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A New Model of Genetic Zone Routing Protocol (GZRP): The Process of Load Balancing and Offloading on The UMTS-IEEE 802.11g Hybrid Networks

Setiyo Budiyanto*[1], Arissetyanto Nugroho[2]
[1]Department of Electrical Engineering, Universitas Mercu Buana, Jakarta, Indonesia
[2]Universitas Mercu Buana, Jakarta, Indonesia
Corresponding author, e-mail: sbudiyanto@mercubuana.ac.id*[1], arissoehardjo@yahoo.com[2]

Abstract

The stages of the process of Genetic Algorithm (GA), are: Encoding Genotype and Chromosome; Set Initialization Population; Evaluation Fitness Function; and Selection Process as well as in the later stages Cross Over Process and Mutation. Outputs from the tests performed in this study can be obtained by comparing the Genes of the Child (condition data traffic on the UMTS Hybrid - 802.11g network after the GA) against Gen Holding (traffic data before the GA process).

The research was conducted by calculating the environmental factors, namely: The scheme Two - Ray Model Propagation and Overlapping Channel Interference Factor, the Doppler Effect be ignored because the User Equipment (UE) is considered not to shift significant arenas on the IEEE 802.11g networks. The results of the research is as follows: In the process of cross over, there is a significant change in the bandwidth, data traffic capacity and Power parameter changes by 9 MHz, 36 MB, and 40 dBm. In the process of mutation, there is a significant change in the bandwidth, data traffic capacity, and Power parameter by 17 MHz, 32 MB, and 20 dBm.

Keywords: *genetic algorithm, UMTS-IEEE 802.11g hybrid networks, two-ray model propagation, overlapping channel interference factor*

1. Introduction

The utilization of data traffic on the Universal Mobile Telecommunications System (UMTS) has been increased, along with the supporting technology development [1]. It resulted in the idea to stream the mobile data traffic to other wireless networks such as Wireless Fidelity, in this study used t type IEEE802.11g [2-3]. Mobile Advanced Delivery Network (MADNETs) is the network is able to process the transfer of data from several different networks (UMTS and WIFI)[4-5]. The process of moving data traffic from UMTS network to a WiFi network and also the reverse process (the transfer of data traffic from the WiFi network to a UMTS network) is namely the process of UMTS - WiFi Offload. Vertical Hand Over (VHO) algorithm Used in order to perform the offloading process [6-7]. Until nowadays, there has not been a study that addresses the special routing protocols that can divert traffic to other access points that are in a cluster. Meanwhile, on the other hand technology Mobile Ad-Hoc Network (MANET) has some concept of routing protocols: Reactive, Proactive, and Hybrid [8].

The activities carried out at the investigation are: Development of Genetic Zone Routing Protocol (GZRP) that has been developed in previous studies [9-11]. Namely by elaborating the Genetic Algorithm begin from population initialization process with the best individuals search by cross over methods as well as to the process of genetic mutation.

2. Related Research

The development of technology resulted in increased usage of data in the mobile network. On the other hand, the technology that existed at present incapable of becoming the solution of the problem of increased traffic on these data; it brought the idea to drain the mobile traffic to other wireless networks such as WiFi [12-13]. A MADNET technology architecture that is capable of forwarding traffic to mobile wireless networks such as WiFi accordance research

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conducted in [4]. On the process of offloading traffic from UMTS network to a WiFi network, contained VHO algorithm is: capable of performing the handover process from the UMTS network to a WiFi network [6]. In UMTS - WiFi Offload technology there has been no special routing protocols that can divert traffic to other access points that are in a cluster. On the other hand, wireless technologies such as Mobile Ad-Hoc Network (MANET) have some concept of routing protocols: Reactive (on-demand), Proactive, and Hybrid [8].

In [10-13], a concept known as load balancing using Genetic Zone Routing Protocol (GZRP) on the wireless network MANET, which is a load balancing with bringing the total packets received to an alternative route so as to reduce the traffic load on a standalone service. According to [9], GZRP is the development of hybrid routing protocols in MANET namely Zone Routing Protocol (ZRP) which is coupled with Genetic Algorithm (GA) [14]. ZRP is used to reduce the burden of proactive routing protocol control and reduce the latency caused by the discovery in a reactive routing protocol. In [15] described a WiFi network interworking and UMTS networks, one of which is the handover process that goes from the cellular network to the WLAN. In [6] described a concept handover algorithms set up with both the process of handover from UMTS to WiFi known as algorithms Vertical Handover (VHO). In [6], Vertical Handover (VHO) focused on Goodput and RSSI, known as Hybrid-RSSI algorithm. One thing that is not easy to get an accurate estimate of goodput in the real environment. The second proposal is a hybrid-RSSI estimation algorithms utilizing VHO goodput to ensure the quality of services provided to users.

