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Research paper



QoS Support with Taguchi Method in Simulation Modeling Hybrid Architecture of Optical and Multi-Hop Wireless Ad Hoc Networks

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Abstract

Majority of the resource consumption is consumed for their operation in the access network of mobile wireless part because of its dynamic topology and limited range of each mobile host's wireless transmissions. This paper presents a technique using OMNeT++ software for building a design of experiment simulation model with Taguchi optimization method supported mobile circumstantial network (MANET) of AODVUU communication protocol to be apply into collaborate multiple layers framework of deploy over passive optical network (PON) referred to as the walk Mobile Hybrid optical wireless access network (erL-MMHOWAN). it's to guage the network quality of service effectively that take into account variety of nodes over that the Edouard Manet could operate. Its performance is examined on the known performance metrics just like the network capability and energy consumption. Simulation result shows for the random mobile property during this convergence of heterogeneous optical wireless network will perform higher with the optimized front-end wireless circumstantial.

Keywords: *mobile ad hoc network, Last Mile Mobile Hybrid optical wireless access network, design of experiment, network capacity, energy consumption, taguchi. .*

1. Introduction

The access network is also experiencing exponential growth of access demand for the mobile Internet services. It is estimated that access networks consume nearly 70% of the total Internet resource consumption worldwide [1, 2] such as capacity or energy consumption. Because of this purpose, network operators, and users have shifted the course towards surroundings-pleasant technologies.

There are type of strategies/technology that can be used to decorate useful resource efficiency and availability in the mobile wi-fi access networks specifically of wireless domain. Among today's machine networking answers, fixed wi-fi access which include fiber-wireless (fi-wi) community based r&f (radio & fiber) technology are taken into consideration to be the most promising shipping era because of its greater mobility, excessive speed, richer in bandwidth resources and occasional fiber attenuation [3].

Aside from that, there are capacity difficulty going through by an critical domain in the get admission to networks this is the mobile wireless get admission to community kind that advanced unexpectedly based on few layout dreams that include mobility, user device re-configurability and versatility. There are different study that based on manet community has investigated the topology layout for distribution manet in city strength distribu-tion over fiber hyperlink [4]. For that reason the goal of this proposed studies will give attention to presenting the green internet get entry to to cell advert hoc users based totally on ieee802.11g dcf (dispensed coordination function) [5]. Mainly, it's miles to combine taguchi optimization aodvuu routing [6] into the wi-fi area of optical fiber-wi-fi (fiwi) backhaul community structure. It became finished with attention of qos resource intake under the varying wide variety of nodes.

Comparable history look at [7] changed into performed for ip networks that became related to a management server for monitoring the community topology and packet float in actual time of the transmission and recep-tion. It was believed that they had benchmarked the manet be-havior for extraordinary performance metrics which can be topology and p.C.-et go with the flow. However, it did no longer cognizance on the effect and interplay of the parameters for the manner performance function in ma-net which would help them to capture the community circumstance information.

To the best of the knowledge, not much work on hybrid optical and wireless network planning accounting for multi-hop wireless extensions to the optical segment, further considering the noise factor and control factor for determining minimum variation response of improved quality of service resource consumption at increasing of a number of nodes.

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2. Solutions

2.1. Erlmmhowan Modelling Setup

The next section carries out the DoE simulation of the erL-MMHOWAN using the parameter settings as shown in Table 1. It shows the parameters used in the simulation and their associated values. The input data for the traffic generator is UDP traffic application format only as it did not provide multi-protocol encapsulation. The chosen reference traffic type of this evaluation is UDP [8] because of less overhead and is suitable for achieving the resource-efficient goal to promote an efficient use of networking resources such as capacity or energy consumption. IEEE802.11g with DCF functions at the MAC layer is used because it is a decentralized medium access method operating in both, infrastructure and ad hoc mode while 2 ONUs-Gateway is used due to it is the suitable number of ONUs to be used in FTTH for mall-school areas. The number of nodes is set at 500 nodes due to the high control traffic overhead and the high inefficiency of multi-hop data forwarding to examine the performance impact of network size. There are a total of 8 experiments were done for it with Random Network Generator 3 to obtain the accurate and the best parameters value for optimizing the tested variables.

