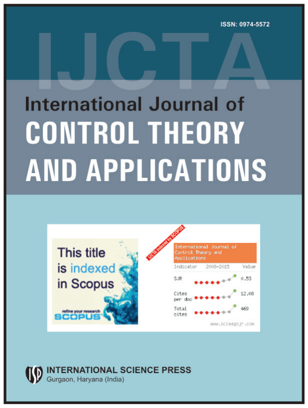

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An Optimized Routing Strategy for Registered Versus Un-Registered Associated Nodes in NEMO

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Abstract: Utilizing tremendous number of nodes having mobility behavior, mobile nodes is increasing as an emerging technology also it is termed as NEMO (Network Mobility). Mobile nodes, vehicle nodes and etc., are moving nodes deployed in NEMO network. Since nodes are moving, it is a challenging task to provide increased Quality of Service (QoS) in NEMO. QoS is a set of parameter values which should fulfill the user requirements. In this paper it is aimed to provide an optimized bandwidth for controlling the network data traffic. Optimizing the bandwidth reduces the time to transfer and reduce the overload in the router by decreasing the header size. This optimization of bandwidth is simulated in NS2 software and it gives better results with improved QoS in NEMO.

Keywords: NEMO, Network Mobility, Mobile Nodes, MANET, Quality of Service, Bandwidth Allocation, Traffic Maintenance.

1. INTRODUCTION

A mobile network is considered as a set of mobile nodes (MN) which move collectively as a unit. The examples of mobile networks are trains, airplanes or ships with wireless devices. It is ineffective for each MN to involve in handover strategy at the same time whenever the mobile network moves. Further, not all the MNs in the mobile network might be sophisticated enough to run mobility bolster protocols like MIPv6 [1], mSCTP [2]. Based on MIPv6, the network mobility basic support protocol (NEMO BSP) is standardized by the IETF Network Mobility working group.

A dedicated service called Mobile Router (MR) is introduced by NEMO BSP in which the appropriate Access Router (AR) is attached on behalf of MNs involved in mobile network. In the mobile network, all MNs are allowed by it to not lose the ongoing sessions irrespective of their abilities amid handover. Each MN setup its own address depending on the Mobile Network Prefix (MNP), in which the MN is periodically broadcasted with Router Advertisement (RA). The MNs is not changed and also it would not aware handover even though the MR changes its point of attachment. Nevertheless, since NEMO BSP is relied on MIPv6 and the drawbacks of MIPv6 are inherited like long signaling delay and movement detection time. Further, the delay influenced by the movement of the MR impacts all MNs in the mobile network. The other problem is that NEMO BSP does not cover MN's movement that moves in or out mobile network. It indicates that MN should possess mobility protocol for own mobility.

In order to reduce a signaling delay in confined areas, the Local mobility management (LMM) protocols are proposed. The most promising LMM protocol presented by IETF is the Proxy Mobile IPv6 (PMIPv6) [3]. The conspicuous characteristic of PMIPv6 is that it is a network-based protocol, which avoids the association of MNs from handover procedure. The node is prevented from modifying their address after handover and movement detection time is evacuated. MNs, which don't have mobility function, modify its purpose of connection without losing connection. A few PMIPv6-based NEMO supporting protocols are proposed [4-6].

The NEMO bolster protocols have contemplated solutions about location management and decreasing handover latency of the mobile network. In any case, they need bolsters for MN's development into the mobile network or the other way around; MN needs mobility protocol even in case of PMIPv6-based NEMO protocols. A Node Mobility supporting plan is presented with a mobile network in PMIPv6 network (nmNEMO). The proposed scheme underpins node mobility between mobile network and PMIPv6 network without MNs' portability bolster capacities. The MR in a mobile network acts as a MAG and gateway. Upon node attachment, MR exchanges messages with node's LMA and imitates its home system.

