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Analyzing Adhoc Network's performance on QoS requirements by varying Packet size and measuring the node's remaining energy

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Abstract— In a adhoc network, the performance of the network will be measured by the PDR (Packet Delivery Ratio), PLR (Packet Lost Ratio), Delay and throughput. There are various parameters that affects these network performance measuring characteristics, among others one parameter packet size is important. Node survival and the draining speed of the node's energy is another very important factor for consideration of the nodes presence in the network. In this research paper, we have presented two set of results recorded. In the first set of results PDR, PLR, Delay, and throughput are recorded by varying the packet size from 48 bytes to 80 KB in an adhoc network of 25 nodes. In the second set, the remaining energy and node's draining energy speed is recorded at different time stamps during the communication in the adhoc network with the same setup of 25 nodes.

***Keywords*—**adhoc network, QoS, packet size, PDR, PLR, Delay, throughput.

I. INTRODUCTION

Quality of Service (QoS) is a generic term collectively used to assess the usefulness of any system with user's perspective. In computer networks, QoS involves adding mechanisms to control the network activity such as transmission and error rates, to assure certain level of service parameters. The main goal of QoS provisioning is to achieve a more deterministic network behavior, so that information carried out by network can be better delivered and network resources are better utilized.

QoS is needed in MANET because different applications have different service requirements e.g. VoIP considers issues like delay, jitter and minimum bandwidth. While there is a high mobility of users and network nodes in emergency and military operations, battery and bandwidth are scarce resources and will be important considerations for QoS.

The network is expected to guarantee a set of measurable pre specified service attributes to the users in terms of end – to – end performance. The different QoS constraints are classified as:

- Time Constraints – Delay, Jitter
- Space Constraints – System Buffer
- Frequency Constraints – Network / System Bandwidth
- Reliability Constraints – Error Rate

Different applications require different network performance based on bandwidth needs and latency sensitivity.

Quality of Service (QoS) is usually defined as a set of service requirements that need to be met by the network while transporting a packet stream from source to destination. The network is expected to guarantee a set of measurable specified service attributes to the user in terms of end-to-end delay, bandwidth, portability of packet loss, energy, and delay variance (jitter). To achieve QoS, independently of the routing protocol, each mobile node participating in the network must implement traffic conditioning, traffic marking and buffer management (Random Early Drop with in-out dropping) or queue scheduling (Priority Queuing) schemes. In MANETs, since the mobile nodes can have simultaneous multiple roles (ingress, interior, and destination), it was found that traffic conditioning and marking must be implemented in all mobile nodes acting as source (ingress) nodes. Buffer management and queue scheduling schemes must be performed by all mobile nodes.

We have divided this research work into two sections, in the first part, the network's behavior and performance is studied by recording the variations in PDR (Packet Delivery Ratio), PLR (Packets Lost Ratio), Delay, and throughput by simply increasing the packet size from 48 bytes to 80KB. In the second part, the node is the central figure and the survival of the node and the remaining time of its existence is measured.

So, the Remaining Energy of every node and node's draining energy speed is recorded on different time samples with noticeable remarks on node's battery power and high draining speed.

II. RELATED WORK

Hannan XIAO, Winston K.G. Seah, Anthony LO, and Kee Chaing CHUA presented a flexible Quality of service model for Mobile Ad-Hoc Networks. QoS support in Mobile Ad-hoc Networks (MANETs) is a challenging task. Most of the proposals in the literature only address certain aspects of the QoS support, e.g., QoS routing, QoS medium access control (MAC) and resource reservation. However, none of them proposes a QoS model for MANETs. Meanwhile, two QoS models have been proposed for the Internet, viz., the Integrated Services (IntServ) model and the Differentiated Services (DiffServ) model, but these models are aimed for wired networks. They proposed a flexible QoS model for MANETs (FQMM), which considers the characteristics of MANETs and combines the high quality QoS of IntServ and service differentiation of DiffServ,. Salient features of FQMM include: dynamics roles of nodes, hybrid provisioning and adaptive conditioning. Preliminary simulation results show that FQMM achieves better performance in terms of throughput and service differentiation than the best effort model [1].

P. Mohapatra, J. Li and C. Gui, discussed QoS in Mobile Ad Hoc Networks. They presented a survey of issues in supporting QoS in MANETs. We have considered a layered view of QoS provisioning in MANETs. In addition to the basic issues in QoS, the report describes the efforts on QoS support at each of the layers, starting from the physical and going up to the application layer. A few proposals on interlayer approaches to QoS provisioning are also addressed. The article concludes with a discussion on the future directions and challenges in the areas of QoS support in MANETs [2].

