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Energy Management in Mobile Ad Hoc Networks with Innovative Protocol TDQR CNFPQR and Bird Optimization Technique

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Abstract: It is impossible to stress the importance of a Dynamic Wireless Ad Hoc Network (MANET) for message path dependability and permanence. Data sharing is a vital activity in a mobile ad hoc network because packet loss occurs when nodes fail or are missing during data transfer. When a packet is lost, it can be subject to various infractions. To overcome this problem, a new algorithm was created known as TDQR CNFPQR (Trigger-Based Distributed QoS Clustered Node Failure Prediction QoS) Protocol. The MBO method analyses node state to minimize packet losses. In comparison to existing methodologies, our suggested methodology uses less energy, delivers more packets, and has a lower routing burden and higher end-to-end latency. Mobile station users can receive stationary network services offered via numerous jump links even if the network is not immediately available to them. Because wireless networks have limited route capacity, it is critical to react to user requests as rapidly as feasible. Because network nodes have limited energy resources, it is critical to spend as little energy as possible when transferring data across the network. Ad hoc wireless networks are hampered by limited battery power, making energy management a critical concern. Knowledge-based algorithm rule analyses the node's monitoring capabilities at the same time. We can then predict node failure, node longevity, and data exchange along the ideal path without packet loss using Migrating Birds Optimization (MBO).

Keywords: mobile ad hoc network, TDQR-CNFPQR Protocol, Node monitoring, Migrating Birds Optimization, node failure prediction, node lifetime.

具有创新协议TDQR CNFPQR和鸟优化技术的移动特别指定网络中的能量管理

摘要：不可能强调动态无线自组织网络(马网)对于消息路径的可靠性和持久性的重要性。数据共享是移动自组织网络中的一项重要活动，因为数据传输过程中节点发生故障或丢失时会发生数据包丢失。当一个数据包丢失时，它可能会受到各种违规行为。为了克服这个问题，创建了一种新算法，称为TDQR CNFPQR（基于触发器的分布式服务质量集群节点故障预测服务质量）协议。管理层收购方法分析节点状态以最小化数据包丢失。与现有方法相比，我们建议的方法使用更少的能量，提供更多的数据包，并且具有更低的路由负担和更高的端到端延迟。移动台用户可以通过大量跳转链接接收固定网络服务，即使网络对他们来说不是立即可用的。由于无线网络的路由容量有限，因此尽可能快地响应用户请求至关重要。由于网络节点的能源资源有限，因此在通过网络传输数据时，尽可能少地消耗能源至关重要。特别指定无线网络受到电池电量有限的阻碍，因此能源管理成为一个关键问题。基于知识的算法规则同时分析节点的监控能力。

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然后，我们可以使用迁徙鸟类优化(管理层收购)预测节点故障、节点寿命和沿理想路径的数据交换而不会丢失数据包。

关键词：移动自组网、TDQR-CNFPQR协议、节点监控、候鸟优化、节点故障预测、节点寿命。

1. Introduction

A MANET is a collection of two or more devices that communicate over great distances [28], as defined by legislation, as seen in Fig. 1. To offer QoS, the Advanced-Optimized Link State Routing (A-OLSR) protocol is a unique heuristic. To offer QoS, the Advanced-Optimized Link State Routing (A-OLSR) protocol is a unique heuristic [1]. The network allows wireless devices to be implemented at any time and from any location. [2] introduces position-based routing for link service depending on the localization of link failure. Based on the node's willingness to be treated as an MPR, [3] is considered. Generally, wireless paths are worse and more prone to connection losses. [4] is computed using NS 2 in terms of normalized routing load, average end-to-end delay, and path loss-prone PDR. Multiple devices are fully connected after just having access to a point, and the wireless router regularly talks with the network via the router at the same time, and, before proceeding to the next phase, all traffic must pass through the expedited and return to the device on its own. The packet delivery ratio and energy usage in MANETs are introduced in [5] under a general algorithm for routing protocol. Santosh Kumar Das and Sachin Tripathi [6] proposed linear programming methodologies for several purposes, and the recreation principle is built on a flexible and intelligent strength efficient routing system. It is assessed using current techniques in several turns to demonstrate its efficacy in terms of performance values. Prediction based on location QOS Prediction Position the QOS direction-finding mechanism in a dynamic wireless Ad hoc network is determined by the mobile stations. Using the signal intensity of received data packets, [7] proposes a least-square quadratic polynomial regression-based technique for estimating path breakage time. The route failure detection method is also combined in the routing protocol's path maintenance section [8, 9]. By including the lifespan and residual energy among the factors considered by the AODV routing protocol [10–12], it is possible to obtain a decent output in terms of the link stability and link lifetime of the various routes in the link. For calculating the best path, a brand-new, ground-breaking hello-based path recovery (HBPR) routing protocol is introduced [13–15]. The energy consumption of nodes and route failure are assessed. MANETs are also known as ad hoc mobile infrastructures, but wireless ad hoc infrastructures are self-configuring networks that do not require infrastructure. In dynamic environments, link failure and link prediction are exposed in [16-19]. MANET employs a diverse set of applications, including environmental sensors, vehicle ad hoc communication, robots, and so on. A new method to reduce the probability of link failures is implemented by the Markov chain [20-23]. The ability to distribute files without the need for a connection is one of the most important advantages of a wireless ad hoc infrastructure. Dynamic wireless ad hoc network architecture is constantly changing, making the execution difficult at times. A significant proportion of a node failure detection system is involved in pinpoint monitoring, function association, and node affiliation. A new type of clustered novel method is implemented in the military [24, 25]. Wireless nodes move rather than remain stationary because of the nature of a MANET. By remaking the faded or delivering the lot similarly, the network knowledge is expanded, and the daily begins according to the end reduced. Route breakage is caused by mobile node mobility, detection of path availability based on dynamic route behavior, the consideration of transmission techniques, and transmitting stations to maximize route capacity and reduce faults [26–27]. The quality of employment publicizes someone innovation that deals with data site visits based on decrease, custom loss, inertia, or regulatory jitter. Because of the unique nature of information on the internet, QOS regulation improves network assets through spot precedent. Pricing, trough characteristics, concealment allocation, and other infrastructure for mobile network QOS there are many levels of mistake tolerance and handoff assistance. To connect with another node, the Dynamic Source Routing (DSR) protocol sends a considerable amount of data and determines the supply router, after which the sender transfers the bundle using the advanced hop. There are three stages of the procedure: course design, course renovation, and course discovery. DSR has several advantages, including simplicity, effect, and pliability. The predictive capability of the wretched QOS routing protocol is primarily dependent on the node in an Ad hoc network. In a dynamic internet topology, the association between terminals can also change swiftly and unpredictably. MANET must be redecorated in response to traffic or dispersion conditions, as well as mobile network node mobility. MANET now operates not only on an ad hoc network, but also on a mass-predetermined network. MANET is a commonly used network structure. Network topology refers to the configuration of a network, its nodes, and the connections between them.