Table 1: Common main parameters of the LMMHOWAN simulation

Parameter	Values
Simulation times	250s
Fiber type	Single mode Fiber
Reach (OLT-ONT)	20km
Number of OLT	1
Number of ONU	2
Number of nodes	20 to 500
Simulation Area	Max 8kmx6km
Traffic Type	UDP
Routing layer	AODV-UU
MAC Layer	IEEE802.11g with DCF
Carrier Frequency	2.4GHz
Data rate	6Mbps, 24Mbps, 54Mbps
Message Length (Packet Size)	512 byte, 1024 byte
Random number generator (RNG)	3

2.1.1 Erlmmhowan State af Art

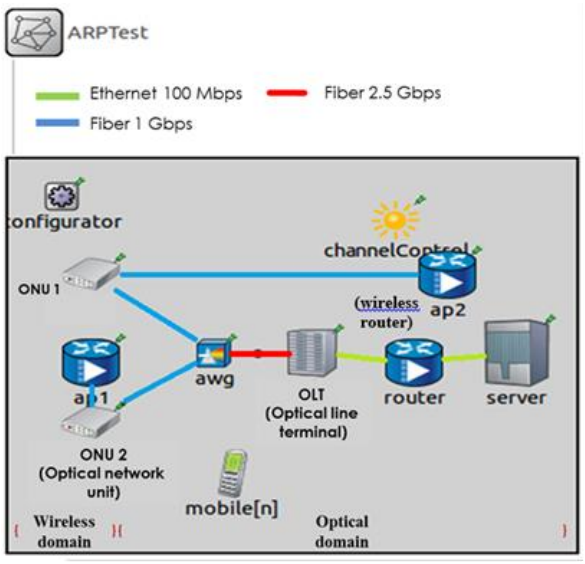

Fig 1: Framework of Multiple Layer Cross Cooperation Solution for erL-MMHOWAN

The present look at on this paper units forth erlmmhowan framework primarily based on fiber-wireless technology may be prolonged to ma-internet radios proposed as a unified analytical framework based on OMNet++ simulation environment [9] for data analysis. An integrated wireless front-end over optical access networks a key supporting technology combined with AODVUU network routing protocol has been proposed here respectively as shown in Figure 1. It is consisting of two main domains with the selected components: ONU, splitter, OLT that reside at the optical backhaul while mobile node, wireless router and wireless gateway in the wireless front end. This is the fundamental approach that based on radio-and-fiber technology with the aggregated optical backbone is to address the mobile wireless access problem. It is to provide efficient resource sharing wireless medium for MANET front-end that consists of independent mobile nodes that are connected to each other. Each participating mobile nodes voluntarily relay the packets to some other mobile nodes using the pre-optimized AODV-UU routing.

2.2. Routing Optimization Based on Taguchi Approach towards LMMHOWAN

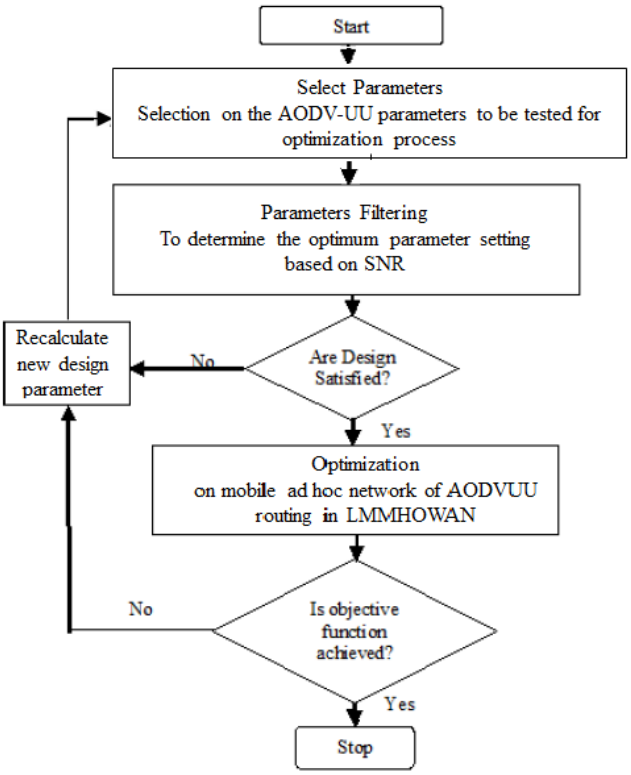

Fig. 2: Optimal design of AODVUU routing in erLMMHOWAN framework based on Taguchi optimization process methodology

This project utilized the Taguchi design method in anticipating the performance of Internet access solutions for AODVUU Packet routing design based on manet community of optimization as proven within the parent 2 underneath the framework of erl-mmhowan. It turned into for quantitatively figuring out just the optimal placing for aodvuu protocol in manet to go along with optical backhaul con-nection as a wireless-stressed out backend. To demonstrate it, the whole seasoned-cess is ready parameter filtering which can be classify into form of parameters; manage and noise factors with admire to the presence variables for quantitatively identifying simply the proper set of ingredi-ents that go collectively to make a amazing product or service is accomplished within the offline mode through using minitab software program, it is where the sign-to-noise (sn) ratios is employs as a quantitative measure for figuring out the most desirable get entry to of wi-fi cellular ad hoc routes over optical pathway to achieve efficient resources. The sn might become aware of the ones control elements that reduce variability. Classes of sn ratios, namely, “large-is-higher” and “smaller-is-better” [10] in taguchi technique can be follow in the aspect filtering procedure however it relies at the

take a look at desires consisting of to minimized the energy consumption or maximized the capacity consumption criteria. However, the loop back will have performed if the factor filtering is not satisfied during the optimization process.

