less in the proposed ORPL protocol. The Figure 15 shows the analysis of overhead with respect to the speed. The overhead is less in the proposed protocol as compare to the existing protocol. The Figure 16 shows the analysis of delivery ratio. In the proposed protocol the delivery ratio is high it will improve the speed of data transmission.

Figure 12: Speed with Delay**Figure**

13: Speed with



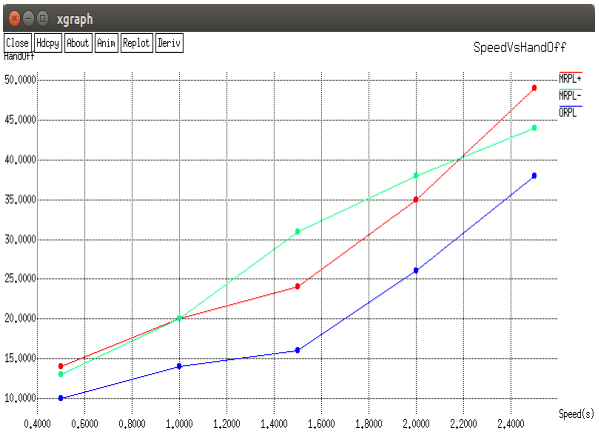


Figure 14: Speed with Handoff

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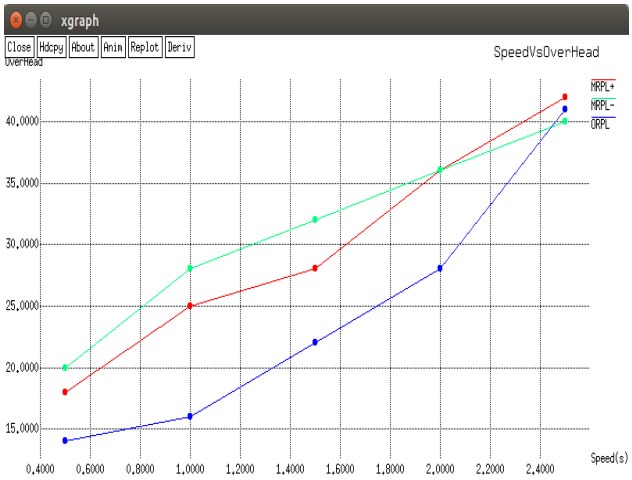
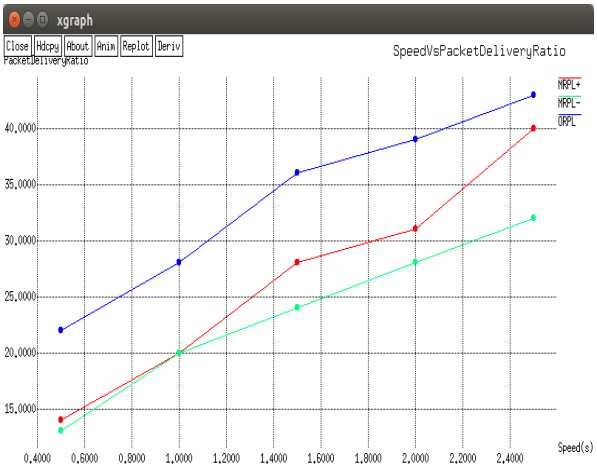
Figure 15: Speed with Overhead

Figure 16: Speed with Delivery RatioEnergy





6. Conclusion

IoT is used for the diverse areas like industries and smart home, hospitals etc. In this paper IoT for WPAN is taken as the application. Different challenges are there in the WPAN and here we are taking the mobility as major problem. Thus to maintain proper mobility in WPAN environment a novel protocol called optimal energy efficient mobility management (ORPL) for 6LoWPAN is proposed. The proposed protocol is mainly used to decrease the handover delay and packet loss. The proposed ORPL protocol is used in hard and soft hand-off. The simulation is performed in NS2 environment. Three different scenarios like data transmission speed, number of nodes and speed are taken. From the analysis it is clear the parameters like delay, energy, handoff delay and overhead are low for the proposed protocol. Similarly the delivery ratio is high for the proposed protocol.

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