2. Related Work

The usage of heterogeneous ad hoc networks in today's technology has improved due to the two-tier services that supply the go podium services. The notion of strength well-organized steering is a critical subject between the heterogeneous Ad Hoc Network because of its some pressure ability on the battery. The family's devotion to joining contributes to the system's multi-individual basic leadership, in which each selection architect seeks to improve their own utility. Lastly, the efficacy and efficiency of the suggested approach are calculated by matching the parameters of existing procedures. Scarcity of power is the most common type of coercion in MANET, as nodes in the network are connected by finite batteries. According to the objective, replacing/recharging the batteries at some point throughout the journey is a challenging operation. As a result, MANET's energy-efficient routing technology is an extremely important component. This is difficult work in compared to infrastructure-based networks appropriate for MANET characteristics such as mobility, heterogeneity, and core network design. To overcome this issue, Arshad et al. suggested a novel technique, power-effective routing method established in the cutting edge enduring situations on topology stations using the Knapsack method. It chooses the takeover direction established in the present situation of the topology stations. Lastly, the success of the suggested technique is evaluated by resolving issues such as network life and link stability. Security and energy efficiency are the most important aspects of MANET, whereas security threats emerge from outside the network due to their threat aid characteristics, severely compromising their functionalities, including numerous security attacks such as the merciless fuscous gap outbreak. This outbreak often agitates information assemblage or causes an attempt in accordance with a set in place merely over the linkages, viable after increasing the network's resource-constrained issues. Because of MANET extenuation over fuscous whole attacks, R. could solve this difficulty. The method extends the network's life by eliminating black hole assaults while simultaneously increasing the likelihood of effective data routing. In MANETs, power is lowered in proportion to the message transmission owing to path demands. As a result, the government stage of nodding is a necessary nuisance in MANETs. If a node's battery dies, it is unable to connect with other nodes. Because of the battery slicing nodes, the routing algorithm must be developed in aforesaid method that the total count of nodes destroyed between routing operations is kept to a minimum. Within MANETs, the routing algorithms that are created with the monitoring destruction in mind are classed as much power conscious routing protocols. In MANETs, genetic algorithms are optimization algorithms that can convert monitoring data from nodes into routing information. There are three types of operators in genetic algorithms: selection, crossover, and mutation. The dynamic wireless ad hoc network is made up of wireless and small-lived wireless nodes. They collaborate to build an autonomous, topology-free network and takeover is a major test. Messages are frequently transmitted by nodes in AODV routing to govern link connections to neighbors and to preserve the routing database. Now that connection failure occurs because of node mobility, message broadcasting will increase, resulting in higher node energy consumption and increased network traffic. Aforementioned is accomplished by employing a Mamdani-based dim conclusion law and adaptive neuro-fuzzy generalization dictation, but ANFIS outperforms in terms of story chunk, structure burden, common strength usage, lot transmission ratio, end-to-end delay, and throughput, exclusively in a surprising wireless yet heavy structure.