2.3. Performance Criteria

To measure the network performance metrics, the following metrics are used:
Total Energy Consumption [11]: This is the sum of energy consumed for all individual mobile nodes when the nodes were in the active state (transmit and receive), including the idle mode of its radio usage via the integrated multiple layers framework with an optical backhaul extension. For any data packet, the lower energy consumption by the participating node can improve the network lifespan indirectly to preserve as much as possible the network connectivity.

$$E(J/s) = \sum (Q(mAh) \times 60 \times 60 \times V(V) \times 1000 \quad (1)$$

Where mobile battery electric charge Q(mAh) in milliampere-hour and mobile battery voltage V(V) in volts.
Total throughput [12]: The throughput metric here measures how well the network can constantly provide data to the user. To achieve a robust network, it is required that the throughput is at a high-level. Some factors that affect the mobile wireless domain throughput are unreliable communication, changes in topology, limited energy, and bandwidth. Total throughput is the total number of a packet arriving at the destination per simulation time for all participating nodes based on IEEE802.11g DCF wireless router with the client.

$$\text{Throughput} = \sum (\text{Number of packet receive (bit/byte)/simulation time}) \quad (2)$$

End to end delay [13]: This is the average time taken in delivery of all data packets from the source node to reach the same destination node. This metric is important in delay sensitive applications such as video or voice transmission. The lower the respective value, the better the network performance will be to signify the lower congestion ultimately in the network, which will reflect the network connectivity.

$$\text{Delay} = S/N \quad (3)$$

where S is the sum of the time spent to deliver packets for each destination, and N is the number of packets received by all destination nodes.

3. Results and Discussion

The simulation setup is evaluated and revealed under the area of a school compound with the improvement scheme called as erLMMHOWAN with the simulation area of 8kmx6km [14]. It is to be compared with the existing works on MANET domain [15] of its effect of the modified simulation parameters and called as oRir scheme for varying number of nodes in terms of energy consumption, end-to-end delay and network capacity performances.

3.1. Energy Consumption

Figure 3 presents the consumption of energy of all nodes while selecting paths from source to destination based on the AODVUU protocol of MANET over HOWAN after optimization (erLMMHOWAN framework). There is an improvement after optimization at around 26.85% based on its average as compared to prior one (oRir). This is based on the parameter filtering process with selected optimum setting of wait_on_reboot values (1 second). Besides that, the particular parameter main function was to prevent unwanted routing loops for low latency effect, it can have efficient booting time from idle state of its radio usage to active state for better performance of energy consumption as shown in Figure 3.

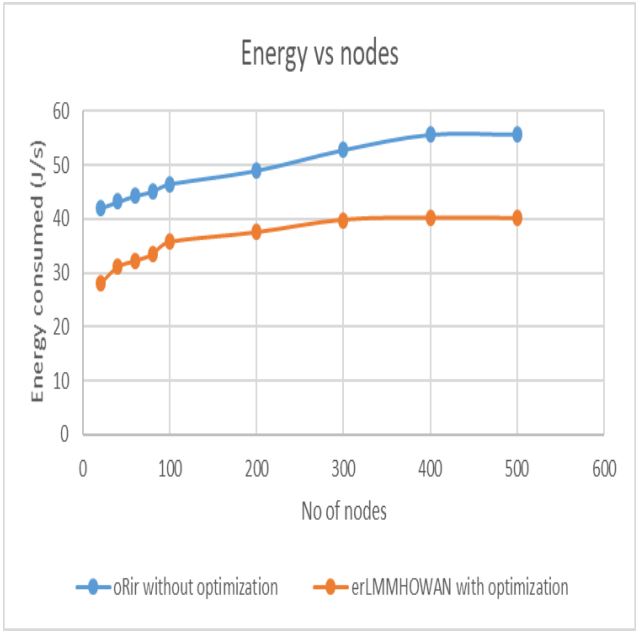

Fig. 3: Energy consumption performance for oRir and erLMMHOWAN multi-parameter AODVUU routing before and after Taguchi optimization mechanism.

