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International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** V **Month of publication:** May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5365

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

A Review on RPL Routing Protocol for Link Recovery Technique in IOT

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Abstract: ***In this study, the technique will be proposed which can establish stable and reliable path from source to destination. Due to mobility of the sensor nodes the link failure may occurs which affect network performance. In this work, the link recovery technique will be proposed in DODAG protocol to improve performance of routing protocol. The link recovery technique will be based on the certain factors like mobility and buffer size. The path from the source to destination is established based on the hop count and sequence number. The path which has least hop count and maximum sequence number is selected as the best path for the path transmission. When the link failure get occurred in the network, then the node which has least mobility and also maximum buffer size will be selected as the node for the link recovery for the path establishment from source to destination. This may improve network performance in terms of certain parameters.***
Keywords: IoT, DODAG, DIO, Routing, Link recovery.

I. INTRODUCTION

A technology which gives its customers access to deep research, convergence, and automation inside the network is called the Internet of Things. Through this system, the sensor node detects the input from the world. The sensor nodes forward the sensed information to the base station. Further, the collected information is uploaded to the key server. The handoff device is modified after the application positions shift. The machine adjustment can be achieved with this precision and reaching to the field. A variety of Network Sensing and Automation technologies are being created. This also demonstrates the latest developments in the mobile development and equipment. The novel progress in the distribution of materials, goods and services, the economic and social sectors has triggered significant changes in the exiting elements. In the current scenario, Internet has linked everyone over public or private Internet Protocol (IP) networks. The citizens will feel the world using the computer. They can also get in touch with each other and share information. Environmental data is obtained by all of the interlinked items. These objects analyze the gathered information to start the act for providing management and decision making [1].

Internet of Things is characterized as a network of physical objects. The Internet of Things isn't all network connectivity. Too much of the internet of things is developed into a network of different types and sizes like cameras, medical tools and industrial models, animals, people, buildings etc. In order to get smart reorganizations, places, process control & administration, all these items are interconnected to each other to provide connectivity and information sharing. The definition of internet of things can be given in three sections.

1) People to people
2) People to machine and
3) Machine to machine

A. Characteristics of Internet of Things

Following are the important characteristic properties of Internet of Things:

1) *Interconnectivity:* According to the Internet of Things, everything is connected each other through global communication and communication infrastructure.
2) *Things-related Services:* The Internet of Things has a capacity to provide things related services in the constraints of services like protection of data services and synchronized consistent services in between the physical and virtual [16] things.
3) *Heterogeneity:* Depending upon the various hardware platforms and networks which exist in applications, different kinds of devices are deployed in Internet of Things.
4) *Dynamic Changes:* The dynamic changes either in services or in location and speed are provided through this network.
5) *Safety:* It includes the protection of personal data and the protection of physical well-being. It also secures the endpoints, the network, and the data stored in that network [17].
6) *Enormous Scale:* In comparison to the devices connected to internet, there are higher numbers of devices that require management and communication services with other devices.

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B. Routing in IoT

A category of Directed Acyclic Graph that is rooted at the sink and uses RPL routing protocol for organizing the routers is called Destination Oriented Directed Acyclic Graph (DODAG). TheDestination Oriented Directed Acyclic Graph Information Object (DIO) messages are originated periodically by the root for initiating the formation of DODAG. The link-local multicast is used to advertise this generated Destination Oriented Directed Acyclic Graph. Information about the root identity, the routing metrics used and the depth / rank of the router that originates are included in the DIO messages .

A simple example of building process of Destination Oriented Directed Acyclic Graph is shown in figure 1.1 Node 3 is beyond the radio range of root node among all the three client nodes shown in the figure. The DIO control message is broadcasted with its rank and id is broadcasted to the client nodes when the root node initiates the generation of a network topology [7]. Here, DAO messages are sent in response from the client node 1 and node 2 to the root for joining DODAG as they are in the radio range of the root. The Client node 3 waits for a period of time to hear from the root node but does not receive any response. Thus, the neighbor nodes start sending DIS message proactively to the solicit DIO. The DIO message that is received earlier to the client node 3 is forwarded if in any case this DIS message is received by client node 2. A DAO message is sent back to the client node 2 by the client node 3 when it receives the DIO message. This message will then be forwarded to the root node from client node 2. Thus, the construction process is completed when the client node 3 joins the DODAG at the end.