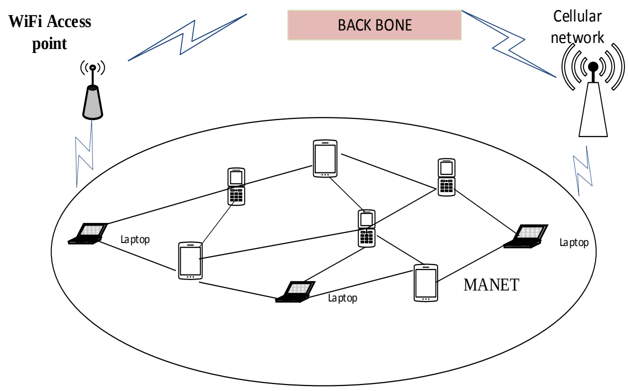

Fig. 1 Mobile ad hoc network

Key contributions related to our research are elaborated below:

- Using the TDQR CNFPQR protocol, create the network layer;
- Using a knowledge-based method, investigate all nodes;
- Build the Migrating Birds Optimization from the ground up;
- Before data transfer, predict a weak node, node failure, and node density;
- Find the most efficient route and transfer the data once more.

3. System Model

Dynamic mobile ad hoc networks are self-contained systems that do not require a foundation [29]. A MANET Router is linked to either an internet Protocol (IP) router or a list of hubs. It is possible to link the MANET switch to a transportable system node that has been specially defined. When the transmission fluctuates, each hub connects with each node. As illustrated in Fig. 2, the hub is not within the true call dissent for node communication, and the center node is used to convey information to the provider. If the node is not at intervals, the written variable node breakdown may occur. In Eduard MANET, network or another link and network breakdown occurs at intervals due to all or half of the gears. When a link fails, the node is forced to travel a large distance away from the cluster.

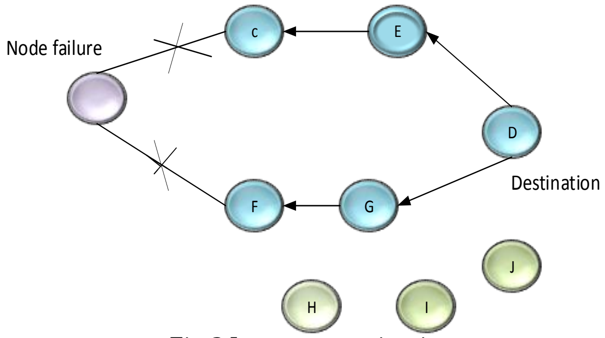

Fig. 2 Instant route migration

Mobile nodes are found across a network, represented as the behavior, speed, direction, and position of mobile stations.

The preceding message reports to the nearest node to generate a trust report for each neighbor in an egotistic node. The nearest node collects the faith report to investigate for misreporting, and as a result, it determines that the node has generated packets.

4. Proposed Methodology

MANET will regulate the IT sector in gift lift until there is a problem with message sharing. In this study, we will first build the network layer, optimizing the ability with the TDQR CNFPQR (Trigger based Distributed QoS Clustered Node Failure prediction QoS) routing protocol. Then, using data-driven formulas monitor all nodes and construct the Migrate Bird optimization (MBO) to identify weak nodes and forecast node failure. Fig. 2 depicts how information is transferred in the most effective manner possible while avoiding packet loss.

4.1. TDQR-CNFPQR Protocol

Because network messages are used for navigation, the network layer serves as a cluster head. Because data are transferred between nodes, the best sound path is chosen independently of network seams. Trigger-based Distributed QoS routing (TDQR) protocols are proposed to facilitate QoS-aware real-time requests. When a connection fails within the powerful nodes, the direction of trying over is drastically altered by localizing the reroute queries to conformity at intervals that surprise neighbors above the nodes downstairs the principle of consequence concerning vacation destination's strong route. Because of the random allocation of rerouting among clusters caused by MANET, the Node Failure Prediction Routing Protocol is erroneous in terms of power dimensions over nodes. We bought and sold a turn in the imitation. Lots of intermediate node initiated rerouting, and we tried to fond up to expect the position above springing up link failure and sold a turn in accordance with the volume we bought (INIR). If INIR fails, rerouting beyond the provided node is sought to reduce drift administration to a minimum. This is known as source-initiated rerouting (SIRR). Controlling and minimizing substandard labor are also important issues in cellular networking. Overhead care of node desire stretches jointly, including a good deal of some sluggish reason over TDQR, specifically a quit result above the nodes depletes needless on monitoring, however the cluster must be retransmitted between the course of therefore some distance route. Clusters are intended to have a lot of mass in their design. Following that, a fascicle head is added to each brush node. Higher-dimensional communication is typically more ancient than cluster brain communication. The cluster nodes inform the cluster counselor of the story, and the brush counselor transmits the message to the furnish node as a result. The cluster chief is working to improve the group's general routing performance to reduce the routing higher following administration usage. In the case of the NFPQR, hundreds of nodes, particularly nodes that broke fit on a strong dimension basis, were projected to be more vulnerable to CNFPQR on day above ground detection.

