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Group Mobility Handover In Mobile WiMAX Network

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Abstract — *This paper presents Group mobility scenarios are that widely seen in military environment, emergency and rescue activities. Group mobility refers to the scenarios that multiple mobile nodes (MNs) move in a group at the same time, usually in the same direction with a small distance of separation. Some various challenges associated with group mobility concept. In the group handover mechanism in WiMAX networks, initiation of the handover Process at the same time due to different users results in network congestion. So, when a group leader is introduced, it provides a solution for this problem. Here, using RWPM(Random Way Point) and RPGM(Reference Point Group) model for measure the Qos Parameter using VoIP applications various Services like BE, UGS, ertps, rtps and nrtps With Group Leader and Without Group Leader network throughput, Average End to End Delay , Average Jitter and Packet delivery ratio. Also measure the handover latency in the network.*

KEYWORDS- *GROUP MOBILITY, HANDOVER, VOIP, WIMAX*

I. INTRODUCTION

WiMAX is a fourth generation wireless communication technology and it is based on IEEE 802.16 specification, which is a standard for Wireless Metropolitan Area Network(WMAN). It is a highly hopeful technology that offers higher data rate, supports large number of users and covers a larger area. Mobility in a network describes the movement of the nodes involved in the network [1]. Group mobility is a concept in which a group of MN's moves at a same time particularly in the same direction with small space of the interval between individual nodes in a particular group. Military tactical communication, disaster recovery, emergency and rescue operations are some of the widespread scenarios of group mobility. In a military environment, there are chances of destruction of the Base Station (BS) due to bombing. So, it could lead to the entire communication breakage. Therefore, a mobile BS is a good choice when compared to the stable base station. Handover is one of the most essential processes because mobile nodes cannot acquire contact to the same BS during mobility [2]. There are various challenges associated with the concept of group mobility handover. In a group handover mechanism, network congestion would occur as a large number of mobile nodes in a group initiates handover at an equivalent time, which in turn raises the chances of handover blocking and also raises the handover latency due to collision involved and the corresponding back offs. At the same time, MN's does not get the coverage from the serving mobile BS. This out of coverage condition occurs due to two reasons. First, when the serving mobile BS moves out of its coverage of the MN's and other BS is distant from it. Second, when the MN's moves out of coverage from the serving mobile BS and the other BS is too far away making handover. So, when a leader MN concept is introduced, it paves a solution for all these problems. The Leader MN integrates numerous handover processes from the group of MN's into solitary, which could eradicate the collision of the ranging request at the base station and reduce the latency found in the network [3]. In addition, it also overcomes communication crack problems by handling local communication when there is no suitable target BS to perform handover. Voice application over the internet can be achieved using VoIP. WiMAX provides different classes of services with good QoS for VoIP [6].

In this work, a scenario is constructed with two WiMAX networks and a group of MN's involving in each network. Among various MN's in a group, a MN is chosen as a leader MN for reducing the handover latency and the communication link fracture. The scenario is analysed with VoIP connections between the two groups and with different service classes of a WiMAX network. The work is implemented using Network Simulator 2.
The paper is structured as Section II deals with the related work, Section III analyses the impact of VoIP over WiMAX with group mobility for various service classes, Section IV deals with the results and discussion and Section V concludes the paper.

II. RELATED WORK

Mobility models depict the movement pattern, location, acceleration change over time and the velocity of the mobile nodes. This movement pattern is responsible for determining the performance of the protocol. In the Random waypoint model [7], node selects a random destination and random speed. The random speed has a maximum and minimum speed. The movement of the nodes is to the selected destination. After reaching the destination, a node waits for some time and then a new destination is selected similarly as the above process. In Random walk mobility model [8], node selects a direction in which it has to be moved from the range $(0.... 2\pi)$. Here, the speed given to the node is user defined. The node stops and chooses a fresh direction and velocity after the randomly selected period of time. In Random direction model [9], each node moves until they are near to the boundary of the simulation. When it reaches the boundary, it starts to move in a new direction. All these mobility models support for the mobility of individual nodes. Reference Point Group Mobility (RPGM) model [10] differs from all these models of mobility. RPGM supports group mobility concept. In this model, groups of nodes travel collectively. The complete group travels following the Random Waypoint model, and each node travels within the group also follow the Random Waypoint model.