3.2. Throughput/Capacity

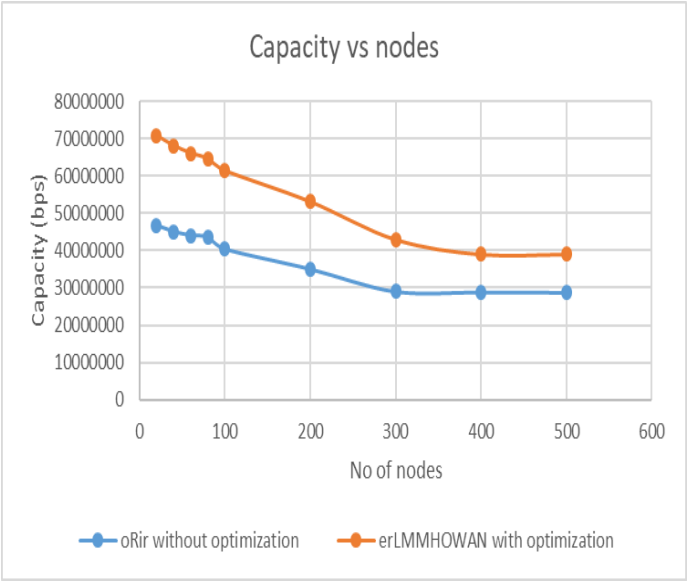

Fig. 4: Capacity performance for oRir and erLMMHOWAN multi-parameter AODVUU routing before and after Taguchi optimization mechanism

After applying this algorithm, our network capacity (erLMMHOWAN) was better than about 47.07% average improvement as compared to prior one (oRir) as shown in Figure 4. This situation happened mainly because of the better link control with optimized link layer feedback (llfeedback) for detection of nodes congestion occur. It enhances the network awareness of the link condition particular when number of nodes is increased. Performance was improved where it has resulted in better packet service time with delay reduced as shown in Figure 5 and increased in network throughput.

3.3. End-to-End Delay

Figure 5 indicates the common overall performance of give up-to-end put off is smaller in our proposed taguchi scheme of editing parameter putting than within the preceding scheme of parameter setting with 13.Forty four% development. Because the number of nodes increases, there's high possibility that the wi-fi the front-cease suffers from a damaged connection resulting in temporal latency (lasting small delay times) because of the high congested path delays the direction looking technique. So, via acquiring best community configurable putting that is to be had on the community layer can accelerate the technique looking new route when the number of nodes boom.

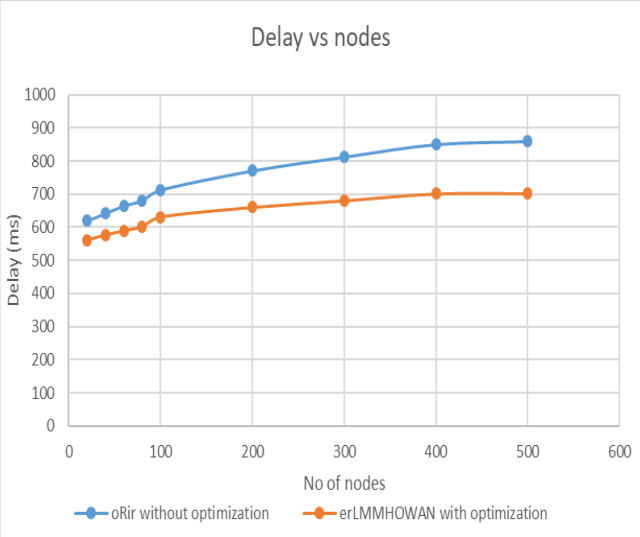

Fig. 5: Delay performance for oRir and erLMMHOWAN multi-parameter AODVUU routing before and after Taguchi optimization mechanism

4. Conclusion

The paper presents the seamless performance can be achieved that is based on the optimum and sturdy style parameters with the target of up the energy resource consumption and maximize theeffectiveness of wireless packet route transmission capability. The Taguchi multi-criterion improvement is integrated with the AODV-UU of Manet over optical backhaul will scale back varia-tion in performance across wireless domain by increasing the over-all performance in erLMMHOWAN QoS potency. It shows that the resource consumption for energy consumption and capabilityconsumption underneath Taguchi multi-criterion improvement is integrat-ed with the AODV-UU of Manet over optical backhaul Taguchi optimized AODVUU routing within the erLMMHOWAN theme is healthier than non-Taguchi AODVUU routing improvement of the oRir mechanism. it absolutely was to beat the continuing major open issue asso-ciated with bandwidth-constrained-variable wireless capability links that area unit showing lower capability than their hardwired counterparts.

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