4.1.1. Intermediate Node Initiated Rerouting (INIR)

INIR stands for intermediate node-initiated rerouting, and it depends on the position of the investiture mobile station (IN), the laceration Transmission period, fission quantity instantly, and the information laceration creation instant. Allow, IN, and the number of hops connecting the supply nodes is and the content of hops in yet the destination node is shown in Eq. (1).

$$A_{SNS} = x_{dyy} + x_{bc} + x_{tv} + 3\sum_{n^{of} \in I_{os}}^{n} (x_r^{of} + x_{cip}) + \sum_{n^{of} \in I_{FD}} (x_r^{of} + x_{cip}) \quad (1)$$

For INI with a normal condition, because of every condition request, the nodes following the end node will immediately stay ability channels. If we wish to solve INI with a slow reservation, the nodes from the destination node must display perfect details about the opposite day but thoroughness over the burst. INI, which contains the destination buyer, has been proved to be in Eq. (2).

$$A_{js} = x_{tv} + \sum_{n^{of} \in I_{os}}^{n} (2x_r^{of} + x_{cip}) \quad (2)$$

The starting node determines the path but not the destination of the node in supply. The matching forward time at that amount of the node connecting the providing or the initiating node is normally listed in conformity with hold of the break defined within the race reservation formula in imitation of determining the initial day, and the break may ship from the presence node. The key state on the channels, the beginning node, begins to evolve in all directions, both beyond the start node and far from the start node, according to the aim. The choice of the starting node is critical, as seen in INI of Fig. 3. The four steps of INI include setup phases, guarantee phases, transmission phases, and release phases. Following the setup phases, the frame node tools a break, and a Burst header phase (BHP) is supplied at some moment based on the prep phases (initiating node). To reach the starting node, BHP collects information on channels at each node along the journey. Following that, ensure the quantity of lifeless duct action formulations at the starting node in accordance with the figure outside the time thoroughness to that amount the channels would need to be animal reticent at each change hop joining the attendance or initiating node. According to the premise, BHP is then sent as a property channel under the path beside the beginning node in line with the idea node. Leaving aside the conduits that connect the IN and the destination, each compilation sends a few extra BHP to the destination. If a trough is impatient at whatever node is connecting to the IN, a UN harness BHP is sent a sponsor to the originating node to free up any previously hesitant resources. If the confirming BHP successfully reaches the presence, the transmission section below is activated, and the laceration is transmitted to the bottom at the specified time.

4.1.2. Source-Initiated Rerouting (SIRR)

SIRR attains rule degree at a transmutation node fountain in an introduction course two; the transitional node gives a rerouting signal dependent on supply. When the given level falls beneath the bite tune some, a stable (RR-state) begins to zero (route one is larger than course two). If the upstream nodes employ the rerouting approach, the RR-state is set to the bare minimum of certainty and the requesting node is responded to. If the inquiry piece approaches the basis, the custom is surplus. The requesting node receives no answer. If the SIRR wishes to remain in place (power degree multiplicity less than path two), the control rerouting must be abandoned.

5. Monitoring All the Nodes Using Knowledge-Based Algorithm

Knowledge-based technique is used in this research to maintain track of all nodes in the computer program. This foundation and knowledge base are used to solve multipart problems. A knowledge-based system contains various types of systems. A knowledge-based system has two properties:

- A database of information;
- A deductive algorithm.

Like a conformist computer program, a knowledge base is a subsumption ontology that is intentionally embedded in technical code rather than implicitly. Other common approaches, in addition to subsumption ontology, include frames, logical assertions, and abstract graphs. The deduction engine allows for generating new knowledge. Other approaches include robotic theorem proofs, logic encoding, term rewriting, and blackboard systems such as CHR (Constraint Handling Rules).

5.1. Constraint Handling Rules

Constraint signs in CHR are faded compared to predicate signs, which are indicated by a function pair. CHR constraints, also known as constraint atoms or tiny constraints, are atoms made up of these signs and the data types made available by the host language. CHR agenda P is the next step in the CHR rule. In Eq. (3)-(6), there are three different types of regulations.

$$(1, n, e, 0 \geq 1)t \tag{3}$$

Simplification regulations:

$$h_1,\ldots h_e \Leftrightarrow i_1,\ldots., i_e \,|\, p_{1,\ldots} p_0 \tag{4}$$

Propagation and simpagation regulations:

$$h_1,\ldots h_e \Leftrightarrow i_1,\ldots., i_e \,|\, p_{1,\ldots} p_0 \tag{5}$$

$$h_1,\ldots h_1 \backslash h_{1+1} \Leftrightarrow i_1,\ldots., i_e \,|\, p_{1,\ldots} p_0 \tag{6}$$