The mobile network which bolsters network mobility has become an emerging technology in recent days. It is also called as NEMO (Network Mobility). It is more suitable for mobile platforms like car, bus, train, air plane, etc. In NEMO, providing the Quality of Service (QoS) is considered as a great challenge. The network has to meet the set of service requirements which is named as QoS. A method which is utilized in the digital communication networks is called Packet Switching in which the content is divided into blocks called packets irrespective of its size, type or structure. The packet are buffered and queued during the travel through the network switches, routers and other nodes. This results in variable delay and throughput relies on the traffic in the network. Here, two major packet switching modes exist. The first mode is the connection less packet switching known as datagram switching and the other one is the connection oriented packet switching which is known as Virtual Circuit (VC) switching [7].

A lot of attention is gained for effective data transfer in the virtual circuit due to its congestion-controlled and delay-reduced approach. In datagram switching, a complete addressing or routing information is included in every packet. The routing of packets is carried out individually and sometimes in various paths. Mobile IP is an IETF (Internet Engineering Task Force) standard communications protocol which is outlined to permit mobile devices to shift from one network to another while maintaining an eternal IP. Mobile IPv4 is outlined in IETF RFC 3344 [8] and Mobile IPv6 is outlined in IETF RFC 3775 [9]. The next generation IP version is the IPv6 that is designated as the descendant to IPv4. A 32-bit address space is utilized by IPv4 and the 128-bit address space is utilized by IPv6. IPv4 and IPv6 contain different address space and also different header format. Additional information is added at each routers whenever a packet is delivered through the traditional Mobile IP from the source to the destination. This additional information helps in identifying the next router and the path. The load of the packet will be increased at each router to a larger size when the number of intermediate routers is much high. This leads to delay in the data traffic and the traffic flow will be more deprecatory. In the virtual circuit switching, the VC identifier is added instead of adding the address information. The concept behind the virtual circuit is to circumvent selecting a new route for every packet. When a connection is established, instead of selecting new routes, a route is recognized for all traffic flowing over the connection as part of the connection setup and deposited in the tables of the routers. An identifier is carried by each packet that tells which VC it belongs to.

2. RELATED WORKS

The datagram switching includes some extra data at every router. It causes delay and deprecatory network traffic. The identifier information is added by the VC, which doesn't consume much space. Rather than including more data like source and destination address at every router, essentially includes the VC Identifier (VCI) will diminish the size of the header. The benefits of VC are connection-oriented services, Quality of Service is ensured, no congestion since resources are allocated in advance and packets are forwarded more rapidly because no routing decision is required, and so forth. The VC can diminish the delay and to enhance QoS in mobile wireless networks [10]. The expanding utilization of transferring multimedia applications, for example, voice, video and information requires the QoS support. Since Army moves hierarchically, nodes in Tactical Internet (TI) have the features of Group Mobility [11] and the topology of TI is not changed violently in the most part time. TI is a critical part of military applications utilizing Ad Hoc technology, which is the essential platform of tactical communication later on war. So it is significant to configure the virtual circuit in TI, which gives end-to-end QoS as well as implements end-to-end compression of packet header [12] to enhance the proficiency of packet transmission.

In Mobile Ad hoc NETworks (MANETs), the success of the virtual circuit closely relies on the resource reservation scheme at the Media Access Control layer. QoS routing protocols search for routes with enough resources for the QoS requirements, which operates with the resource management mechanisms in order to implement paths by the network that satisfies end-to-end QoS requirements [13-15]. In MANETs, the QoS routing is found to be difficult. Since the mobile node requires mechanisms to store and update link information [16], the overhead is too high for the bandwidth limited MANET. In virtual circuit, the multicast services need a communication path from a sending node to a specific number of receiving nodes. Hence, the multicast calls are concurrently configured in various directions. Subsequently, the service processes in these directions become mutually dependent and a blocking in one group impacts a blocking in other groups involving in the connection [17].

