

# PROPOSAL OUTLINE FOR MASTER RESEARCH

**Name of the Student: - Fatima Mohamed Alatiresh**

**ID No.: - 31757037**

Place of Research Work & Organization: **Libyan Academy - Misurata Branch - Libya**  
**Supervisor**

Name: - Prof. **Mohammed A. Sullabi**

Organization: - Information Technology Department

## 1. Proposed Topic of Research:

*Study and comparison between two target functions of the RPL protocol in the Internet of Things.*

## 2. Introduction

In recent year, the Internet of Things (IoT) has drawn significant research attention. IoT is considered as a part of the Internet of the future and will comprise billions of intelligent communicating ‘things’. The future of the Internet will consist of heterogeneously connected devices that will further extend the borders of the world with physical entities and virtual components. The Internet of Things (IoT) will empower the connected things with new capabilities.

IoT represents a system which consists a things in the real world, and sensors attached to or combined to these things, connected to the Internet via wired and wireless network structure. The IoT sensors can use various types of connections such as RFID, Wi-Fi, Bluetooth, and ZigBee, in addition to allowing wide area connectivity using many technologies such as GSM, GPRS, 3G, and LTE. IoT-enabled things will share information about the condition of things and the surrounding environment with people, software systems and other machines. by the technology of the IoT , the world will becomes smart in every aspects , since the IoT will provides a means of smart cities , smart healthcare , smart homes and building , in addition to many important applications such as smart energy , grid , transportation , waste management and monitoring .

## 2. Problem Statement

The RPL is the standard routing protocol for IoT. The general performance of Low Power and Lossy Network (LLN) is highly dependent on the choice of routing protocol and quality of its implementation because they are very resource-constrained, such as power supply. Therefore, control traffic, power consumption, and packet delivery ratio plays a vital role in the performance of the routing protocol. Two objective functions within RPL protocol, ETX and OF0, are used to determine the route for packets within IoT networks. Nonetheless, the IoT network design and the spread of sensors or devices will have a major impact on which objective function to choose for routing the packets. Therefore, a comparative study of using (ETX) and (OF0) to prove their effectiveness in reducing energy consumption and delivery of packages using the simulator Cooja with using a different network topology. The comparison will be based on a number of the objectives that mentioned above and to indicate which of these functions are efficient based on power consumption and packet delivery ratio.

## 3 - Motivation

- I. In order to be able to choose the best RPL protocol, we need to make a broad comparison of the RPL functions in order to be able to design the Internet of Things that allow us to reduce the power loss and the packet loss, and thus a comparison between ETX and OF0 will be done in order to reach the desired goals.
- II. To analyze deeply the performance of the objective function and determine which of them is suitable for different Internet of Things topologies based on performance matrices which are Energy consumption, packet loss, delay.

## 4 - Objective Function:

Is a selection path mechanism when choosing parent node by node underneath to form DODAG. (Nurrahmat Pradeska, Widyawan, Warsun Najib, Sri SungKus, 2016).

## Expected Transmission Count (ETX)

ETX is a software link reliability and quality metric. ETX is commonly used by the routing protocol as a metric for determining the best path. ETX is used to find the highly stable and reliable path on multi hop networks such as IoT, ETX can be considered as a link metric that predicts the number of retransmissions needed for a packet to be successfully received at the destination. ETX performs in finding the best path and predicting the number of retransmissions needed to receive the packet.