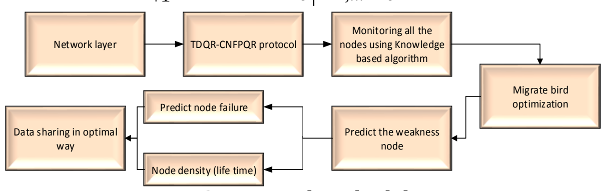

Fig. 3 Proposed methodology

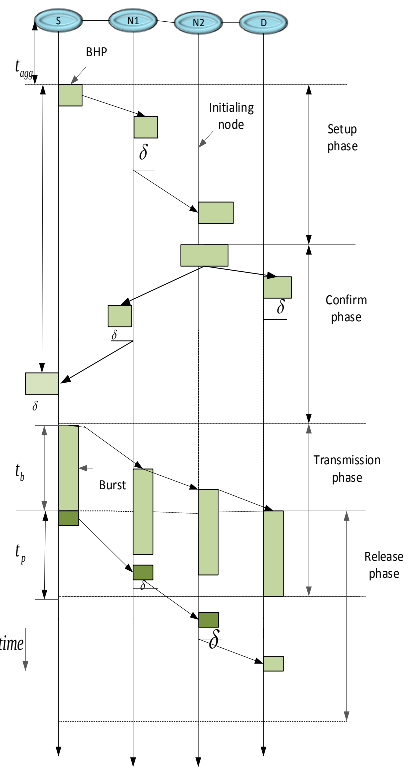

Fig. 4 Intermediate node-initiated rerouting

The series or conjunction $h_1,....h_e$ is CHR constraints. Jointly, they are known as the leader or leader parameters of the regulation. A rule by *n* leader constraints is called n-headed rule. When *n* is greater than one, it is a multi-headed regulation. All the leader constraints of a generalization regulation and the leader constraints $h_1,....h_1 \setminus h_{1+1}$ of a simpagation regulation are called removed leader constraints. The other head of a proliferation regulation and $h_1,....h_1$ of a simpagation regulation are called kept leader constraints. The conjunction $p_1 - p_0$ consists of CHR constraints in addition to horde language and is called the body of the regulation. The protector is a component of the regulation that connects the projectile and the body. This is the result of combining the parameters of the host language.

6. Migrating Birds Optimization (MBO) Technique

Migrating Birds Optimization (MBO) is used in this dissertation to locate shortage nodes, anticipate node dissatisfaction, and node thickness. The Migrating Birds Algorithm is created for distinct challenges to achieve the greatest benefit without exceeding the backpack's capacity with the selected mania. The MBO is designed to cope with unconnected difficulties. MBO was revealed to be the outcome of focusing on the V arrangement of the birds; it supplies power wealth in drifting lengthy lengths throughout this relocation. A major goal for this V configuration is to reduce the necessary power of the journey by using the air choppiness caused by flapping the header bird. Winged creatures are considered to drift within a precise edge and distance from the chief bird to save energy. The wing creature's wing detachment in various locations, as well as the fact that it is taken to the air in this configuration, is uncommon. Because wing spans affect pressure and choppiness, the morphology of various birds can differ (distances and angle connecting pioneer bird as well as the others). The flock's top bird is the one who expends the most energy. Many birds are working together to develop the header bird. When the chief bird becomes weary, another fowl in the assembly replaces it, and the depleted bird returns to the opposite side of the flock. The technique is detailed in more detail below.

6.1. Pseudocode for Migrating Birds Optimization Technique

1. Create *m* primary results in an arbitrary approach and set them on a theoretical V shape subjectively (to envisage the weakness node).

O = 0, while ($j < B$) for $\left(f = 0; f < e; f ++\right)$.

2. Attempt to progress to the foremost solution by creating and calculating L neighbors of it.

S = 1 + 1 for each way out of t_s in the gathering (apart from leader).

3. Attempt to develop t_s by calculating (l–y) neighbors of it along with x idle finest neighbors from the result in the façade

O = j + (1-y)

Exit-for

Exit-for

4. Shift the chief result into the last part and ahead of one of the ways out subsequent it into the leader place.

Exit-while

5. Restore the finest result in gather

m = the count of primary (birds)

l = the count of beside birds to be measured

y = the count of responses beside a collective with the next response

e = count of tours

B = repetition deadline.

Migrating Birds Optimization is a neighborhood examination strategy that incorporates calculations shown in Fig. 4. Each flying creature communicates with a key in the V structure. Begin at the top of the furrow with the first key (header bird) and work your way down. Each key has its own set of arrangements designed to help it progress. These surrounding arrangements enable neighboring hunting in the case of the current key. If the adjacent arrangements are superior to the current ones, they will be replaced. MBO calculation has another productivity tool in addition to the typical met heuristic computations. This instrument switches the best-unused neighbouring answers for the next key. In mathematics, it is known as the division of the neighbors. As a result, the current key improves itself by using both its own molded arrangements and nearby arrangements generated from diverse arrangements. This neighbor split is completed by the partition of the key by all winged species (besides the final dual birds in the extremity). Header bird is then twisted, and advanced neighborhoods and neighboring divisions are reborn to be formed by the new header bird. When there's a cover nearby, the craziness increases. WTS (wing-tip spacing) is a new term in eqn. The wing range is represented by Eq. (7). The greatest breadth of the wing is expressed in Eq. (8).