In mobile networks, the Quality of Service (QoS) is increased with respect to delay by utilizing the assistance of Delay-Sensitive Mechanism to Establish Route Optimization (DeSMERO). Our idea could be implemented by the service providers in order to provide better QoSs to the consumers for delay-sensitive applications like video conferencing, telephony, etc., [18]. A novel technique is presented to forecast reason(s) for failure in the QoS and to find the algorithm(s)/mechanism(s) responsible for the failure [19]. Various raw radio rates and user throughput are incorporated by each network. The actual throughput is always smaller than the raw radio data rates [20]. There is an incredible need to utilize bandwidth adequately which in turn increases the execution of the wireless network. In [21], detail examination of different web applications and wireless technologies with network parameters, for example, bandwidth, radio rate, user throughput, type of duplex communication framework was finished. It likewise relates web applications, wireless technologies and network parameters to utilize the bandwidth successfully. To total up, giving QoS will be a more troublesome in NEMO [22] (i.e. mobile network that supports network mobility). Thus many components or parameters are included to give QoS in mobile networks. As the mobile wireless networks starve for bandwidth, it is more suitable to present a procedure to use the bandwidth adequately.

3. OPERATION OF NEMO

A mobile network (known also as a "network that moves," or NEMO) is defined as a network whose attachment point to the Internet differs with respect to time. An example of a network-mobility scenario is depicted in the figure 1. The NEMO group uses a terminology named as a router which gives connectivity to the Mobile Network (MN) as a Mobile Router (MR). The Mobile Network Nodes (MNNs) are defined as the devices belonging to the mobile network in which the connectivity is obtained through the MR. There are various types of MNNs: Local

Mobile Node (LMN) is a node which implements the Mobile IP protocol and its home network is located in the mobile network; Local Fixed Node (LFN) is a node that has no mobility specific software; and Visiting Mobile Node (VMN) is a node which implements the Mobile IP protocol, that possesses its home network outside the mobile network, and it is visiting the mobile network [23].

The Home Agent (HA) is situated in the home system of the mobile network which is an area where the mobile network addressing is topologically right. The Correspondent Node (CN) is a node which sends to or gets a message from MNN. Access Router (AR) is the router where the MR is connected when it is moving out of home network to interface with its home system. Care of Address (CoA) is the address given to MR when it is mapped with the AR through the visited network. The HA will allude dependably the CoA for MR address. At the point when any node situated at the Internet, known as a CN, exchanges IP datagram's with a Mobile Network Node, the accompanying operations are included in the communication. When the MR moves far from the home connection and joins to new access router (AR), a Care-of-Address (CoA) is obtained from the visited link. When, the MR gains a Care-of Address, it quickly sends a Binding Update to their Home address.

4. EXISTING APPROACH

M. Dinakaran et. al., (2010), presented a basic communication methodology in NEMO among MNN and CN. MNN and CN communicated through bi-directional tunnel method where tunnel is established between the corresponding MR and HA. The data transmission is happen after encapsulating the packet whereas it increases the packet size and takes more time to de-encapsulation and transmission and it needs amplification for bottlenecks. In the existing system communication happens only between known or new CN to MNN which restrict emergency situations based communications.

But, in this paper the above problems are solved by providing flexible communication among any CN to MNN through NEMO Routers with the help of identifying their Fundamental Circuit. Considering the FC maintains the mobility of the nodes information, if require it reestablish the connection between CN, MN and NEMO Router through FC. One of the advantages in this paper is re-establishing and resuming the connection and data transmission is applicable in NEMO network whenever it requires. This increases the throughput, and avoids data loss with mobility. There are two different types of nodes are considered in this NEMO network communication. Registered and un-registered nodes are communicating in NEMO network. Whenever a new NEMO node wants to make a communication with other node or NEMO router it initially communicated with the home agent in its home network. The common data transmission is NEMO Node to Home Agent, Home Agent to NEMO Router then to NEMO Network Node-i. During the communication the nodes are verified as registered or unregistered. If it is unregistered the details of the node is collected and verified dynamically in order to provide security whereas for registered nodes, no, due to the information about the registered nodes are stored in the Base station registry already. Each time of new communication, the Home Agent investigates the node and the node details with authentication for providing authorization. The registered NEMO nodes can transfer the data immediately to any node in the NEMO network.