## Objective Function Zero (OF0)

considers the hop count as a routing metric to select the best parents from candidate neighbors, during the DODAG construction, nodes should consider the shortest path in terms of hop count to the grounded root.

the use of node metric may provide poor link quality (nodes select the path with the minimum hop count even if they are unreliable and lead to more retransmissions, which provides more packet loss)

## 5. Questions of the Study

This research is aimed to answer the following questions:

- ✓ Which objective function that fits IOT networks in terms of packet loss and power consumption?
- ✓ Which network design is the best fit for both objective function ETX and OF0

## 6 -Limitations of the study

**Study and compare two functions of the RPL protocol on IOT to choose the best among them in terms of packet delivery rate and energy consumption reduction.**

## 8-Related works :-

This section provides a set of selected related works to the functions of the RPL. The related work arranged from the oldest to the newest:-

- **Mamoun Qasem, Hussien Altawssi,(2015)[3 ]** , the performance of RPL is evaluated in terms of using OF0 or MRHOF for the light network density. The results revealed that the RPL performance for both OFs is best in relation to PDR and power consumption values when we use the RX 60% for the majority of circumstances, where the PDR average when using RX 60% is quite similar to that when using RX 100%, but with a lower power consumption.
- **Hayder A. A. Al-Kashoasha,b Yaarob Al-Nidawia ( 2016 ) [ 4]**, The results are shown here a new RPL metric called Buffer Occupancy, which is important to consider when congestion does occur in 6LoWPAN network, The proposed objective function has been implemented and tested in Contiki 2.7 with two different size networks and compared with three objective functions.

- **Aashima Bisen , Jimmy Matthew, (2016) [ 5] ,** have estimated and analyzed the performance of RPL in various situations and for various metrics, Here comparison has been made utilizing the metrics: Radio duty cycle,number of hops(per node) and Power Consumption.  
That has been reached when the no of nodes increases then the metrics will also increase. Moreover, the sort of mobility directly affects the received packets; the Mobile nodes can lose many packets when they move as opposed to fixed node.
- **Wail Mardini, Maad Ebrahim, Mohammed Al-Rudain (2017) [ 6] ,** The simulation results showed that OF0 is better than MRHOF in terms of Energy Consumption, There is no big difference of both Objective Functions in Mobile-Random Topology except that OF0 is better than MRHOF in Power Consumption. The RPL Routing Protocol and Its Objective Functions need more enhancements to deal with Mobile-Random Based Networks.
- **Amnah Al-Abdi, Wail Mardini , Shadi, Tareq (2019) [7],** RPL is considered the standard routing protocol in the IoT. Study addressed the use of multiple RPL instances for enhancing the performance of IoT-based systems. The nature at the diversity of the data traffic types in IoT-based systems are the main motivations for thinking about employing multiple RPL instances in such systems, in which an instance can be used to represent the nodes which are generating a specific type of data traffic.
- **Shimaa A. Abdel Hakeem , Anar A. Hady , HyungWon Kim (2019) [8],**the control overhead, latency, packet delivery ratio, and power consumption while optimizing two OFs (OF0 and ETX); Results show that the proposed ETX outperform OF0 in packet delivery ratio and power consumption. OF0 experience higher latency than using ETX: As the network size increase, the number of hop count increases.
- **Wail Mardini, Bassam , Muneer , Amani , Esraa (2020) [9] ,**study was conducted to evaluate two RPL modified algorithms through coordination the objective function to equalize energy distribution among nodes in WSNs.As noted, the value ETX\_SCALE and ETX\_ALPHA of new\_etx equation, and THRESHOLD lead to efficient energy through equalizing energy distribution among nodes in WSNs. Threshold value proved that can used to improve reliability through increasing packet delivery ratio in WSN.

## 9-Background of the study

It is important at the beginning to clarify the exact meaning of the common terms used in the field of the study are briefly defined as follows:

### **- Internet of Things (IOT):**

The Internet of things refers to a type of network to connect anything with the Internet-based on stipulated protocols through information sensing equipment to conduct information exchange and communications in order to achieve smart recognitions, positioning, tracing, monitoring, and administration. (Keyur K Patel, Sunil M Patel,2016).

### **- Routing Protocol (RPL):**

routing protocol for low power and lossy networks is a distance vector routing protocol here the routing is based on destination oriented Acyclic graphs or DODAGs Therefore, RPL uses these types of control messages which are:

#### 1) DIO: DODAG Information Object.:-

This message is Multicast down wards. A given node in a DODAG may multicast this message , which lets other nodes know about it things like whether the node is grounded or not , whether it storing or non-storing , and it announces other nodes "if they are interested to join , please let me know".