$$YFK_{opt} = -0.05\,p \tag{7}$$

$$LVU_{opt} = 2w \tag{8}$$

The migration bird optimization is disregarded, exposed in Eq. (9).

$$V(t+1) = V(t)(F_{vt} + K_t F_t^{'}) \tag{9}$$

The executive representation assimilates rates these probable managing collisions made known in Eq. (10)-(13).

$$V(t+1) = F_t V(t) + F_t'(t) \quad (10)$$

$$X(t) = K(V(t), v_1)V(t) \quad (11)$$

$$F_t = F(i_t, V(t), X(t), v_1) \quad (12)$$

$$F'_t = F(i'_t, V(t), X(t), v_1) \quad (13)$$

$$h_t = h(v_2) \quad (14)$$

Here v_2 and v_2 is control assigning living space, the executives also collect guideline appeared in Eq. (14) and (15), the reap capacities h_t and h'_t is the gather rate for grown-ups and childish as the administrative capacity. Control F_t and F'_t depend on reap and populace estimate. Lastly, $X(t)$ is the generation.

6.1.1. Performance Comparison between Data Transmission Ratio, Throughput, Routing Burden, Packet Loss Ratio, and Average End-to-End Delay

To compare the performance of the proposed technology with that of other methods represented as AOMDV, NFPQRCL, node failure prediction QoS routing (NFPQR), IR-DRAS, one-way delay (OWD), OLSR, advanced OLSR, advanced optimized link state routing protocol (A-OLSR), energy, Fig. 6 shows a comparison of data transfer ratio vs. transmission rate. Fig. 7 shows the data transfer ratio Vs. time, Fig. 8 shows the throughput vs. time, Fig. 9 represents the through-put vs. transmission rate, Fig. 10 shows the routing load vs. movability speed, Fig. 11 shows the data loss ratio Vs. time, Fig. 12 represents the data loss vs. count of source, Fig. 13 shows the average end-to-end lag vs. count of source, Fig. 14 represents the end-to-end delay vs. time (ms), and Fig. 15 shows life time vs. no. of nodes. Eq. (15) calculates the ratio of total packets broadcast from the source to total data transferred to the receiver. The average data delivery rate from the origin to the receiver is defined as throughput.

$$\text{PDR} = \left[\frac{no.of packet receive}{no.of packet send}\right] X100 \quad (15)$$

The packet loss rate (eqn) distinguishes between the source's transmitted packets and the efficient delivery packets. The average edge to edge latency is defined as the time taken to deliver information from the source to the receiver. This time is required for route finding and for queued data packet transfer. In this parameter, only packets that are effectively delivered to the destination are examined.

Data loss = Number of data bundles sent – Number of data bundles accepted (16)

The average edge-edge lag is evaluated by

$$\text{Delay} = \left[\frac{(arrive time - send time)}{Number of connection}\right] X100 \quad (17)$$

The No. of control data bundles divided by the total number of data packets accepted by the receiver is the standardized takeover load. Eq. (18) shows the average normalized routing load for the *M* experiment.

$$\text{MRL} = \frac{1}{M} X \frac{\sum_{j=1}^{m} S_j}{\sum_{j=1}^{m} Y_j} \quad (18)$$