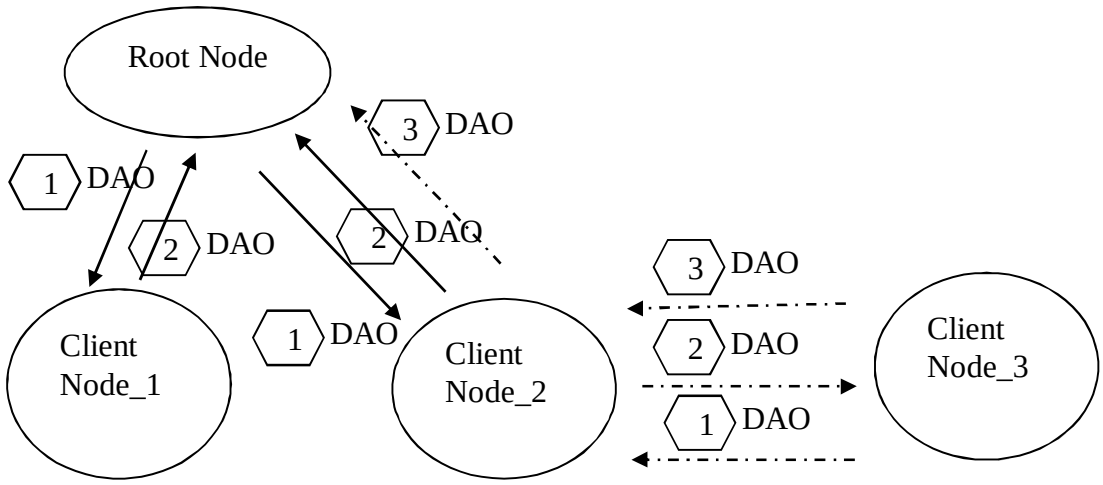


Figure 1.1: DODAG construction process [9]

In the DIO Base this sequence counter is present to indicate the DODAG version being formed. Its version number is monotonically increased by the root whenever the root decides to create a new version of the DODAG to revalidate its integrity and allow a global repair to occur. Its Version Number is globally significant and indicates the Version of the Destination Oriented Directed Acyclic Graph in which a router is operating. The purpose of this counter is to differentiate a movement in which a new route supersedes a stalled one from a route redundancy scenario in which multiple routes exist in parallel for the same target .The path sequence in a DODAG is significant globally and shows the freshness of the route to the related target[9]. An older (lesser) value received from an originating router indicates that the originating router holds stale routing states and the originating router should not be considered anymore as a potential next hop for the target. The Path Sequence is calculated by the node advertising the target, that is, the Target itself or a router advertising a Target on behalf of a host, and is unchanged as the parent routers propagate the DAO content to the root. If a host does not pass a counter to its router, then the router is responsible for calculating the Path Sequence on account of the host and, for this matter, the host may only register in one router if a DAO message with the same goal is sent to several parents for route replication purposes at a specified time point, otherwise the path sequence is the same in all DAO messages for the same goal.

C. Application

Internet of Things is one of the emerging advancement of technology. It is been used in almost every fields and industries performing certain tasks and applications. It is very vast and diverse technology which is making the work of users easy and time saving [5]. It covers the smart environment. Some of the applications are described and elaborated in details as follow:

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1) *Structural Health:* It is used to construct large buildings by keeping in mind their infrastructure and architecture. It monitors the vibrations and the type of material being used for the construction of any building, bridges and historical monuments etc. It enables the facilities of transportation like smart roads are constructed and attractive high-ways which displays all the warning messages and traffic rules as per the requirement of the traffic, manages the traffic jams and accidents.
2) *Air Pollution Monitoring:* It controls the pollution by controlling the emission of carbon-dioxide from the factories, industries, vehicles and the harmful gases coming out from the farms. It detects and keeps proper check on the forest fire by creating the fire alarms in the forests. It monitors [14] the weather conditions, by forecasting the weather report by various modes like through internet, FM radio and through news.
3) *Explosive and Hazardous Gases:* It detects and identifies the type of gases used in various industries and factories and generates a record that by what percentage they are affecting the environment. It monitors the toxic gas and oxygen level in the chemical farms. It keeps an eye on the water, oil and gas level in the storage tanks and cisterns. It has the ability to predict the early requirement to repair the appliances and automatically maintain the services being employed at the time of repair [3].
4) *Patients Surveillance:* It facilitates the monitoring the conditions of patients in the hospitals and old age homes. It is used in medical fridges, which stores all the vaccines inside the freezers for very long time. It provides assistance to all the elderly or physically disabled people living away from their families. It also introduced a Bluetooth connected toothbrush which is very easily controlled by smart phone; this provides information about [2] the brushing habit of any individual. This information can be stored for personal use or can be forwarded to the dentist in case of any severe diseases. It monitors the physical activities by making use of wireless sensor network. This wireless sensor network can be placed inside the mattresses which will record the heart rate, breathing and large motions caused at the time of tossing and turning during sleep. This can be controlled and managed by an application installed in the smart phone.
5) *Smart Cities:* Intelligent parking, structural health, noise urban maps, traffic jam, intelligent lightning, garbage management, smart transport system and intelligent building are the few Internet of Things smart city applications. RFID, Wireless Sensor Network and Single sensors as Internet of Things devices are used by these smart city Internet of Things applications. The range of bandwidth varies from minimum to maximum [20].
6) *Smart Agriculture and Smart Water:* The farming tasks can be improved and strengthened by the Internet of Things technology. This technology can monitor the moisture in soil and trunk diameter in winery for controlling and maintaining the level of vitamins in farming goods.This technology also detects the presence of liquid outer to the tanks and change in force along pipes and monitors the change in water level within rivers, dams and reservoirs. In this type of Internet of Things applications, Wireless sensor network and single sensors are used as Internet of Things devices.
7) *Retail and Logistics:* The employment of the Internet of Things in retail chain management offers a lot of benefits. These benefits involve the observation of storage circumstances with the supply chain and tracing of the manufactured goods for traceability aims and fee processing on the basis of place or action period for public transportation, gyms, theme park and so on [13]. RFID and WSN are the Internet of Things devices used in this type of application.

D. Link Recovery in IoT

The increasing deployment of the Internet of Things has rendered it necessary to examine extensively the consequences of time delays and data drops for the provided wireless ecosystem in order to research connection failures and assess loop time in the event of link failures. This delay in processing time differs with device time error; it is a natural pause arising from the implementation of control programs. The results of processing time delay are known as the problems of delay and loss and can be evaluated for cycle time to connection failure. Because of the heterogeneous existence of IoT in the communication phase some knowledge is needed.

Intelligence in this sense is the capacity of a system to be conscious of the world, in which it works, and to collaborate with the other sensors and utilize the data that it has obtained from its surroundings.Many wireless networks of great scale use low-powered embedded devices for applications associated with data acquiring and actuation. Such embedded devices run under extreme restrictions of resources and interact through a loss channel.These low power devices which are the part of large scale wireless network containing more or less other devices may enter or leave the network at random times [15].

Routing protocols are categorized as proactive, reactive and hybrid routing protocols, in aspects of how routing decisions are being made.Throughout any point, proactive protocols hold the route details in tabular format; reactive protocols construct the on-demand route while hybrid routing utilizes both proactive and reactive routing algorithms. Reactive protocols allow more effective usage of the bandwidth, it is more appropriate for fluid networks while conservative protocol is appropriate for static networks.

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II. LITREATURE REVIEW

Xiang, C. et al. (2015) presented a lightweight description method to describe the QoS, dramatically decreasing the time complexity of service selection. The complex problem of QoS-based service selection was decomposed into a simple and basic sub-problem [21]. A QoS-based service matching algorithm has been proposed that greatly improves selection accuracy by taking into account the entire meaning of the predicates. The trace-driven simulations show that in comparison with current methods, our method can increase matching precision by 69 per cent and recall rate by 20 per cent.

Kiruthika, J. et al (2015) focuses on addressing the issues of quality of service (QoS) and considers key factors in the design of quality models for IoT systems and the challenges to be addressed[10] . The challenges IoT faces and the standardization of IoT systems will be constantly evolving to keep up with the changes in both the technology and the areas it affects. There is a huge emphasis on big data and data mining techniques as the data gathered from these devices and systems are constantly on and monitored.