#### 2) DIS: DODAG Information Solicitation.:-

When no announcement is heard, and if node wants to join a DODAG it sends a control message , for that it wants to know if any DODAG exists. so the message which it sends is like "is there any DODAG".

#### 3) DAO: Destination Advertisement Object: -

it is A request send by a child to parent or root. This message requests to allow the child to join to a DODAG

#### 4) DAO-ACK: Destination Advertisement Object Acknowledgement:-

it is a response send by a root or parent to the child, this response can either be a yes or no.

## 10-Goal and Scope of the Study

This research aims to show the efficiency of the RPL protocol, using two functions ETX and OF0, and by analyzing in depth these functions and determining which of them are suitable and capable of saturating the Internet in terms of reducing energy consumption, improving access to the network and the rate of packet delivery.

## 11 -Contribution and importance of research

The aim of this research is to study and analyze the substantive functions of the RPL protocol, it will be an analysis on different topologies because the Internet of things is not a single topology, and these functions are compared and its effectiveness in reducing energy consumption and delivering packages in order to improve and develop these technologies.

## 12. Performance Matrices:

Basically to evaluate the proposed protocol and compare its performance based on energy and scalability issues, the following matrices are must be used by the researcher:-

- I. **Energy Consumption:** - The energy efficiency of the sensor can be calculated as the total energy consumed divided by the total amount of data transmitted. This performance metric impact directly by all the different sources of energy consumption in WSN such as idle listening, collision and overhearing.
- II. **Average Delivery Ratio:** - The packet delivery ratio is the number of data packets received to the total number of packets sent over all the networks.
- III. **Latency:** - The End-to-End delay is a metric used to measure the performance. The delay defined as the time taken by a data packet to travel through the network from a source to the destination sensor. The average source-destination path delay of a data packet is computed by

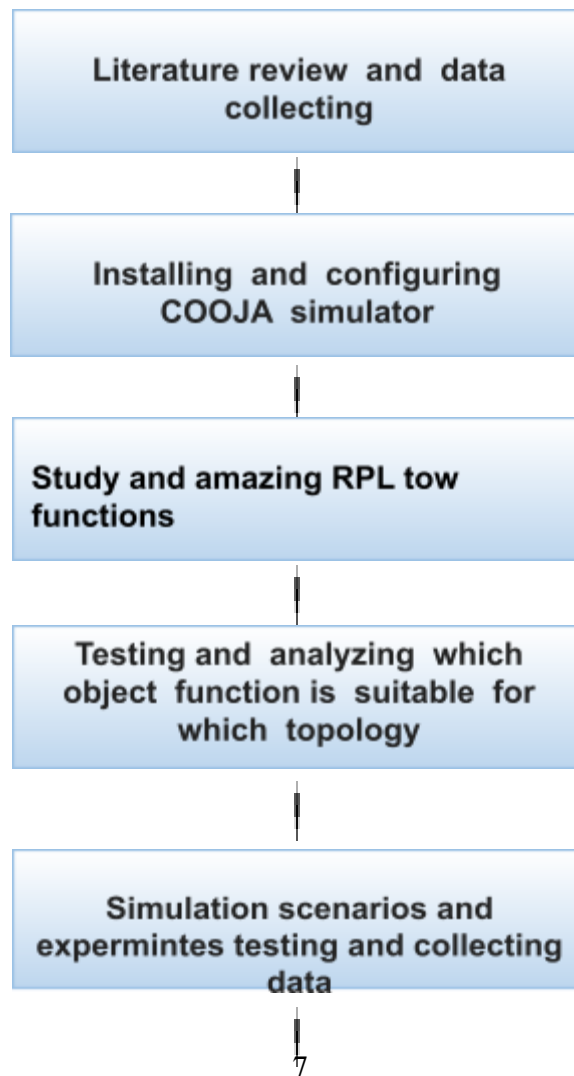
subtracting the time when the first packet was transmitted by the originator sensor from the time when the first data packet received by the final destination