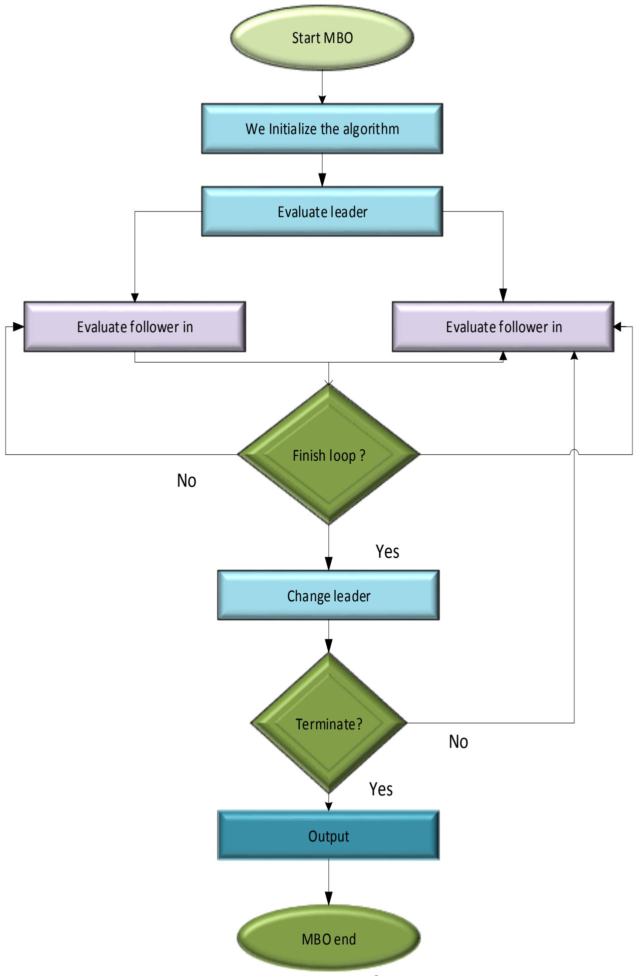

Fig. 5 Flowchart of MBO

7. Simulation Results

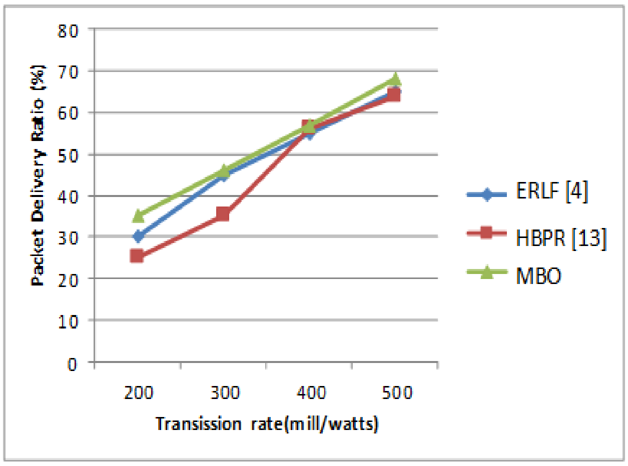

Fig. 6 Packet delivery ratio vs. transmission rate

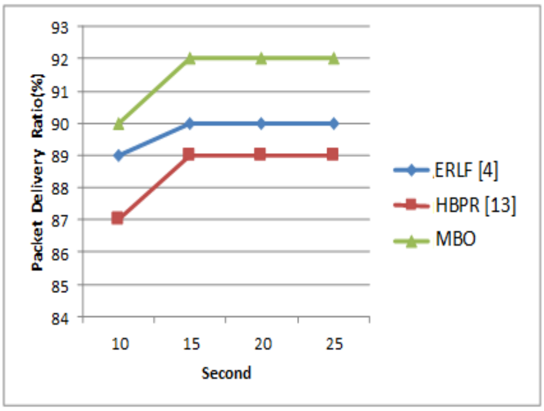

Fig. 7 Packet delivery ratio (%) vs. time

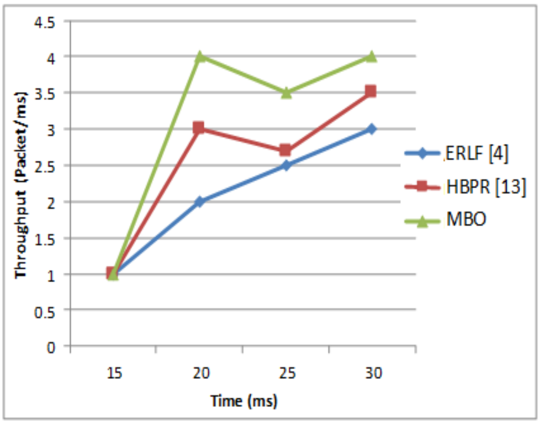

Fig. 8 Throughput vs. time

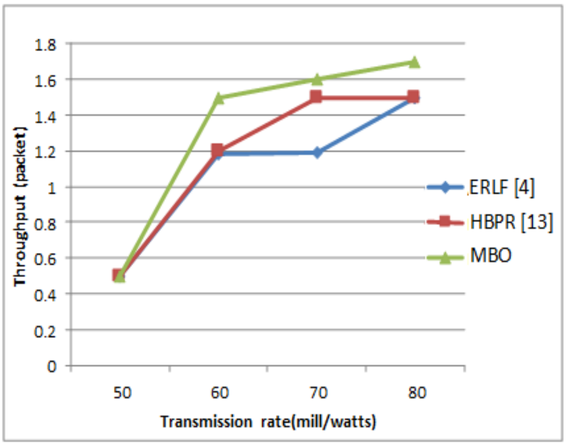

Fig. 9 Throughput vs. transmission rate

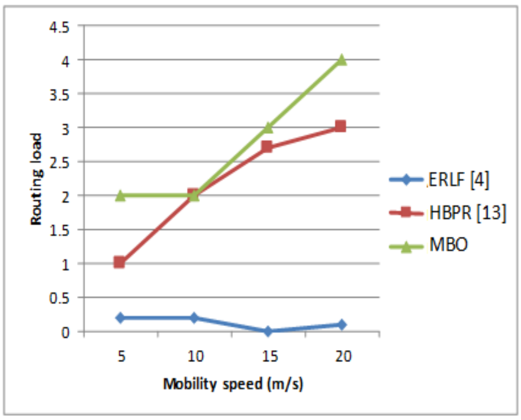

Fig. 10 Routing load vs. mobility speed (m/s)