In [10-11], [16-17], has carried out research related to the use of protocols GZRP combined with VHO occupancy in order to achieve efficiency levels of data traffic, either on the network or UMTS and WiFi networks; as well as the simultaneous performance of both networks. The discussion in detail to the discussion of performance improvement GZRP protocol can be used as a very interesting discussion in order to seek more comprehensive solutions related to problems that occur in the process of load balancing using GZRP protocol.
The Hybrid protocol used is the Genetic Zone Routing Protocol (GZRP) [10-11], is able to improve the efficiency of the performance of a network. It can also reduce the load on the track by balancing the distribution of packet delivery over the course of the alternatives available. Utilization concept GZRP especially in the process of traffic load balancing between nodes.
This study aims to investigate intelligent systems load balancing algorithms and WiFi offload in the wireless communication traffic bottlenecks can be overcome; in addition, also equal distribution of traffic and to develop methods of genetic algorithm combined routing protocol ZRP (Zone Routing Protocol) in the process of offloading in the load balancing and IEEE 802.11g WiFi network. In this case the load balancing process in the Hybrid UMTS networks-IEEE 802.11g. Load balancing happened in the WiFi network is a follow up of the process of offloading data traffic from UMTS network to a WiFi network. Offloading process occurs when the condition value is smaller than the UMTS RSS RSS threshold (do the process of moving traffic from UMTS networks to WiFi).

3. Proposed Algorithm

Offloading process occurred conditions at the time a UMTS RSSI value less than the RSS threshold (carried out process of moving the traffic from a UMTS networks to WiFi). The parameters used in this study were related to load balancing using GZRP (in the WiFi network) is the bandwidth, capacity and power. These three parameters will be linked with other methods of dealing with the propagation and interference, while the effect doopler ignored for User Equipment (UE) is considered not to shift a significant place. Propagation models used is the: Two-ray propagation model models, while the interference parameters using Overlapping Channel Interference Factor. The algorithms developed in the study can be seen in Figure 1.

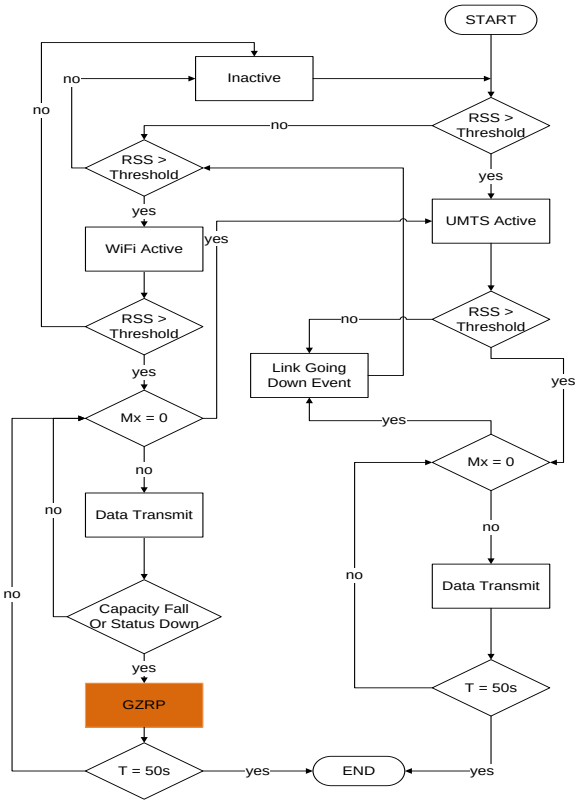


Figure 1. The Proposed Algorithm

Figure 1. Schematic of a working system algorithm developed in the the research, it can be seen Wi-Fi offload process that can be described as follows:

1. User Equipment (UE) is automatically connected to the UMTS network, if RSS> RSS threshold, then it would use the UMTS network; If the RSS <RSS threshold then alert will be given a link going down and will carried out Initialization network conditions and checking RSS in the nearest WiFi node.
2. If the WiFi network also did not have RSS> RSS threshold, then the demand for packet was suspended for a specified timeout. Subsequently, the EU network be deactivated.
3. At the time of the network used, has one of the parameter value 0 of the variable Mx, it will be vertical handover. The parameters that determine handover is defined in Equation (1).