In [11], the authors suggest a group handover scheme using the deployment of a mobile router over the train which helps in the initiation of group handover in order to reduce the latency caused due to the group handover mechanism. In [12], the channel borrowing scheme is used for reducing the handover dropping probability when mobile relay station exists. The major drawback with this idea is, in real environment, mobile relay station does not exist and thus it could not be used for group handover. In [13], tunnelling approach is used at the transport layer to assist handover mechanism. But the disadvantage is that it could be valid only for soft handover. In [14], for congestion avoidance, an algorithm for target BS selection is used. It helps to roam in the heterogeneous communication network. But it is found to establish additional delays for handover. In [15], link
layer and the network layer are integrated to minimize the latency of handover. A channel borrowing algorithm is used to get the better group handover mechanism. In all these cases, the structure of the moving group is unalterable, that is, any MN cannot remain the group and the other MN cannot join the group vigorously. So a leader MN concept is used in which a MN is chosen as the leader MN when the mobile nodes in a group moves out of coverage of the serving base station and the other base station is far away from that particular group [3].

III. PROPOSED SCHEME

The Performance of the Routing Protocols that evaluated using different Mobility models like Random Waypoint (RWPM) and Reference Point Group Mobility (RPGM) models. The Routing Protocols like AODV and DSDV using in the Mobility models.

3.1 Random Way Point

The RWPM (Random Waypoint) model which contains pause time between change in direction and speed. Once the Mobile Node (MN) begins to moving position, it stays while in one location for a specified pause time. After specified pause time over ,mobile node (MN) randomly selects their next destination.In the simulation area and chooses a speed uniformly distributed between the minimum speed and maximum speed and travels with a Speed v having value uniformly chosen in interval (0, Vmax). Vmax is parameter that can be set for reflecting degree of mobility. After the MN continues going towards the new destination at the chosen sp eed. As the mobile node arrives at the destination, it again stays at a Pause time and vice versa.

3.2 Reference Point Group Mobility Model

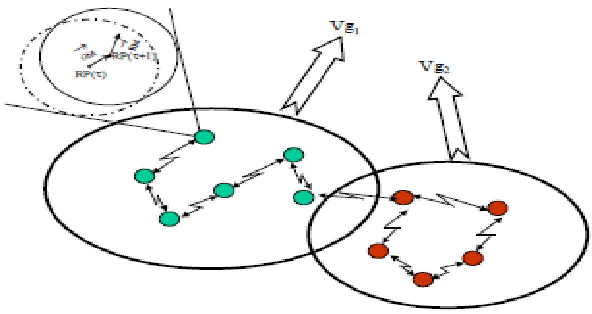


Figure 3.1 RPGM Model

Motion Vector Of group member described as,

$$V_i^t = V_{group}^t + RM_i^t$$

The Moment of group member can be characterized by following Equations,

$$|\vec{V}_{member}(t)| = |\vec{V}_{leader}(t)| + random() \times SDR \times V_{\max}$$
$$\theta_{member}(t) = \theta_{leader}(t) + random() \times ADR \times \theta_{\max}$$

Where, 0 < SDR, ADR < 1 & SDR= Ratio for Speed Deviation ADR= Ratio for Angle Deviation
SDR (Speed deviation ratio) and ADR (Angle deviation ratio) both are used to control the deviation of velocity and direction of the group members from of SDR and ADR which is used for control the deviation of the velocity direction and magnitude and Direction of the group members from that of leader. By simply adjusting these two parameters, that generates different mobility scenario.