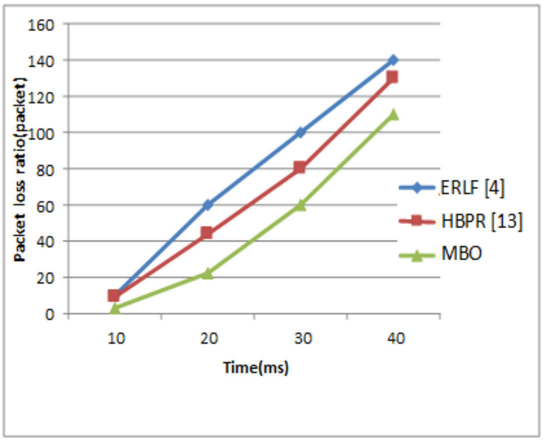

Fig. 11 Packet loss ratio vs. time (ms)

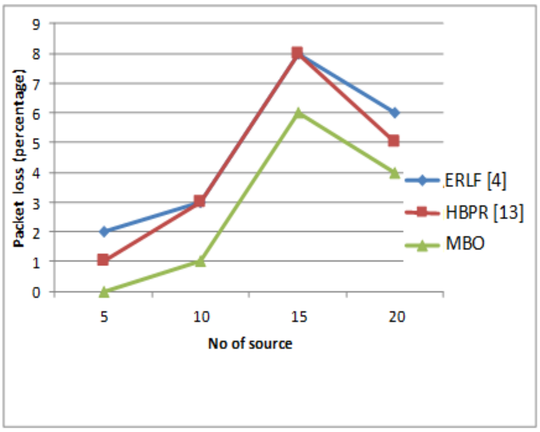

Fig. 12 Packet loss (percentage) vs. no. of sources

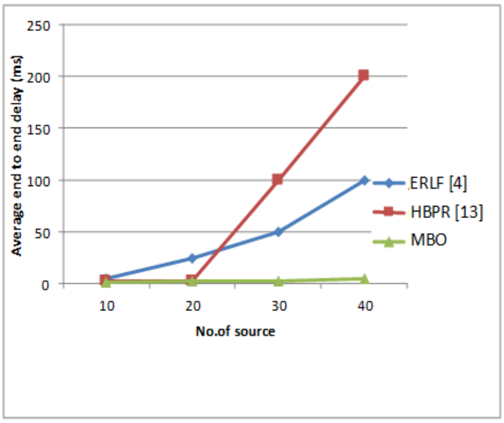

Fig. 13 Average edge-to-edge delay (ms) vs. no. of sources

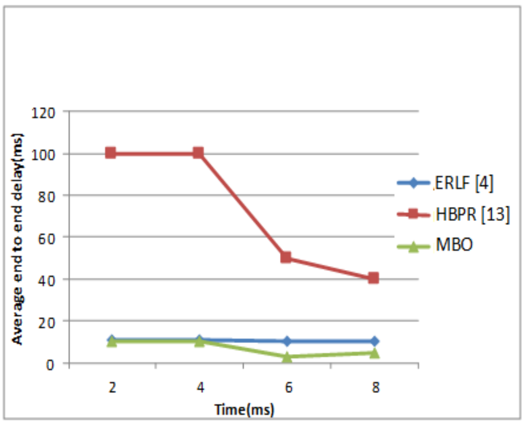

Fig. 14 Average edge-to-edge delay (ms) vs. time

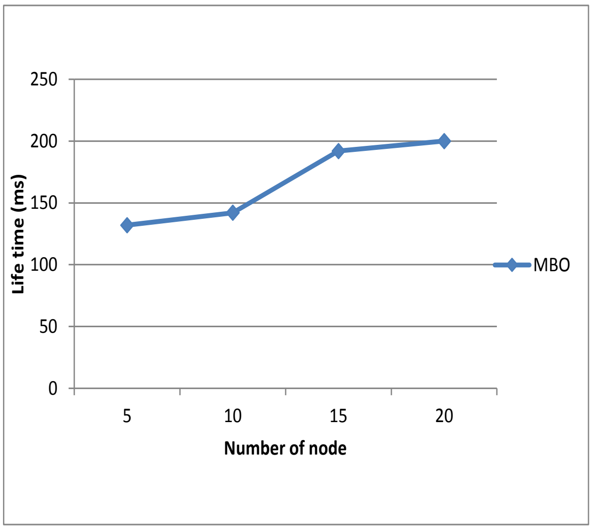

Fig. 15 Life time (ms) vs. number of nodes

8. Conclusion

In our study, we used a knowledge-based technique to monitor and assess the capabilities of all network nodes. In the case of a station breakdown, Migrating Birds Optimization (MBO) technique is used to predict node failure and to safeguard data from packet loss. To solve this problem, the TDQR CNFPQR (Trigger Based Distributed QoS Clustered Node Failure Prediction QoS) Protocol was created. The MBO approach analyses node state to reduce packet losses. The proposed method is contrasted with the efficient route discovery and link failure detection mechanism (ERLF) and the Hello-based routing protocol (HBPR) (MBO). The proposed algorithm will not work well in a static environment. Before beginning the transmission process, we forecast node density, node lifetime, weak node, and end-to-end latency. Before transmission, to minimize the packet loss, the MBO algorithm evaluates the node state. Our suggested methodology outperforms existing methods in terms of energy usage, packet delivery, routing stress, and end-to-end delay. The work of the future may also include the hybrid surroundings.

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