G. Santhi, and A. Nachiappan, also presented a survey of qos routing protocols for mobile ad hoc networks. A Mobile Ad-hoc Network (MANET) is composed of mobile nodes without any infrastructure. MANET applications such as audio/video conferencing, webcasting requires very stringent and inflexible Quality of Service (QoS). The provision of QoS guarantees is much more challenging in MANETs than wired networks due to node mobility, limited power supply and a lack of centralized control. Many researches have been done so as to provide QoS assurances by designing various MANET protocols. In recent years a number of QoS routing protocols with distinguishing features have been newly proposed. However, systematic performance evaluations and comparative analysis of these protocols in a common realistic environment have been performed only in a limited manner. This paper presents a thorough overview of QoS routing metrics, resources and factors affecting performance of QoS routing protocols. The relative strength, weakness, and applicability of existing QoS routing protocols are also studied and compared. QoS routing protocols are classified according to the QoS metrics used, type of QoS guarantee assured and their interaction with the medium access control (MAC) protocol [3].

O. Aruna, A.K. Prathipati, discussed the QoS Signing and Routing in MANET. As one know that today is the time of network where one can have efficient data and voicecommunication services as the ability of network is growing the data available in network is also growing every organization are making our good will on the basis of the large database available in the environment of Internet. Internet making communication easy by introducing new techniques and tools to have solution of problems arising when one communicating through network but the quality communication is always have an opportunity in the front of all the manufacturer and developer of this filed . If one thing about a kind of network where one can have small area network with security and reliability are called Ad hoc Network (MANET). If one study all the traditional wireless architecture then one finds is the best example of AD Hoc Network. A Network without infrastructure facing so many problems related to bandwidth, fault tolerance and reliable communication. This paper deals with quality of service considerations in mobile ad hoc networks and provides a brief overview of the state of the art in this field. It contains the most up-to-date overview of QoS models, QoS routing, as well as resource reservation techniques and concludes with identifying some open issues in this challenging area [4].

Dmitri D. Perkins, and Herman D. Hughes, presented a survey on quality-of-service support for mobile ad hoc networks. They are intended to provide a broad and comprehensive view of the various components and protocols required to provide QoS support in computer networks, focusing primarily on ad hoc networks. First, we introduce the unique characteristics of mobile ad hoc networks, which distinguishing this new network architecture from traditional infrastructured wired and wireless networks (i.e. cellular-based networks). We also discuss the impact of these characteristics on QoS provisioning. Next, we describe the first QoS model proposed for mobile ad hoc networks and its relationship to QoS models proposed for the Internet. We then present a review of the proposed algorithms for each QoS component (e.g. QoS routing, resource reservation and the MAC layer) [5].

Ash Mohammad Abbas and Øivind Kure presented a survey on Quality of Service in mobile ad hoc networks. They presented a review of the current research related to the provision of QoS in an ad hoc environment. We examine issues and challenges involved in providing QoS in an ad hoc network. We discuss methods of QoS provisioning at different levels including those at the levels of routing, Medium Access Control (MAC), and cross layer. Also, we discuss schemes for admission control and scheduling that are proposed in the literature for the provision of QoS. We compare salient features of various solutions and approaches and point out directions for future work [6].

Mrs. S.Rajanandini, K.Reshma, also discussed the quality of service in MANET. Quality of service (QoS) in Mobile Ad-hoc Network (MANET) is a commonly emerging field. A mobile Ad-hoc network is a collection of mobile devices that practice a communication linkage system with no established structure. In line for hasty development of multimedia technology along with mobile technology and real time applications partakes to strictly maintain the quality of services like throughput, energy depletion, interruption etc. This Journal provides the depiction around the Quality of service [7].

P. LOBO, S. ACHARYA, R. O. D'SOUZA, discussed quality of service for manet based smart cities. In the past decade’s digital revolution has caused major breakthroughs in integrated communication technologies field and has changed the way people work, communicate and live. Cities are moving from static infrastructure and buildings to dynamic smart ecosystems known as smart cities. Smart city refers to urban development in various domains of the city like transport, healthcare, home, buildings etc. by using various technology and communication services. As the systems in smart city are heterogeneous, highly mobile, pass large number of messages, MANETS have specific characteristics that can satisfy these requirements. Smart city applications require high reliability, bandwidth, delay and loss of packets should be reduced. Therefore, providing Quality of service (QoS) in such applications is vital. This paper contains a literature review on QoS and network architecture for smart cities, challenges in providing QoS for applications like healthcare [26].

