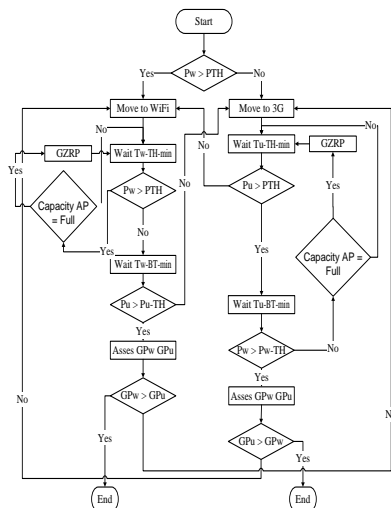# IMPROVED PERFORMANCE OF HYBRID ALGORITHM FOR 3G – WIFIOFFLOAD NETWORKS

Setiyo Budiyanto*, Muhamad Asvial, Dadang Gunawan

Department of Electrical Engineering, University of Indonesia Depok 16424, Indonesia

Graphical abstract

Abstract

A new algorithm for optimizing 3G–WiFioffload and load balancing between nodes, called as New – Genetic Zone Routing Protocol (N – GZRP), is proposed in this paper. N – GZRP is a combination of outputs of Roulette Wheel selections method (RWs) and Rank Selections Method (Rs). Output from RWs is optimized by Rs where Rs is used as a threshold value of the uncertainty that occurs due to the use of RWs. The algorithm is implemented for detecting the performance of mobile devices on several different types of networks. The simulation results are compared with the (RWs)–GZRPand ZRP algorithm. The simulation results show that 35% of power consumption can be saved by using the proposed algorithm compared with GZRPalgorithm. Moreover,when compared with ZRP algorithm the proposed algorithm can save 60% power consumption. In addition, N – GZRP has a more stable throughput which is 3 Kbps higher than ZRP. The simulation results also show that N–GZRPhas smaller average delay than GZRP and ZRPwhich are about 20 msand 1400 ms, respectively.N – GZRP also reduces the synchronization delay about 25 ms and 45 ms compared withGZRPalgorithmand ZRP algorithm, respectively.

Keywords: Roulette wheel, rank, GZRP, 3G – WiFi Offload

1.0 INTRODUCTION

In wireless communication systems, there has been a problem where the traffic data are not spread evenly between one area and otherareas. Some methods such as load balancing and offloading have been employed to solve the problem.In [1–2]Genetic Zone Routing Protocol (GZRP) combined with vertical handover (VHO) for applications in 3G – WiFiOffload network wasproposed.GZRP is a hybrid algorithms composed of Genetic Algorithm (GA) and Zone Routing Protocol (ZRP)whileZRP consists of the Intra – ZoneRouting Protocol (IARP), Inter – ZoneRouting Protocol (IERP) and Broadcast Resolution Protocol (BRP) [3-4].

In MADNET, to improve the performance in the 3G to WiFi offloading traffic various researches havebeen proposed: Empowering Users for Cost – Aware Offloading with Throughput – Delay Tradeoffs [5], Economics of Mobile Data Offloading [6], A Bandwidth Trading Market place for Mobile Data Offloading [7], On the Design of Energy – Aware Heterogeneous Networks 3G / WiFi Under Realistic Conditions [8], enabling Energy – Aware Collaborative Mobile Data Offloading for Smartphones [9].

In addition, several schemes have been developed in literature to fix the problems on MANET performance, such as: Scenario – based Performance Comparison of Reactive, Proactive and Hybrid Protocols in MANET [10], Ad Hoc On – Demand Multipath Distance Vector Routing Protocol Based on

Node State [11], and Performance Analysis of Single path and Multipath Routing Protocol over ADHOC Cognitive Radio Networks [12]. GZRP inMANET technology provides services to small number of hops. Therefore, it can reduce the delay of thesynchronization process for a network with many wireless access points (AP).