5. PROPOSED QUALITY OF SERVICE STRATEGY

In this paper, it is aimed to increase the Quality of Service in NEMO whereas it is assumed that all the nodes in the NEMO are moving nodes. Online Bill payment, online fund transfer and ATM (Asynchronous Transfer Mode) based scenarios are taken as the sample NEMO network environment. The header size of the networks is assumed as 5 bytes as opposed to 40 bytes in IP (Internet Protocol) - based networks. The Fundamental Circuit (FC) approach exploits the Identifier called as FCI (Fundamental Circuit Identifier) to implement a route among the source and the destination. At whatever point there is a demand for the information transmission, a FC is set up utilizing FCIs. At the end of the day, the route is established amid the call setup utilizing the VCI that is allocated to the intermediate channels. Presently, every packet is swap over by means of the implemented FC.

Any NEMO Router can join or leave from any FC. In this case, if the FC is re-established then the transmission of data packets also resumed. Once the packet transmission is completed then the FC is terminated. This entire procedure of the proposed QoS NEMO routing is given as step by step procedure as:

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{

1. Create number of Channels c_i
2. Create number of links L_i
3. Determine and deploy initial nodes CN_i
4. Define number of channels for each link
5. Assign Fundamental Circuit Identifier for all the channels. FC_i
6. Establish the FC
7. Start Data packet transmission DT_i
8. If the distance (d) is increased among NEMO Router and NEMO nodes then reestablish new FC
9. Once again restart/resume the data packet transmission
10. Terminate the FC after data packet transfer completion

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The entire FC scenario is shown in Figure 1, in which the proposed procedure for a mobile network is demonstrated.

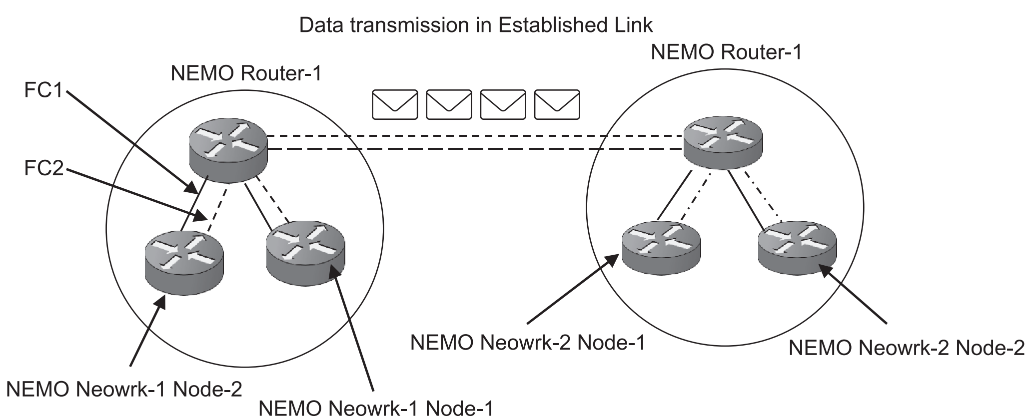

Figure 1: Sample NEMO Network Environment

The FC is set up between NEMOR1 (NEMO Router 1) and NEMOR2 (NEMO Router 2). The connection amongst NEMOR1 and NEMOR2 is assumed to have 2 channels. A NEMON1-N1 (NEMO Network-1's Node 1) can exchange information to MN2-N2 by means of one channel and NEMON1-N2 (NEMO Network-1's Node 2) can exchange information to NEMON2-N1 through other channel. Every mobile router keeps up a table that has two noteworthy fields IN and OUT. The FCI is deposited in these fields. The mobile router directs the packets depending on the data accessible in the header and table. As the size of the packet header is 5 bytes, it is conceivable to exchange more packets by means of FC. As such, the bandwidth utilized by the control information is enormously decreased from 40 bytes to 5 bytes. The rest of the bandwidth (35 bytes/bundle) utilized by control information can be utilized to send more payload.

6. SIMULATION RESULTS AND DISCUSSION

The above discussed scenario is created and simulated in Network Simulator 2 software and the results are verified. There are four different NEMO network is created with four FC, four NEMO routers and 80 NEMO nodes are deployed whereas each NEMO network comprises of 20 nodes. The data packet transmission among NEMO nodes in different networks N1, N2 is transmitted through NEMO Routers 1 and 2, which is depicted in Figure 2. The entire simulation parameters with assumed values are given in Table 1.

