RPL Enhancements: A Review

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ABSTRACT

Routing protocols in low power networks with static nodes support joining and leaving of nodes, similarly RPL is also able to support adding and removing nodes. However, the process of detecting mobile nodes and maintaining the routing tree is very slow. Mobility is indicated as one of the main sources of inconsistency in RPL. This paper gives the findings of existing approaches that are based on different routing metrics and concludes that the use of a combination of multiple metrics will further improve the RPL performance in future.

Keywords: Routing Protocol for Low-Power and Lossy Networks, Wireless Sensor Networks, Medium Access Control, Internet Protocol, Low-Power Wireless Networks

1. INTRODUCTION

Wireless Sensor Networks are a basic portion of sensible environments like sensible homes, buildings, and cities [1]. Sensible environments trust upon the detected data from the important world. WSNs contain specialized parts that ensure sensing, procedure, and communicative capabilities for watching distributed locations [5].

The IETF IPv6 Routing Protocol for Low-Power and Lossy Networks (RPL) [1] is extensively used to support routing among sensor nodes. In most scenarios, a backbone network of intermediate nodes is installed, which is likely to be static. RPL practices a hierarchical routing method for the static backbone network. Key characteristic of movement is an extremely dynamic topology which marks in frequent interruptions with neighboring nodes. As of these disconnections, packets directed towards a mobile device can be directed to edges (parents) even afterward the mobile device is currently out of reach of these parents[2].The practice of this protocol could become public and standard in IPv6 sensor networks in the future, even though some obstacles that slow acceptance today. RPL is an elastic protocol, which in concept permits the interconnection of significant communicating objects of high heterogeneity, with robust checks in memory, handling power, and dynamism resources. This elasticity is paid in complexity: RPL conditions are complex, and current operation is generally not complete [3]. The RPL routes are constructed agreeing to an Objective Task and a set of metrics and controls [6].To talk congestion glitches that happen in situation of substantial data traffic, Di Marco et al. take benefit of cross-layer strategy and suggest a Medium Access Control (MAC)-aware routing metric that proceeds into explanation complex communications between MAC and routing. Two metrics labeled R and Q that cover ETX by seeing effects of contention and MAC parameters were delivered [8].

An optimization problem is well-defined through an exploration space and a excellence or fitness function. The exploration space limits the thinkable formations of a solution vector, which is related with a mathematical cost by the fitness function. Thus, resolving an optimization problem contains in discovery the least-cost formation of a solution vector. Owing to the high complication that this kind of problems typically shows, the usage of programmed intelligent implements is a compulsory requirement once facing them. In this sense, metaheuristic algorithms arise as well-organized stochastic practices able to resolve optimization glitches [1].

2. RELATED WORK

Jamal Toutouh et al. [1] a sequences of illustrative metaheuristic algorithms (PSO, GA, and SA) are considered in this artifact in command to discovery of automatically optimal outlines of this routing protocol. **David Carels et al. [2]** examine the glitches that halt consistent traffic movements to mobile devices afterward using RPL. A novel mechanism is used to advance downward route modernizing is proposed. It is revealed that it achieves the packet delivery ratio from 30% to 80% to mobile nodes while dropping the total RPL signaling overhead without using position information. **Belghachi Mohamed and Feham Mohamed [3]** present the usage of the remaining energy and the communication delay as direction-finding metric in the subsequent hop choice process for the RPL protocol. Project an objective function for this metric built on ant colony optimization (ACO), and then associate the outcomes of tests recognized with the RPL built on ETX. **H. Santhi et al. [4]**offering a novel, and optimal effective routing protocol which delivers improved throughput, compact end to end delay calculated precisely for use in multi-hop wireless ad-hoc networks of mobile nodes. **Meer M. Khan et al. [5]**RPL does not deliver any management framework that can outline message conversation between different sink nodes for improving the network performance. A sink-to-sink management framework is projected which employs the periodic route repairs messages issued by RPL to talk network status detected at a sink with its adjacent sinks. **Weisheng Tang et al. [6]** propose a congestion prevention multipath direction-finding procedure which practices many routing metrics established on RPL, named CA-RPL. A direction-finding metric is proposed for RPL that reduced the average delay neighboring the DAG root, and the weight of all paths is calculated through four metrics. **Hossein Fotouhi et al. [7]** demonstrate that interoperability among fixed and mobile nodes container is successfully attained through the practice of suitable hand-off and topology administration techniques. Suggest a mobility administration framework (dubbed mRPL+) combining two hand-off models: (1) hard hand-off, wherever a movable node has to halt a link in advance discovery a new link, and (2) soft hand-off, where a movable node chooses the fresh link earlier disconnecting from the existing one. **Patrick Olivier Kamgueu et al. [8]** analyses present workings on RPL and highlights important offerings to its enhancement, mainly those related to topology optimization, safety and mobility. **Hanane Lamaazi et al. [9]** evaluate the RPL in three configurations: compound sink, scalability, and movement models. Outcomes show that RPL performances are significantly subjective by the amount of nodes, the amount of sink nodes, and the movement type. **Jeong GilKo and Andreas Terzis [10]** present the ideals projected by operating teams, and outline however the investigation community sharply contributes during this course by effective their strategy and providing open basis implementations.