- IV. **packet loss** :- When accessing the internet or any network, small units of data called packets are sent and received. When one or more of these packets fails to reach its intended destination, this is called packet loss. For users, packet loss manifests itself in the form of network disruption, slow service and even total loss of network connectivity. Any application can be disrupted by packet loss, but the most likely victims are applications that rely on real-time packet processing, such as video, audio and gaming programs

### 13. Methodology

**The methodology used in this study:-**

**This study goes through several steps in order to achieve it. The figure(1.1) shown below illustrates these steps.**



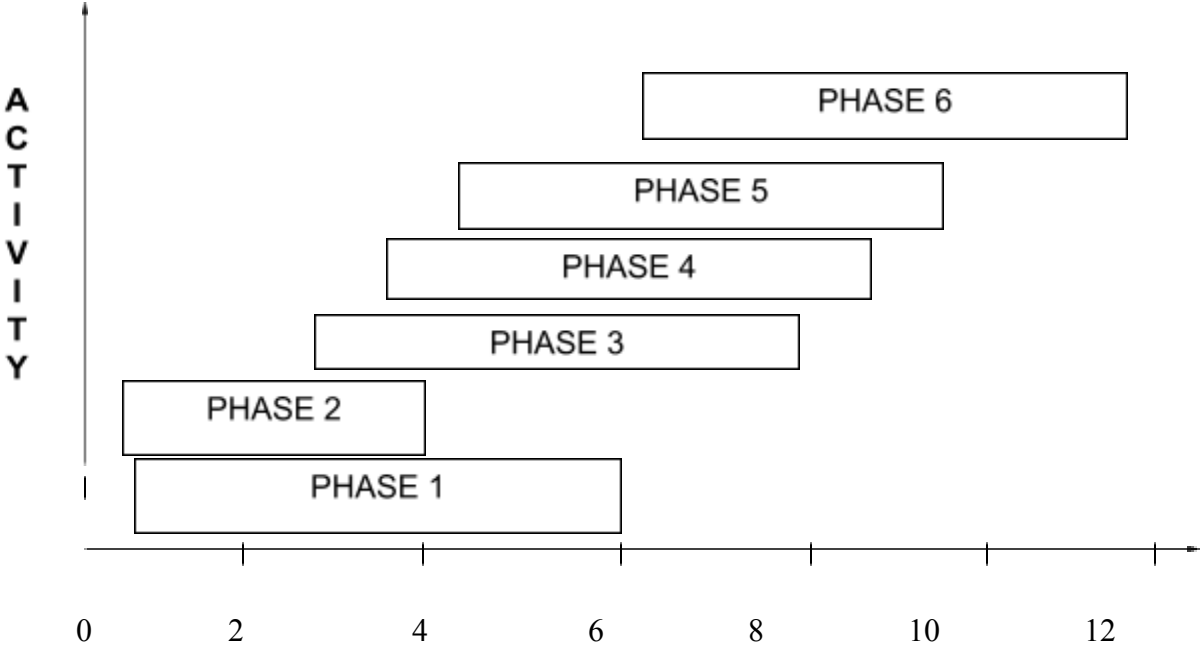
Discussion and analyzing result  
and conclusion writing

Figure 1.1 Research Methodology.

14. Work Plan:-

- Phase 1: Literature survey and Analysis.
- Phase 2: Installing and Configuring Simulation Tool (cooja).
- Phase 3: Study and Design RPL protocol .
- Phase 4:Implementation the RPL using cooja.
- Phase 5 Collecting and analyzing the results of compare designed OF0 and ETX.
- Phase 6: Conclusion and thesis writing.

Plan of Work Chart:



## Durations in Months