Quality of service (QoS) in Mobile Ad-hoc Network (MANET) which is universally growing area. A mobile ad-hoc network is a collection of mobile devices which form a communication network with no pre-existing infrastructure. Due to rapid expansion of multimedia technology, mobile technology and real time applications has need to strictly support quality of service such as throughput, delay, energy consumption, jitter etc. This paper presents the description about the QoS [27].

Surjeet, A. Prakash and R. Tripathi, proposed a QoS Bandwidth estimation scheme for delay sensitive applications in MANETs. For last few years, Mobile Ad hoc Networks (MANETs) have attracted a great interest in case of wireless and multime- dia technologies. Infrastructure less nature of MANETs makes Quality of Service (QoS) provisioning very challenging and important research aspect. To find a QoS constrained route from source to destination, we should be able to effec- tively determine the available resources throughout the route. The routing protocol is the most integral part of any type of QoS provisioning. It has to decide which route is able to fulfill the requirement of the desired QoS for specified ap- plication. In this paper, modification has been proposed in the existing MANET protocols to get the information about total path bandwidth for delay sensitive applications. It uses modified technique for bandwidth estimation and for route maintenance. The proposed protocol is implemented and simulated using NS-2 simulator. Results of our implementa- tion show that there is much improvement in overheads without any impact on overall end-to-end throughput [28].

MANET is a collection of wireless nodes that can dynamically form a network to exchange information without using any pre-existing fixed network infrastructure. The special features of MANET bring this technology great opportunity together with severe challenges. This paper describes the fundamental problems of ad hoc networking by giving its background including the concept, features, status, and applications of MANET and we have discussed security and Quality of services (QoS) challenges of Mobile ad-hoc networks [29].

An inelastic flow is a flow with an inelastic rate, i.e., the rate is fixed, and it cannot be dynamically adjusted to traffic and load condition as in elastic flows like TCP. Real time, interactive sessions, and video/audio streaming are typical examples of inelastic flows. Reliable support of inelastic flows in wireless ad hoc networks is extremely challenging because flows and routes dynamically change and flows compete for the shared wireless channel. Bandwidth must be reserved for inelastic flows at session set up time. To avoid repeated attempts to set up reservations in a ‘volatile’ network and prevent serious network capacity degradation due to call set up overhead, a Call Admission Control strategy robust to mobility must be developed. In this paper we propose ProbeCast, a probe based call admission control scheme with QoS guarantees for inelastic flows. ProbCast was designed for multicast streams but can also work, by default, for unicast. In ProbeCast, a path (or a tree) is probed for capacity availability. If an intermediate link along the probed path fails to meet the QoS requirement, the flow is ‘pushed back’ via backpressure upstream to an intermediate branch or possibly to the source. The backpressure principle is simple; however, its implementation requires some care to avoid unfairness and eventual capture by one of the flows sharing a congested bottleneck. We show that proportional fairness among inelastic contenders will prevent capture. To achieve this, we have developed the Neighborhood Proportional Drop (N-PROD) scheme. N-PROD guarantees fair rejection of unfeasible flows and maintains the same proportional drop rate among surviving flows in the same contention domain. We demonstrate the efficacy and robustness of ProbeCast for unicast as well as multicast scenarios using the Qualnet simulation platform [30].

E.S.A. Ahmed, and R. A. Saeed presented a gateway selection scheme for MANET to Internet connectivity. Nowadays, MANETs becomes a most types of the networks used in many applications, which support a communications between several sources and destinations without using infrastructure mode. Since these networks are infrastructure free, so it required a mechanism to route the information from the sources to destinations and the routing protocols has been studied deeply. Other consideration that becomes a most important issue is how to connect the MANET to the Internet and the most important parameter is how to interface between these networks. Gateways are most important mechanism to interface between these networks and it must be stable to ensure good quality of services for MANET and Internet connectivity. The main challenges in MANET-Internet connectivity are gateway discovery and gateway selection. Many solutions are proposed and implemented by the different authors/researchers to discover the gateway to the internet so that gateway discovery as we know has been deeply investigated. The second challenge is how to select an optimal gateway and a few different mechanisms have been proposed to select gateways. In this paper we present a review of various gateway selection schemes which are used in MANET to Internet connectivity [31].