Table 2.1: Summary of RPL enhancements

Author	Year	Approach	Findings
Jamal Toutouh	2012	Optimal parameter setting of the routing protocol, by defining an optimization problem.	In terms of the performance of the optimization techniques Used, SA outperforms the other studied metaheuristic algorithms when solving the defined optimization problem.
David Carels	2015	A new mechanism to improve downward route updating.	Improvements of the end-to-end packet delivery ratio by up to 40%, depending on the scenario.
Belghachi Mohamed	2015	Use of the residual energy and the transmission delay as routing metric in the next hop selection process for the RPL protocol.	Energy and delay aware routing metrics and information on resources availability of sensors are used to improve the energy efficiency of RPL.
H. Santhi	2016	Novel, and optimal efficient routing protocol which provides increased throughput, reduced end to end delay designed specifically for use in multi-hop wireless.	This novel enhanced version of the Associativity Based Routing protocol not only provides a simple and stable routes but also more efficient and optimal route from the source to the destination.
Meer M. Khan	2016	A sink-to-sink coordination framework.	Proposed framework distributes network load among sink nodes for achieving higher throughputs and longer network's life time.
Weisheng Tang	2016	Congestion avoidance multipath routing protocol which uses composite routing metrics based on RPL, named CA-RPL.	Proposed CA-RPL reduces the average time delay by about 30% compared to original RPL when the inter packet interval is short and has almost 20% reduction in packet loss ratio.
Hossein Fotouhi	2017	Mobility management framework (mRPL+) unifying two hand-off models: (1) hard hand-off, where a mobile node has to break a link before finding a new link, and (2) soft hand-off, where a mobile node selects the new link before disconnecting from the current one.	For higher traffic loads a soft hand- off model is able to provide good reliability (≈100% PDR) with extremely low hand-off delay (4 ms) and very low overhead (similar to RPL). For lower traffic loads, again mRPL+ outperforms RPL by reducing network inaccessibility times.
Patrick Olivier Kamgueu	2018	Reviews recent works on RPL and highlights major contributions to its improvement, especially those related to topology optimization, security and	Investigated security concerns related to RPL, especially those involving internal nodes as source of the threat. Mitigation strategies provided to counter the identified

		mobility.	threats were reviewed and compared.

3. CONCLUSION AND FUTURE SCOPE

Variations in the environments caused due to electromagnetic noise, humidity, temperature, and so on, intend the researches in Low-Power Wireless Networks (LPWNs) to assume the network with different topological conditions. However, mobility is a major concern in RPL. Since Internet Protocol (IP) in LPWNs with mobility support enables the network to be integrated in other wireless devices, mobility support is an important requirement. Even though the mobility management schemes are accurate, they are complex. As wireless nodes have certain drawbacks, like reduced power, low-energy and limited resources, attention is required while designing the mobility management scheme. By broadcasting the data to the neighboring nodes in the low-power network, it could provide mobility support and this forms one of the simplest ways to address the above issues. However, broadcasting the data requires a lot of processing and energy consumption.

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