This paper is focused on how to overcome issues pertaining offloading between different networks (3G and WiFi), particularly in IERP. The combination of Roulette Wheel and Rank Selection Method as a data selection, called as N–GZRP, is proposed. The main contribution of this paper is to improve the performance of the Quality of Services (QoS) in terms of Received Signal Strength Indication (RSSI), data selection, delay, throughput, and power consumption. The simulation results show that better performance can be obtained using the proposed algorithm compared with GZRP and ZRP algorithms.

The rest of this paper is organized as follows: Proposed Algorithm is described in section 2.0 the Simulation Results and Discussionare presented in Section 3.0 and the conclusion of the paper is in Section 4.0

2.0 PROPOSED ALGORITHM

N – GZRP algorithm has a low complexity and implementsseveralsimple rules to determine a good combination weight QoS. It can be seen by smart methods, such as Fuzzy Multiple Attribute Decision Making (FMADM) to decide parameters [13]. However, the previous research did not discuss the concept of routing in multi base stations. In contrast, the proposed algorithm discusses the routing in the multi base stations so that the load and QoS performance can be increased.

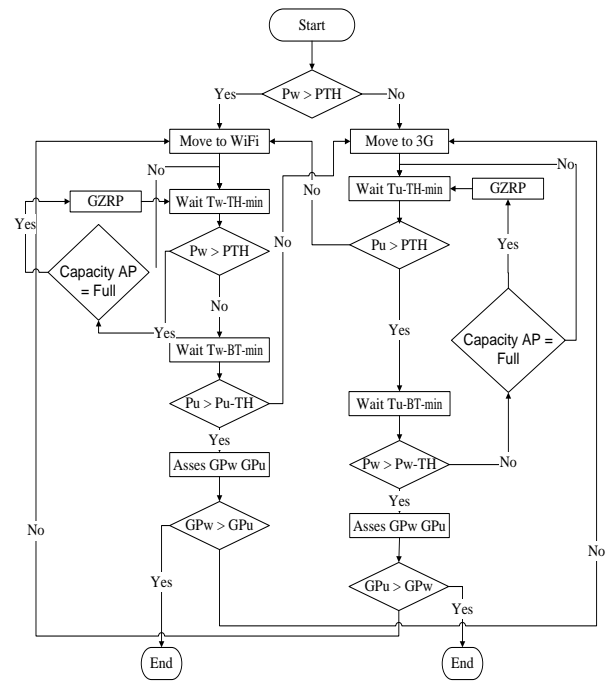The process of the algorithm is shown in Figure 1, as follows :

Figure 1 Flowchart of N – GZRP algorithm

In Figure 1 the algorithm of the N – GZRP is explained as follows

a. If the power of the mobile station at the network (P_w) is higher than the threshold (PTH) value, then the fixed network (Wi - Fi) isactive; but ifP_w is less than PTH then the 3G network is active.

b. The values of RSSI (TW) and RSSI througput (TH-min)affectthe activation of Wi – Fi Network. If the TW is higher or equal to TH-min; then Power (P_w) is able to activate the Wi – Fi network.

c. If the capacity of the AP is saturated and the condition of RSET (T_w) is equal to RSSI throughput then the GZRP load balancing is active.

d. If P_u is greater than or equal to P_u-TH, then the next process is observe good put on the network (GP_u).If GP_w is greater or equal to GP_u then the routing process will end, but if GP_w is less then GP_u then network will switch to 3G network. 3G network will be active when the power of the Wi – Fi network is less than the threshold value. This state depends on the value of RSSI 3G (T_u) network and threshold of 3G network (TH-min).Next step is to observe the power of 3G network and RSSI of 3G.

e. In the 3G network power conditions are affected by the power of Wi – Fi. If the power of the 3G network reachesP_u, then there will be load balancing using GZRP. GZRP is

affectedby occupancy of the AP which is based on Roulette Wheel (RW) selection method.

f.   Data obtained from point f are random. For monitoring traffic easily, the rank selection method based on goodput of the ratio between 3G and WiFi is used. At the time of the GPU has a valued greater or equal to GPW, the the traffic will be switched from 3G to WiFi network.