$$M_x = f(b_x - b_{th}) . \ f(RSS_x - RSS_{th}) . (P_x - P_{th}) . \ f(C_x - C_{th}) \quad (1)$$

Annotations:

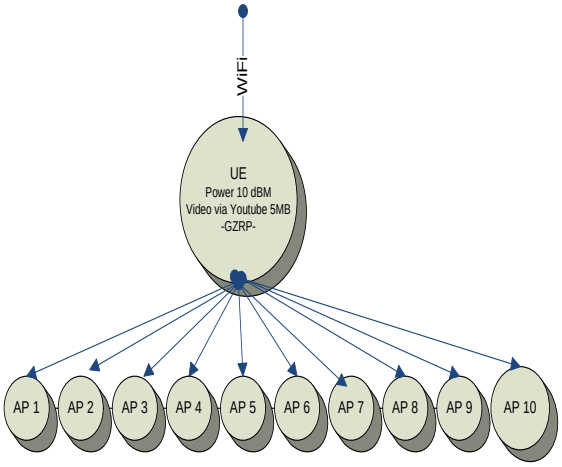
b_x = The bandwidth used by the network to connect (to a UMTS network or WiFi network)
bth = The threshold of the bandwidth required by the EU
RSS = The value of the received signal strength by the EU
RSS_{th} = The RSS threshold value of the EU
P_x = The energy possessed by the base station and the access point
Pth = The energy required by the EU
C_x = The capacity of the network service capabilities by the EU
Cth = The threshold of capacity is required to process UE connection to the network

In a WiFi network, are applied the algorithm with the ability to determine when capacity nodes is in the process of transition or receive the data reaches the threshold or link node status is down applied GZRP routing protocol.

4. Simulation, Results and Discussion

The study bounded during load balancing from a UMTS network to the IEEE 802.11g network. The Genetic Algorithm process begins; as for the stages of the process is carried out as follows: Encoding, Population Initialization, Determination of Value Fitness, Selection, Cross Over and Mutation.

To initiate this process first define the problem, the scenario was made of the condition of User Equipment (UE) and Access Point (AP). AP assumed each of which there are 10 with the bandwidth, capacity and power as follows:



Annotations :
Bandwidth (B_{th}) = 5 MHz
Capacity (C_{th}) = 5 MB
Power (E_{th}) = 10 dBm

Figure 2. Assumptions for User Equipment (UE)

Details of the process, described further, as follows:

1. Encoding in the process of Genetic Algorithm

The encoding process in the genetic algorithm is the process to encode a gene in a chromosome. These genes can be represented in the form of binary bits, real number, a list of rules, permutation elements, and element of the program or other representation that can be operated in the genetic operations.

In load balancing, to a WiFi network each node is encoded form of binary numbers are adjusted for the number of nodes. Forms for each individual chromosome can be seen in Table 1, as follows:

Table 1. The form of chromosomes to each individual (in binary format)

	Bandwidth (MHz)	Capacity (MB)	Power (dBm)
AP1	000101	000110	010100
AP2	000110	001000	010100
AP 3	001000	001010	010100
AP4	001001	001111	010100
AP5	001011	010100	010100
AP6	001101	011001	010100
AP7	001110	011110	010100
AP8	010000	101000	010100
AP9	010010	101101	010100
AP10	010100	111000	010100

Based on the data presented in Table 1, it can be seen that the WiFi network (IEEE 802.11g) consisted of 10 individuals (access point) where each chromosome is defined in binary form. Defining chromosomes are based on three parameters such as bandwidth that put the group first column, column group capacity in the second and third power in the column. Each chromosome is made up of six genes that total in single individual genes to 18 genes.

Fitness Function in the Genetic Algorithm

A function is a reference for the optimal value based on the objectives, namely: the selection of the optimal AP for the EU to consider the bandwidth, capacity and power. The fitness function used can be seen in Equation (2) as follows:

$$X[i] = \left[A * (B_{xi} - B_{th}) + B * (C_{xi} - C_{th}) + \left(\frac{1}{C*(E_{xi}-E_{th}}\right)\right] \quad (2)$$

Description of the parameters used in Equation (2):

X[i] = Fitness Function for the access point number - i
A = Coefficient of Bandwidth
B = Coefficient of Capacity
C = Coefficient of Power Consumption
B_{xi} = Bandwidth contained in the access point
B_{th} = Bandwidth Threshold (contained in the UE)
C_{xi} = Capacity of Access Point
C_{th} = Capacity Threshold (contained in the UE)
E_{xi} = Power of Access Point
E_{th} = Power threshold (contained in the UE)