III. EXPERIMENTAL WORK AND RESULTS

Result Set 1 : It is noticed that as the packet size increased the PDR % (packet delivery ratio) is increased proportionally, whereas PLR % (Packet Lost Ratio), All Delay and throughput is decreased as shown in the table 1 and figure 1, 2,3, and 4 below:

Table 1: Transmission Details by varying packet size

Packet_Size	PDR (%)	PLR (%)	All_Delay	Throughput
48	59	40	0.0383537	0.626105
53	54	47	0.0494296	0.51602
64	68	31	0.146784	0.674863
128	59	41	0.104924	0.380365
256	65	35	0.0670402	0.313171
512	72	28	0.0240692	0.255368
1024	80	20	0.00503489	0.229596
2048	88	12	0.00708417	0.220947
3072	90	10	0.00244778	0.206265
4096	93	7	0.00360063	0.22558
5120	93	7	0.00543793	0.241605
10240	95	5	0.000486122	0.100714
20480	97	3	0.000319902	0.0746338
40960	98	2	0.000400277	0.0725372
61440	98	2	0.000140661	0.0724945
81920	98	1	0.00013329	0.0716675

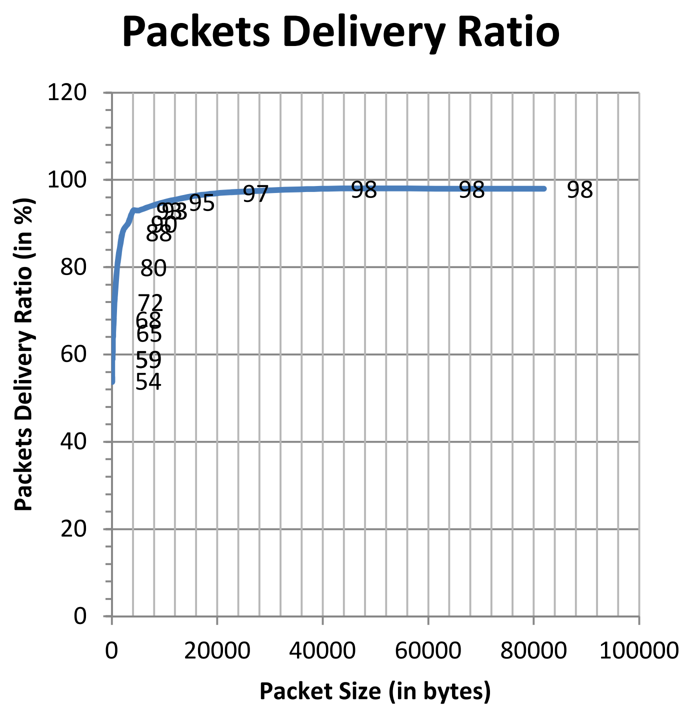

Figure 1 : Results of Packet Delivery Ratio (in %) by increasing the packet size (in bytes)

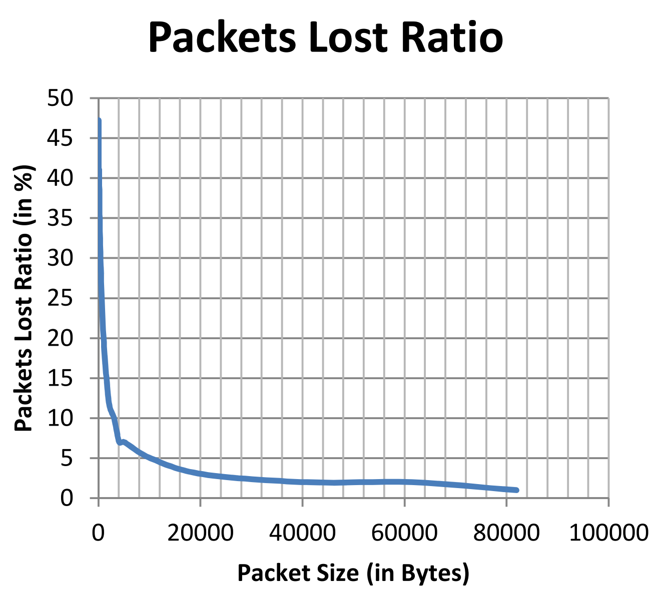

Figure 2 : Results of Packet Lost Ratio (in %) by increasing the packet size (in bytes)