The performance of the entire existing algorithms decided to use some selections methods, these methods areused interchangeably, starting with the RWs then followed by the Rs selections method respectively.
These methods can be described as follows:

$$FXi \quad = \quad \frac{FRWi}{(nlev + 1) - nolev} \qquad (1)$$

Where FXi is a function of network performance optimization using the Roulette Wheel and Rank Selection Method, FRWi is network condition using Roulette Wheel selection method, nlev is number of hop count in proportional fixed network condition, and nolev is number of 3G base station in mobile network.

The accuracy of choosing data is expressed by:

$$PXi \quad = \quad \frac{FX_i}{\sum\limits_{i=1}^{N}(FXi)} \qquad (2)$$

Where Pxi is the possibility of the election of data accurated.

When the coveraged MN location APs hasmany hops to gateway Ap, MN will proceedto use GZRP algorithm to fix the the number of hops so that the MN can handover in a short time. The formula in [15] is used to determine the queue at each AP, this parameter is known as Node Weight (NW) and given as follows:

$$NW_x(t) = \alpha e_x(t) + \beta I_x \qquad (3)$$

I_x is defined as the length of the buffer queue at time t, $e_x(t)$ is the rest of node energy at t. Furthermore, the Path Weight (PW) which is the minimum value of the NWis obtained from (4):

$$PW_i(t) = \{min(NW_x(t))| \ x \in NODE\} \qquad (4)$$

When the value of PW is attained then we update the PW gained from updating of routing in the NW. Next we define the main path obtained from the least PW, while the main path obtained from (5):

$$route_{list} = max\{PW_p(t)| \ p \ \in PATH\} \qquad ....(5)$$

Where$route_{list}$represents the path of the data transmission and PATH is the set of paths in the routing table.   When it acquires the best route, the process of communication with the AP Gateway can be proceeded.

3.0 SIMULATIONS, RESULTS AND DISCUSSION

3.1 Simulation Steps

This section describes the simulation steps used to implement the proposed algorithm. The simulation process on 3G – Wi-Fi offload is done by using NS2. The simulation process in this research used more Wi-Fi access points than the simulation in [1-2].
The goal of this simulation is to determine the time needed as well as the battery consumption of the AP when it is synchronizing with the 3G network due to its inability to connect with the Wireless Access Gateway. The AP can not connect with it because it is too far away. The data simulations are given in Table 1.

Table 1 Data simulations

Data Simulations	
WiFi Access Point	20 items
3G Base Station	8 items
Range Simulation	600 m x 800 m
Power of MS	4500mAH
Traffic Type	TCP
Transmission Range :	
3G Base Station	200 m
WiFi Access Point	50 m / item
Bandwidth :	
3G Base Station	12 Mbps
WiFi Access Point	7 Mbps
Maximum Speed	0.5 m/s

3.2 Results and Discussion

3.2.1   Power Consumption

This result compares the power consumption of the two existing algorithms, namely RWs-GZRP and ZRP, and the proposed algorithm. The power consumption is observed to determine the stability and quality of the system.
The results are shown in Figure 2.It can be seen that the proposed algorithm has more stable power consumption.It increases about 35% due to the increase of the hop counts. For the RWs-GZRP, the power consumption fluctuates, and for the ZRP algorithm the power consumptionis about 60% higher than the proposed algorithm.
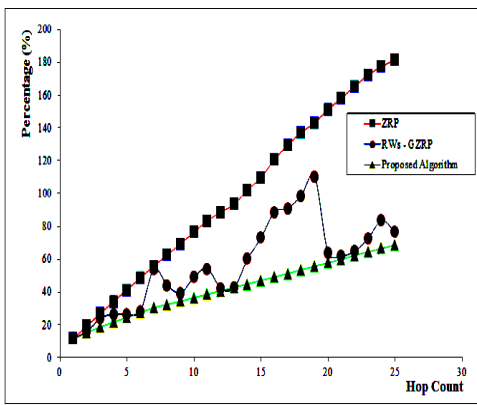
Figure 2 Comparison of power consumption of ZRP, RWs – GZRP and N – GZRP