5. Results and Analysis of the Research

In this section will be discussed related to the results and analysis of outcomes which have been obtained. In this research, discusses the process of genetic algorithms starting from the stage of the gene encoding the individual constituent (access point) and ending with the mutation of an existing gene. The following discussion details about the results of research and analysis of the results of this study:

a. Process of Cross Over at the MADNETs Network by GZRP

The discussion done with the assistance of software NS2.35 and Matlab; for further validation of the data based on by parameter adjustment (6). Be discussed in more details regarding the parameters of bandwidth, capacity and power before and after through GZRP (by comparing the value of both of them using the parameter propagation and interference).

b. Parameter Bandwidth in the Crossover Process

The first parameter is used as a media data validation at the the cross over is bandwidth. Values bandwidth before experiencing GZRP process is the result of the bandwidth that has been presented in Table 1 while the value of the bandwidth after processing GZRP is the value of the match by fitness on the bandwidth which has been interbred by another access point. Outcomes bandwidth obtained before and after the process of GZRP, as shown in Figure 3:

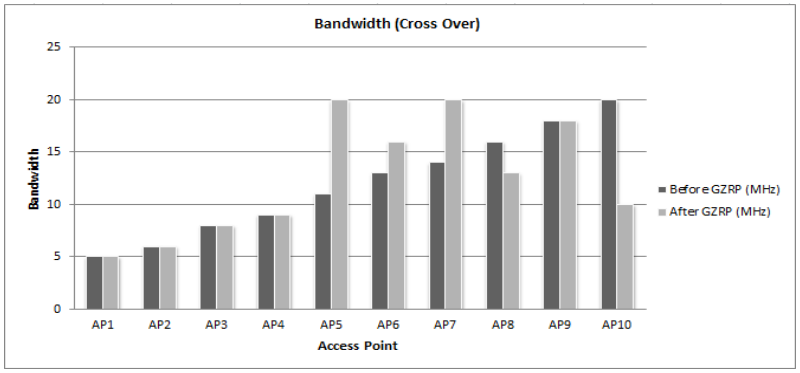


Figure 3. Bandwidth on the conditions before and after the process GZRP

Based on the Figure 3, can be seen the results of the cross over process in the bandwidth parameters contained in the access point. It was concluded that the access point 5 has a value change is the greatest bandwidth is 9 MHz.

c. Parameter Capacity Data Traffic in the Crossover Process

In the cross over process, the data traffic capacity is used as a parameter in terms of measurements and data validation. The value of capacity in before the GZRP process is the

result of the capacity that has been presented in Table 1, while the value of capacity after processing GZRP is the value of the match with fitness on the part of the capacity that has undergone cross over to the other access point. Outcomes of capacity earned before and after the process of GZRP, as shown in Figure 4.

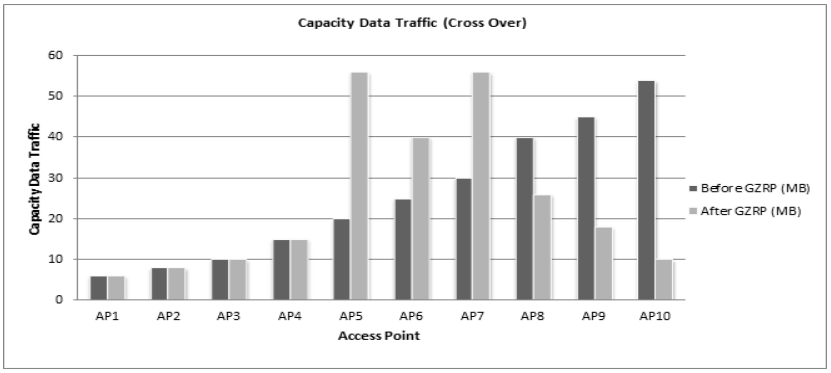


Figure 4. Capacity Data Traffic on the conditions before and after the process GZRP

Based on the Figure 4, can be seen the results of the cross over process in the capacity of traffic data parameters contained in the access point. It was concluded that the access point 5 has a value change is the greatest capacity of traffic data is 36 MB.

d. Parameter Power in the Crossover Process

Process of Mutation at the MADNETs Network by GZRP: Mutations in the the GA will influence the gene at the individual, which generates the best individual or otherwise decreased of quality. In the process of testing mutations in MADNETs network using GZRP, which used the same parameters as in the process of Cross Over: Bandwidth, Capacity Data Traffic and Power.