Table 1: NEMO Simulation Parameter Setting

Parameters	*Values Assigned*
Network Size	1500 × 1500 m
Number of Routers	2 to 5
Number of Nodes	20 to 100
Transmission Range	180 m
Average Speed	10 m/sec
Direction	360, Random
Simulation Time	100 Sec

DPIN		DPOUT	
NEMO-N1-N1	1	NEMO-Router-2	2

DPIN		DPOUT	
NEMO-Router-1	2	NEMO-N-2-N1	1

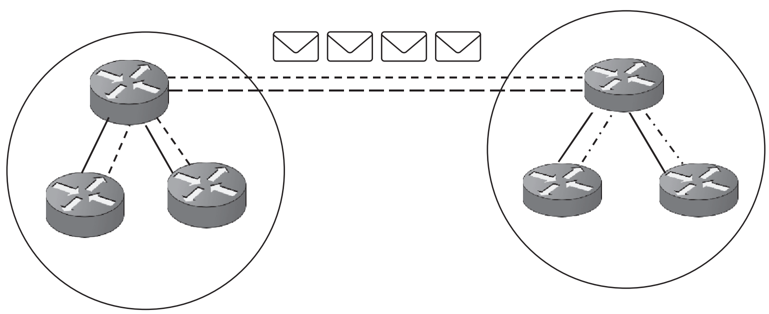

Figure 2: Proposed Method with FC Approach

In the traditional network IP, the size of the data packet is increased due to inserting additional information such as destination address and source address. This causes increased delay in data transmission and provides ineffective bandwidth usage. But here, in router the data packets are wrapped up with the header information while transmitting from one router to the next router. All the routers in the NEMO have to check the data packets to forward to the next router if it requires. If the data packet reaches the final destination router /peer router, then the wrapped packet with be unwrap the header information. This wrapping and unwrapping the data packets saves the time, delay in data transmission and increases the load of each router in the NEMO network.

In order to verify the performance of the proposed approach the QoS parameters are verified in the simulation. To do this the number of nodes, speed of the mobility, intermediate routers are changed in the NEMO network and executed. Initially the time/delay taken for data transmission for number of packets and number of intermediate routers is verified. The obtained results in terms of data transmission delay in calculating delay are shown in Figure 3, Figure 4 and in Figure 5. In this simulation, the number of nodes deployed in different NEMO network is changed from 20 to 100 and delay is verified from the execution. It is simulated in various rounds like in the first round of operation it is assumed that 20 numbers of nodes are deployed, in the second round of operation it is assumed that 40 numbers of nodes are deployed and so on. Finally in the fifth round of operation the number of nodes deployed in the NEMO network is 100 nodes. From the simulation, it is noticed that when the number of nodes is increased, the time taken for data transmission is also increased. It is because of more number of nodes chooses the appropriate router, get authentication and chooses the proper route. Also more nodes can transmit more number of data packets whereas the time taken for data transmission is also increased and it is shown in Figure 3. If the number of network, sub network or network region is increased the automatically the intermediate nodes, routers is also increased. It requires more number of investigations on nodes, data packets for providing authorization. Also the verification of data packets says the information about the next router to where the data packet to be transmitted. Hence, when the number of intermediate nodes/routers increased the time taken for data transmission is also increased. The corresponding simulation result is shown in Figure 4