Rahman, H. et al. (2016) proposed a hybrid Quality of service-Aware Data Aggregation (QADA) scheme is proposed [18]. This scheme combines the features of the cluster with tree-based data aggregation schemes and addresses some of their major limitations. Results from the simulation show that QADA outperforms cluster and tree-based aggregation schemes in terms of power consumption, network lifetime and increased traffic load bearing.

Yachir, A. et al. (2016) proposed a new service-oriented, user-centered and event-aware Framework capable of performing services monitoring to handle automatically events that may occur in ambient environments [22]. The overall proposed framework was implemented and validated in an Ambient-Assisted Living environment through a scenario dedicated to the daily activity recognition. Furthermore, the performances obtained from extensive tests clearly show the effectiveness and feasibility of the proposed approach in the case of a large-scale environment.

Rao, S. et al. (2017) presented a study in which the data is transmitted by the Internet of Things devices to the base station using the User Equipments (UEs), otherwise known as uplink transmission [19]. In order to perform further processing, the data is transmitted from the base station to the cloud. For each of these three approaches, the end-to-end outage probability at the devices is evaluated. Least outage probability at the Internet of Things devices is achieved as per the conclusion achieved while applying the proposed technique.

Dong, L. et al. (2017) proposed a novel technique which acted as a solution to the problems arising in Information Centric Networking (ICN) [4]. The average number of notifications being received in single and multiple producer scenarios are minimized using this mechanism. The subscription and redundant notification messages are transmitted across the network using the least possible bandwidth through this research.The subscription condition is successfully collected and then allocated in disjoint sets of proper transmission using the technique proposed. Thus, the duplicate notifications which carry the similar updated information from multiple producers are removed by this proposed technique.

Fitzgerald, E. et al. (2018) presented a study which was related to the different algorithms and formulations of mixed-inter programming [6]. The issues of energy-optimal routing and multiple-sink aggregation within Internet of Things edge networks were solved by this approach. Due to the least and highest utilization of energy, it is important to consider optimization of network. Substantial amount of energy is saved through this approach. It is seen that by utilizing the direct and shortest-path flows from sensors to actuators around 13 times higher energy is utilized by the 40-node networks.

Idrees, A. K. et al. (2018) proposed a novel approach through which the lifetime of PWSNs which is named as DiDAMoK. Within the sensor nodes, this lifetime is distributed uniformly and it works in a periodic manner [8]. There are three stages amongst which these periods are setup. All the collected and saved data within the sensor nodes is read by the sensor node in the initial stage. These readings are then transformed into a set, and there are generated dynamic clusters that relay the nature of aggregated readings. For transmitting the cluster to sink, one reading is chosen as the representative reading in the final stage.

Li, R. et al. (2019) proposed a novel problem termed n × 1-outof-n oblivious transfer and propose a protocol that combines modern cryptography and hidden permutation to efficiently solve the problem [12]. The hidden permutation can be used to implement an anonymous communication system. Our future research will focus on the following two directions: developing novel mechanisms that can support different oblivious transfer applications such as the case when clients join the system asynchronously.

Li, J. et al. (2020) proposed an algorithm based on uniform sampling and Bernoulli sampling to address these issues [11]. This research has provided logical proofs to show that the proposed algorithms return accurate results with a given probability. Results of the simulation show that these algorithms have high energy consumption performance as compared to a simple algorithm distributed.

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III. RESEARCH METHODOLOGY

In this research work, the technique will be proposed which can establish stable and reliable path from source to destination. Due to mobility of the sensor nodes the link failure may occurs which affect network performance. In this research work, the link recovery technique will be proposed in DODAG protocol to improve performance of routing protocol. The link recovery technique will be based on the certain factors like mobility and buffer size. The path from the source to destination is established based on the hop count and sequence number. The path which has least hop count and maximum sequence number is selected as the best path for the path transmission. When the link failure get occurred in the network, then the node which has least mobility and also maximum buffer size will be selected as the node for the link recovery for the path establishment from source to destination. This leads to improve network performance in terms of certain parameters.As shown in figure 5.1, the network will be deployed with the finite number of sensor nodes. The source and destination nodes will be selected for the path establishment. When the link failure occurred in the network, then the path will be recovered from source to destination based on node mobility and buffer size. The sensor node which has least mobility and maximum buffer size will be selected as the best node for the data transmission.