3.2.2   Throughput

This investigation is to figure out prevalence of the better throughput performance. Figure 3 shows a comparison of the throughput of ZRP, RWs-GZRP and N-GZRP algorithms [1-2].
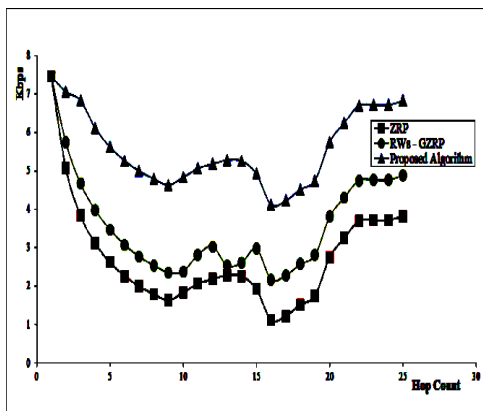

Figure 3 Comparison of throughput of ZRP, RWs – GZRP and N – GZRP algorithm

The throughput generated by the N — GZRP algorithm is similar to the throughput of the ZRP algorithm, but the value of throughput N —GZRP is totally different with RWs — GZRP algorithm (throughput of N — GZRP is about 3 Kbps greater than ZRP). The main difference between GZRP with N - GZRP is in stability of the system. In Figure 3, N - GZRP in hop count 10-15 has a more stable throughput value around 0.7 Kbps compared with GZRP.

3.2.3 Average End-to-End Delay

Delay is invitable in communication, it is also employed in simulation that has been designed. The comparison of the delay plots of the GZRP, ZRP, and N-GZRP is shown in Figure 4.
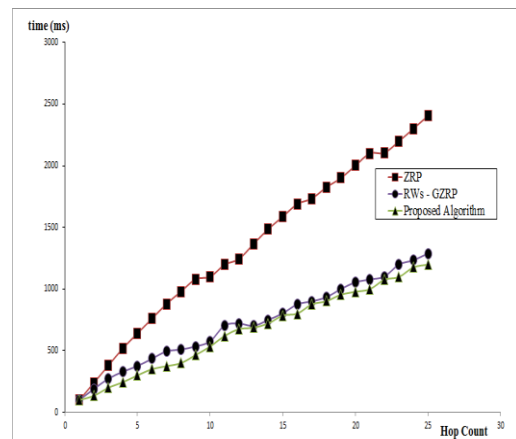

Figure 4 Comparison of average delay of ZRP, RWs–GZRP and N–GZRP algorithm

It can be seen that the difference of the average delay between the proposed algorithm and the RWs-GZRP algorithm is about 20 ms and the difference of the average delay between the proposed algorithm and the ZRP algorithm is about 40 ms.

4.0 CONCLUSIONS

In this paper the 3G network topology-WiFi offload using hybrid algorithm by comparing its effect in terms of the method of data selections has been studied. The acquired results are as follows:

1.   The proposed algorithm has more stable power consumption than the other two existing algorithms. The power consumption of the proposed algorithm does not depend on the hop counts. It increases about 35% due to the increase of the hop counts. For ZRP algorithm, its power consumption increases about 60%, and for the RWs-GZRP algorithm the power consumption is fluctuating.

2.   The proposed algorithm is able to generate larger throughput than the existing algorithms. Its troughput is 3 kpbs larger than the throughput of the ZRP algorithm. The proposed algorithm is also able to generate a more stable throughput than that of the RWs-GZRP algorithm.

3.   The proposed algorithm has a smaller average delay of about 20 ms than the RWs-GZRP algorithm, and 1400 ms smaller than the ZRP algorithm.

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