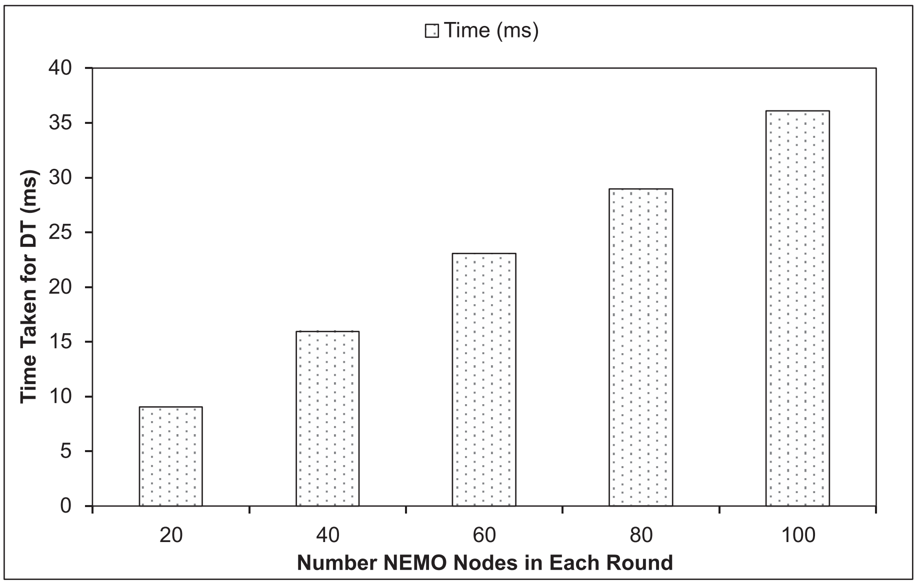

Figure 3: Delay in terms of Number of NEMO Nodes

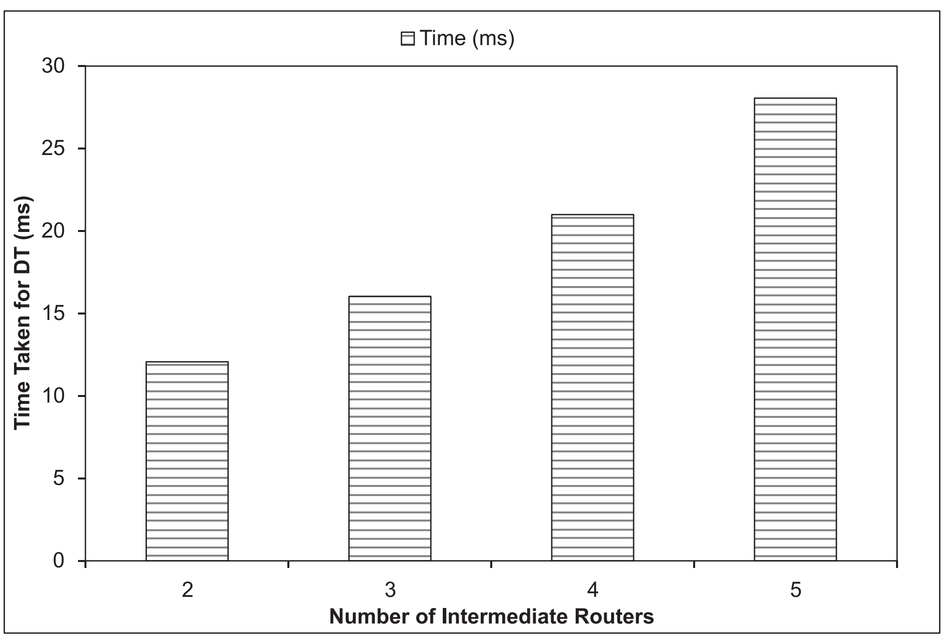

Figure 4: Delay in terms of Number of NEMO Intermediate Routers

where it shows that the time taken is increased for increased number of routers. In this scenario the number of intermediate routers are assumed ass 2, 3, 4 and 5.