e. Parameter Bandwidth in the Mutation Process

The first parameter is used as a tool for validation data on the mutation process is bandwidth. The value of bandwidth before experiencing the GZRP process is the result of the bandwidth that has been presented in Table 1; the value of Bandwidth after processing GZRP is the value of the matches with fitness on the bandwidth that has develop of mutation. Outcomes of bandwidth earned before and after the process GZRP, can be seen in Figure 5:

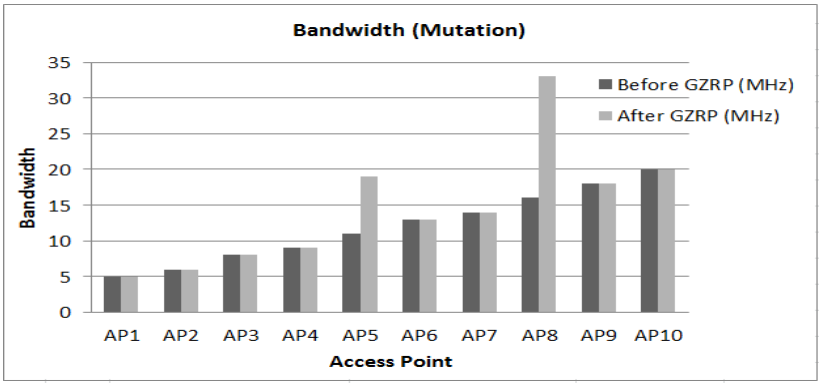


Figure 5. Bandwidth on the conditions before and after the process GZRP

Based on the Figure 5, can be seen the results of the cross over process in the bandwidth parameters contained in the access point. It was concluded that the access point 8 has a value change is the greatest bandwidth is 17 MHz.

f. Parameter Power in the Mutation Process

The value of power before experienced the process GZRP is the result of a power that has been presented in Table 1, while the value of power after processing GZRP is the value of the match with fitness on the part of the capacity that has undergone mutation to the other access point. Outcomes of power earned before and after the process of GZRP, as shown in Figure 6:

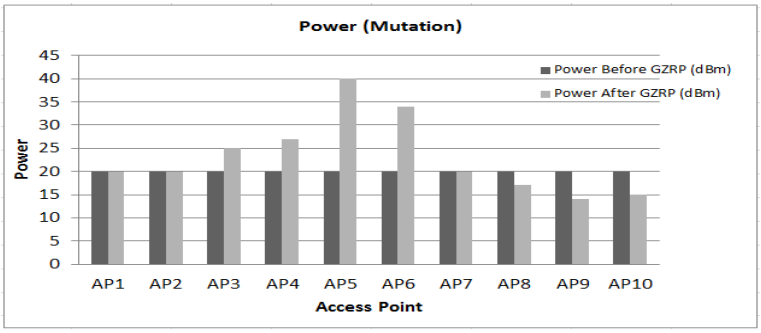


Figure 6. Power Bandwidth on the conditions before and after the process GZRP using two ray model and interference dynamic overlapping channels

Based on the Figure 6, can be seen the results of the cross over process in the power parameters contained in the access point. It was concluded that the access point 5 has a value change is the greatest power is 20 dBm.

6. Conclusion

In this section, there will be a discussion and analysis of results obtained from testing the model renewal GZRP on IEEE 802.11g network, the load balancing the process and offloading on Hybrid UMTS networks - IEEE 802.11g. The process of discussion and analysis of the test results of the research that has been done is to determine the performance of the performance of the system that has been created based on the methodology proposed in this study.

1. The process of GZRP on the MADNETs network; The steps undertaken in this process starting from the Encoding, Population Initialization, Determination of Value Fitness, Selection, Cross Over and mutation.
2. The discussion on the results of research that has been done by calculating the propagation factor two ray model and interference dynamic channel assignment.
3. In the the process crossovers; Access point 5 have the value changes bandwidth, capacity and power of the greatest in the amount of 9 MHz, 36 MB and 40 dBm. Retrieved a conclusion based on these conditions, namely: User Equipment will be connected to the Access Point 5 at the time of the selection of the access point with the network UMTS - WiFi (IEEE 802.11g).
4. In the process of mutation; Access point 5 have the value changes bandwidth, capacity and power of the greatest in the amount of 17 MHz, 20 MB and 20 dBm MHz. Retrieved a conclusion based on these conditions, namely: User Equipment will be connected to the Access Point 5 at the time of the selection of the access point with the network UMTS - WiFi (IEEE 802.11g).

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