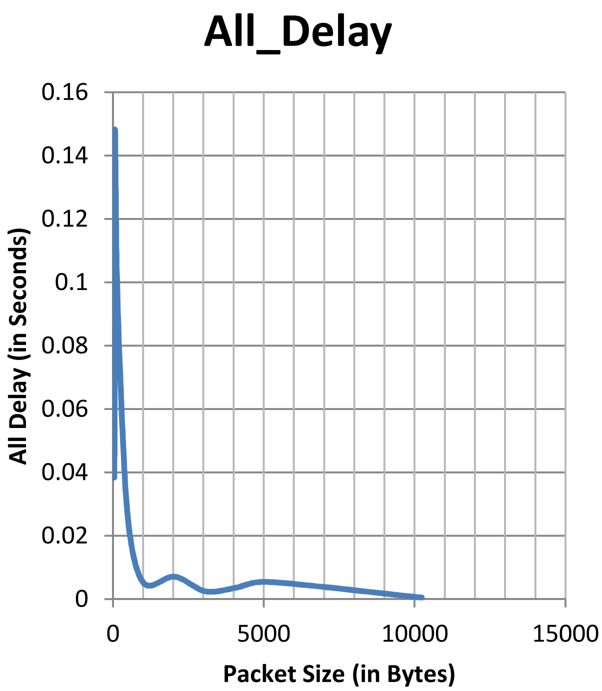

Figure 3 : Results of All Delay (in Seconds) by increasing the packet size (in bytes)

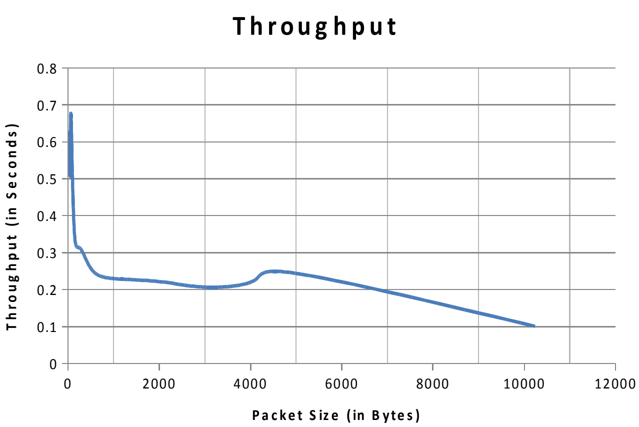

Figure 4 : Results of Throughput (in Seconds) by increasing the packet size (in bytes)

Result Set 2: In the second scenario, remaining_energy and node's draining_energy_speed is noticed. The samples are taken by per node at different time stamps and the remaining_energy and draining_energy_speed are recorded. During the execution of various test, two remarks are added in the recorded results : (1) when node battery power is low, and (2) when the draining speed is high.

When the remaining_energy of the node is higher than 0.0543445, the results are recorded and as the remaining_energy reaches to 0.0546874, the message "battery is low ….. change node" will be displayed.

When the draining speed is higher than 8.0000e-06 (i.e. 0.000008), the message "draining speed is high …, Change Node" will be added to the log and node will be changed or the current node will be now out of trace. Otherwise the draining speed of the node will be recorded at every transaction.

We have recorded around one lakh something records at different times during simulations. Some of the result samples are shown in the table 2 below:

Table 2 : Results of Node Energy and Draining Speed

Time of Data Recorded	Old Value of Node Energy	Remaining Node Energy	Nodes_draining_Speed
0.018136	0.0999534J	0.0999463J	7.10E-06
0.0181361	0.0999534J	0.0999454J	8.04E-06
0.0181361	0.0999543J	0.0999463J	8.04E-06
0.0181362	0.0999613J	0.0999532J	8.04E-06
0.0181363	0.0999613J	0.0999532J	8.04E-06
0.0181366	0.0999622J	0.0999542J	8.04E-06
0.0181366	0.0999613J	0.0999532J	8.04E-06
0.0181366	0.0999622J	0.0999542J	8.04E-06
0.0181366	0.0999613J	0.0999532J	8.04E-06
0.021	0.1J	0.0999732J	2.68E-05
draining speed is high …, Change Node			
0.021136	0.0999732J	0.0999661J	7.10E-06
0.03	0.0999636J	0.0999459J	1.77E-05
0.0300002	0.0999741J	0.0999538J	2.03E-05
0.0300003	0.0999637J	0.0999459J	1.77E-05
0.0300004	0.0999637J	0.0999459J	1.77E-05
0.0300005	0.0999702J	0.0999538J	1.64E-05
0.0300006	0.0999646J	0.0999469J	1.77E-05
0.0300007	0.0999646J	0.0999469J	1.77E-05
draining speed is high …, Change Node			
0.030136	0.0999459J	0.0999388J	7.10E-06
0.0301362	0.0999538J	0.0999458J	8.04E-06
0.0301363	0.0999459J	0.0999379J	8.04E-06
0.0301364	0.0999459J	0.0999379J	8.04E-06
0.0301365	0.0999538J	0.0999458J	8.04E-06
0.0301366	0.0999469J	0.0999388J	8.04E-06
0.0301367	0.0999469J	0.0999388J	8.04E-06
draining speed is high …, Change Node			