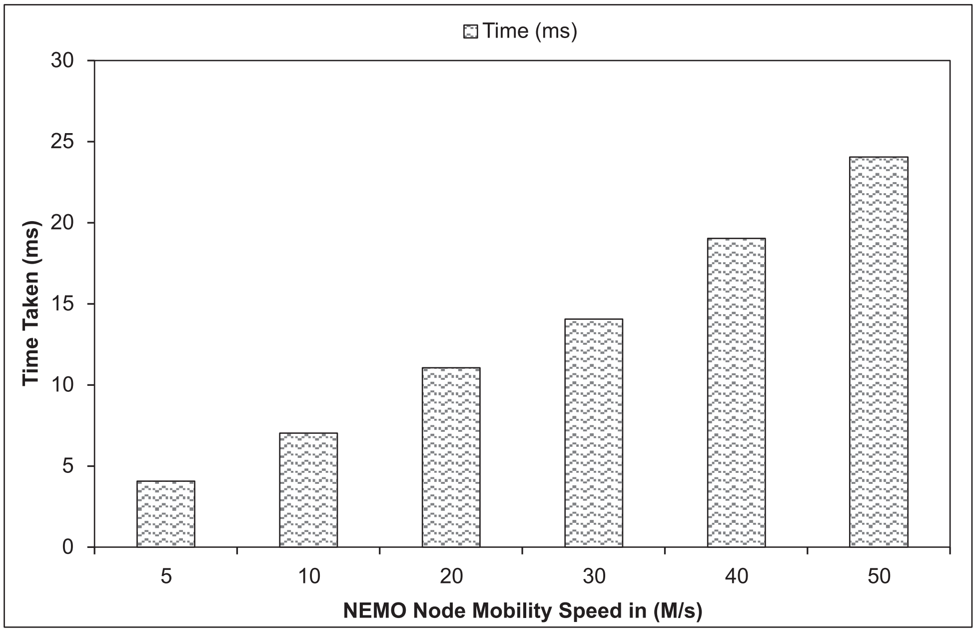

Figure 5: Delay in terms of Number of NEMO Node Mobility Speed

Similarly the delay is depending on the mobility speed of the NEMO nodes in the network. Continuous connection among the nodes and the routers or with the FC may loss when the node moves speedily. If the node move speedily then the transmission of data packet should resumed in order avoiding data loss. Here, the mobility of a NEMO node is assumed as 5 meter per second to 50 meter per second. In order to maintain the route, authentication, establishing and re-establishing the connection, sending and resuming the data transmission the network takes little more time than the normal one. From the simulation it is observed that the time taken for data transmission is increased due to increased mobility speed of the NEMO nodes. The obtained result is shown in Figure 5.

Throughput is another QoS parameter which decides the efficiency of the network where it says the amount of data transmitted in a stipulated interval of time. The number data transmission depends on the number of communication whereas it depends on the number of nodes involved in communication at the same time. It also depends on the size of the data transmitted in the network. Here the throughput is calculated according to the number nodes deployed in the network. The number of NEMO nodes deployed in the network is assumed as 20 in first round, 40 in second rounds, 60 in third rounds, 80 in fourth round and 100 in final round. In each round the throughput is calculated and verified. The obtained throughput in each round is shown in Figure 6. From Figure 6, it is observed that the throughput is increased due to increased number nodes deployed in the network.

The efficacy of the proposed approach is also verified in term of scalability by increasing the number of NEMO Network (NEMO-N_1, NEMO-N_2… NEMO N_n). Whenever the number of network increases the number of NEMO Routers is also increased to connect the networks. It is well known that if the network size increases then the reestablishing, resuming the connection and data transmission should be applied. It is simulated and the result is verified. From the result it is observed that when the number of intermediate routes is increased it affects 1% of the throughput. It is shown in Figure 7. From the above results and discussion it is noticed that by eliminating the overload in bandwidth, the NEMO network efficiency can be improved.