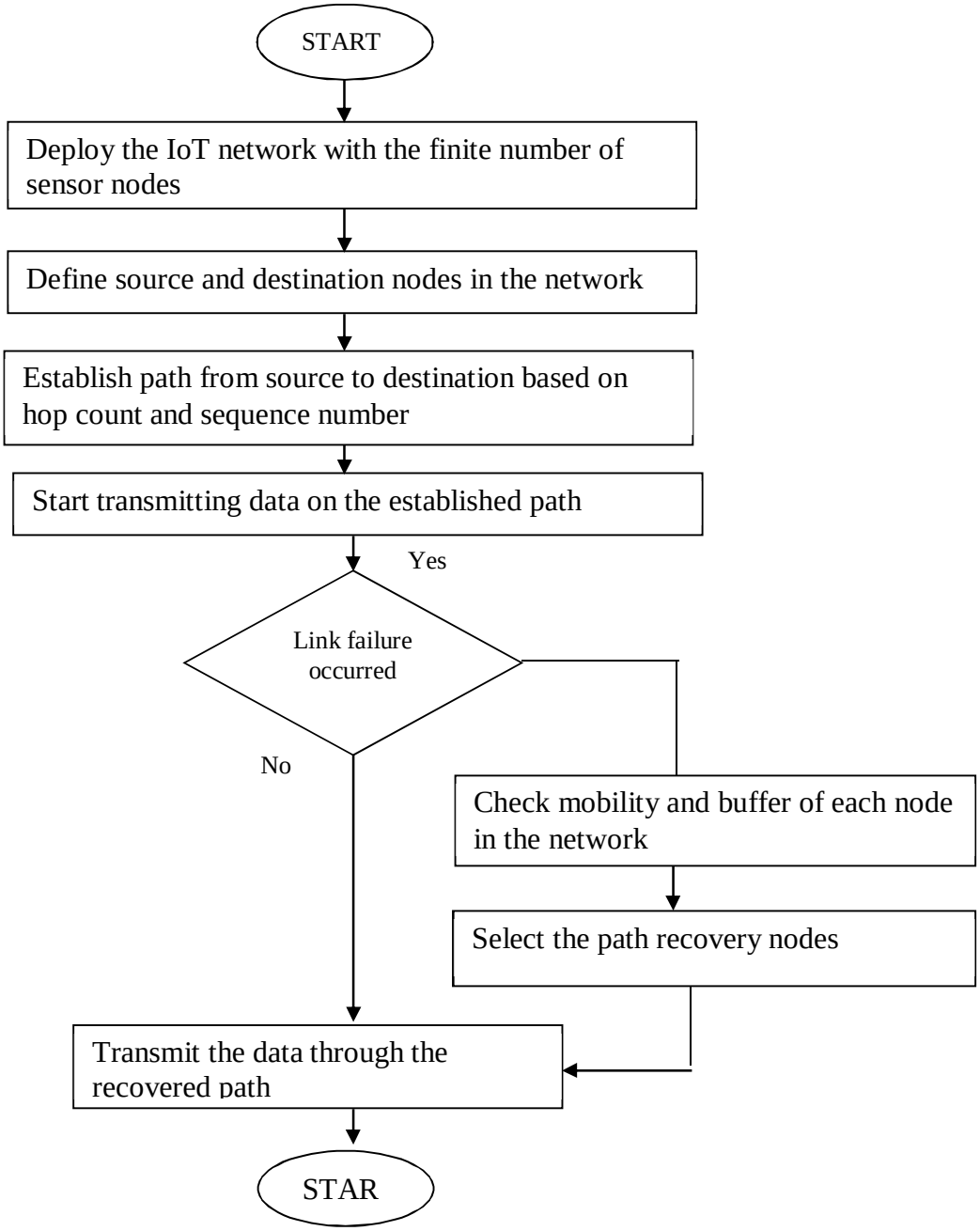


Figure 5.1 Research Methodology

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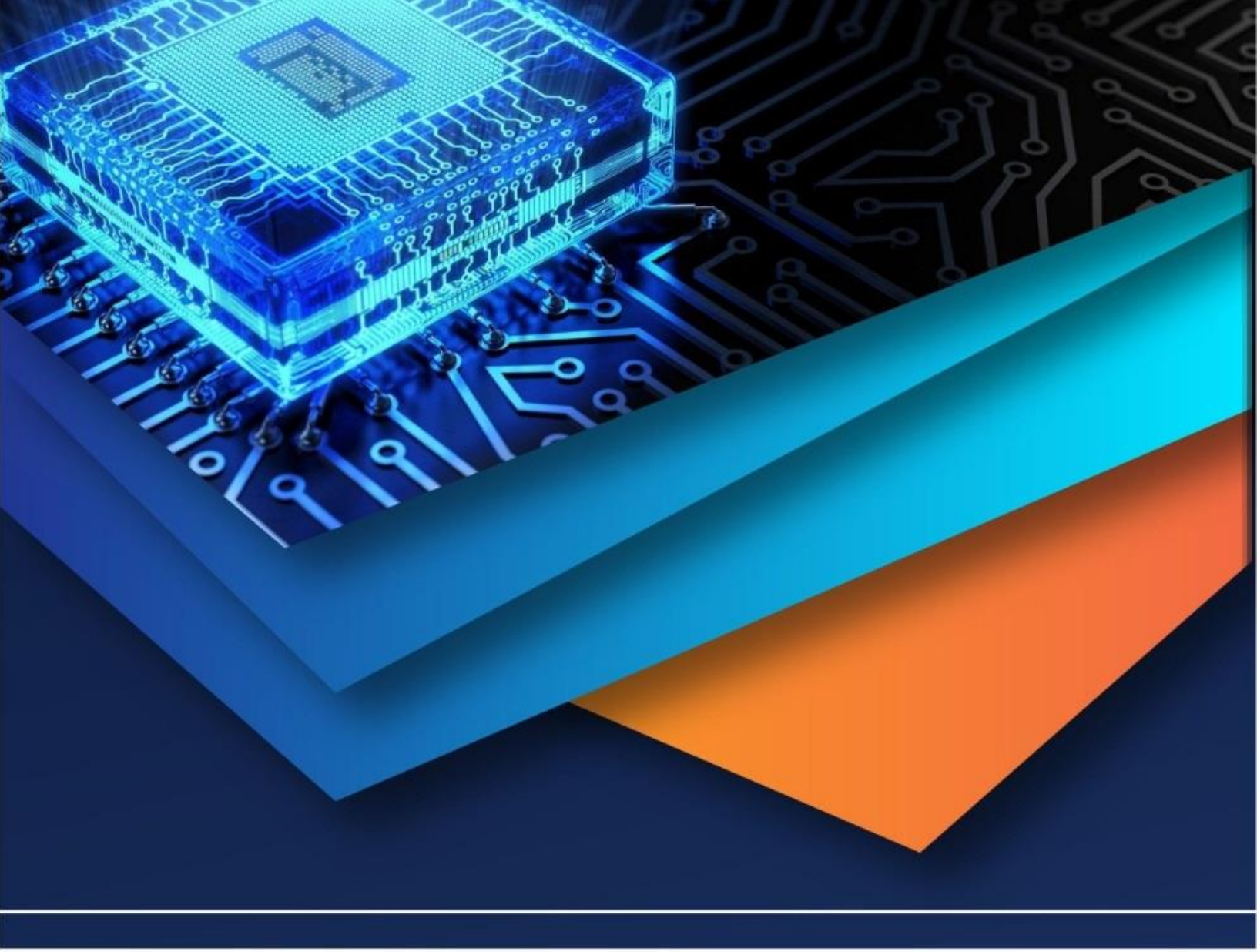
IV. CONCLUSION

In this review paper , this may be concluded that the mobility of the sensor nodes is very high due to which it is difficult to establish reliable path from source to destination. The technique of path establishment which are proposed in the previous research are not so reliable for the data transmission .The Internet of things is the decentralized type of network which is much vulnerable to security attacks. The version number attack is the active type of attack which affects network performance. The technique needs to be designed for the isolation of version number attack in IoT.The technique of RPL(Routing Protocol for Low power and Lossy Networks) needs to propose which can establish path and chances of link failure should be least in the network.

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