The results shows that the algorithm Rem_Energy (oldValue, remainingEnergy) works well with simulation on network as defined earlier. This is also illustrated in the figure 5 that the algorithm is regularly calculating the node energy on every millisecond and Change of Node takes place when energy draining speed is high.

IV. CONCLUSION

As QoS (Quality of Service) is important to achieve better performance of network in terms of packet delivery, packet lost, delay and throughput. In this research work, we have implemented the NQoS (Network Quality of Service) by having wifiMac as NqosWifiMacHelper and analyzed the network behaviour on these parameters by varying the size of the packet. It is noticed that as the packet size increased the PDR % (packet delivery ratio) is increased proportionally, whereas PLR % (Packet Lost Ratio), All Delay and throughput is decreased as shown in the table 1 and figure 1, 2, 3, and 4.

As node's energy is another important factor for node's life in the network. So, it has been taken up as next factor for our research work. Remaining Energy of every node has been measured and node's draining_energy_speed is recorded at different time stamps with two noticeable remarks on node's battery power and high draining speed. The simulation result has been shown in table 2 and figure 5.

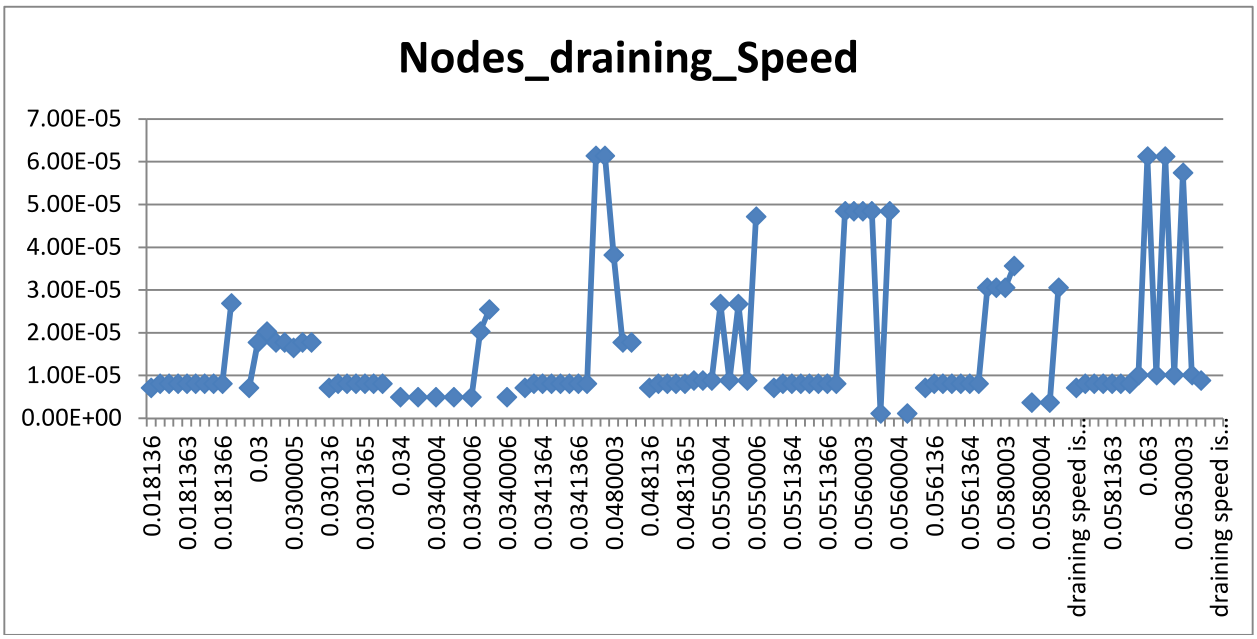

Figure 5 : Nodes Draining Speed and change of Node of high draining speed

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