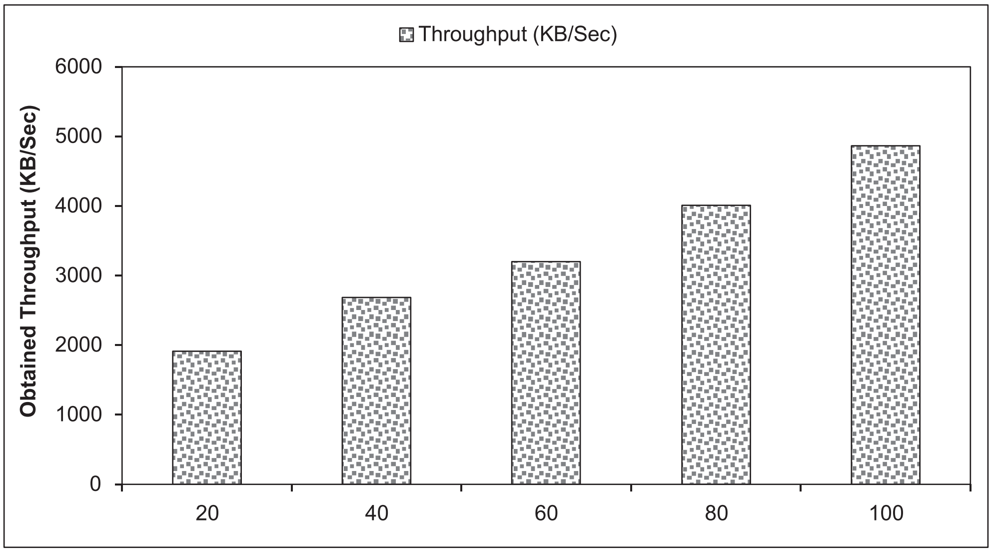

Figure 6: Throughput in terms of Number of NEMO Nodes

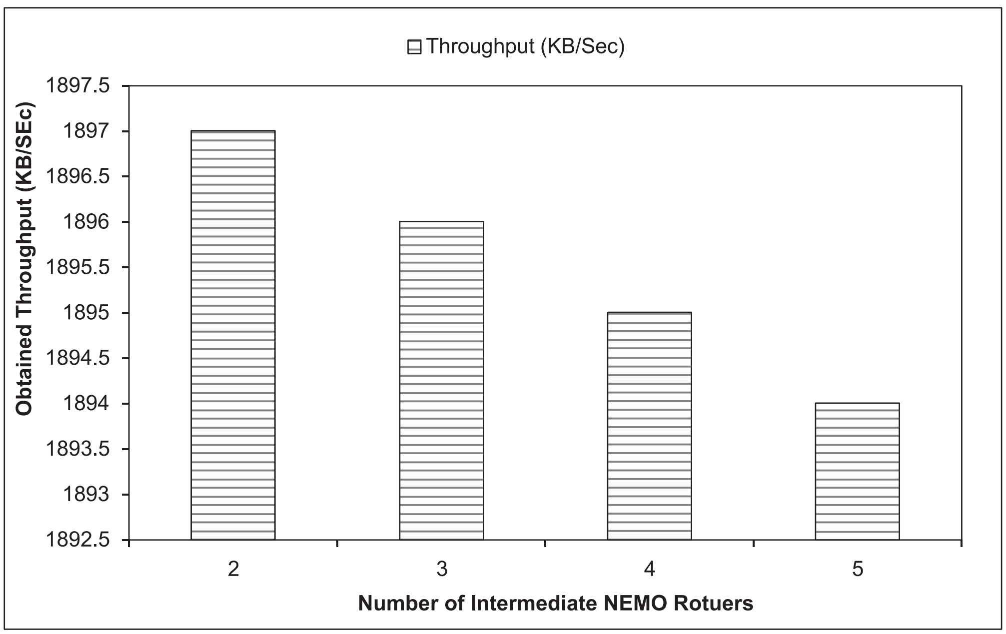

Figure 7: Throughput in terms of Intermediate Routers

7. CONCLUSION

The main objective of this paper is to increase the QoS in NEMO network. NEMO network comprises of mobility based nodes that is the nodes in NEMO are basically moving in nature. In this paper in order to improve QoS, the bandwidth controlled, optimized routing is enabled. Optimized bandwidth for controlling the network data traffic can be obtained by reducing the size of the data packets by eliminating unnecessary header information in the data packets. This optimization on bandwidth reduces the time to transfer and reduce the overload in the router by decreasing the header size. This approach is simulated and the results are verified. From the obtained results it is clear, noticed and concluded that this optimization of bandwidth is more suitable for NEMO network.

In future work, the performance of the proposed approach is verified than delay and throughput, and it is compared with conventional approaches applied for NEMO network and the performance should be verified in terms of QoS.

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