3.2 Routing Protocol

DSDV (Destination-Sequenced Distance-Vector Routing protocol):DSDV is a table driven routing scheme for mobile networks. Each node work as router where routing table is maintained and periodically routing updates are exchange, even if route is not needed. A sequence number associated with every route or path to destination that prevents routing loops. Routing information exchanged even if network is idle which uses network and battery. So, it is not preferable for high dynamic networks. Each node maintains its own routing table having information about cost of links and network topology between nodes.

AODV (Ad hoc On-demand Distance Vector Routing): AODV is an on Demand routing protocol which is combination of DSDV and DSR. Route is calculated on demand means when and as need by the destination. AODV that maintains routing table where they maintains one entry per destination unlike DSR that maintains multiple route cache entry for each destination. AODV provides loop free routes AODV provides loop free routes while repairing link breakages. AODV uses RREQ/RREP (Route request/ Route reply) mechanism for route destination and discovery sequence number for each route entry like DSDV protocol.

3.3 Parameters evaluates performance of RWPM and RPGM

(a) Average Throughput:

Average throughput is the rate that successful message which delivered over a communication channel. This data may be delivered over logical or physical link. The throughput is usually calculated in Bits per second, also data packets per second or data packets per time slot.

$$T_p = (Tbr / St) * (8/1000) Kbps$$

Where, T_p =Average Throughput

Tbr = Total number of bytes received

St = Time for simulation

(b) PDR (Packet Delivery Ratio):

PDR (Packet delivery ratio) that delivered data packets that generated by constant Bit rate source to destination point.The performance of routing protocol is better if PDF value is higher that shows how successful packets are delivered.

PDR= Ps/Pr

Where, Ps= Sent Packets

Pr= Received Packets

(c) E2E Delay (Average End to End Delay):

Average End to End delay is an average of data packets and this delay can be caused by many reasons like route latency, queening at interface & retransmit delay at MAC. En d to End delay can be calculated by dividing time difference between each CBR sent packet and received at the source to destination, the total number of CBR packets received at the Destination. For better performance of protocol End to End delay must be low as possible.

$$\text{Average End to End delay} = \frac{\sum (Timereceived - TimeSend)}{TotalDataPacket\,\mathrm{Re}ceived}$$

(d) Average Jitter:

Average jitter is a delay variation that introduced by components with communication path. It is variation in time between packets receiving. Equation 10 shows steps for calculating of average jitter value. It is an average of absolute difference in time for taking successive packets to reach the destination.

$$\text{Average Jitter} = \frac{\sum i \left| (Packetarrival_{i+1} - Packetsent_{i+1}) - (Packetarrival_i - Packetsent_i) \right|}{n-1}$$

e) Handover Latency:

Handover latency is ratio as Time Difference between the destination and source to the total received packet at the destination. In RWPM model handover latency is increased compare with the RPGM model.

IV. SIMULATIONS AND RESULT ANALYSIS

In this Part,we have finding different parameters of RWPM AND RPGM Model like Average throughput, Packet delivery ratio(PDR), Average Jitter ,Average End to End delay (E2E delay) and handover latency of network using AODV and DSDV routing protocol used by with and without group Leader concept. We have using following Parameters for Simulation environment.

4.1 Simulation Parameters

Table 2 Simulation Parameters

Parameter	Values
Simulator	NS2 (2.28)
Channel Type	Channel/Wireless
Protocols	AODV,DSDV
Simulation duration	300 second
Mobility model	RWPM ,RWPM
Traffic model	CBR
MACLayer Protocol	802.11
Network Size	5,10,15, 20,25 nodes
Topology	2000m*1800m
Antenna	Omni directional
Transport Protocol	UDP
Propagation model	Two ray ground
Radio Type	802.16e
No. of Groups	2,3,4,5
Application	VoIP
Service Type	UGS, BE,rtps,nrtps,ertps

4.2 Simulation Scenario in NAM

Parameters: Mobile nodes: 18 and Base Station – 2(With Group Leader Concept)

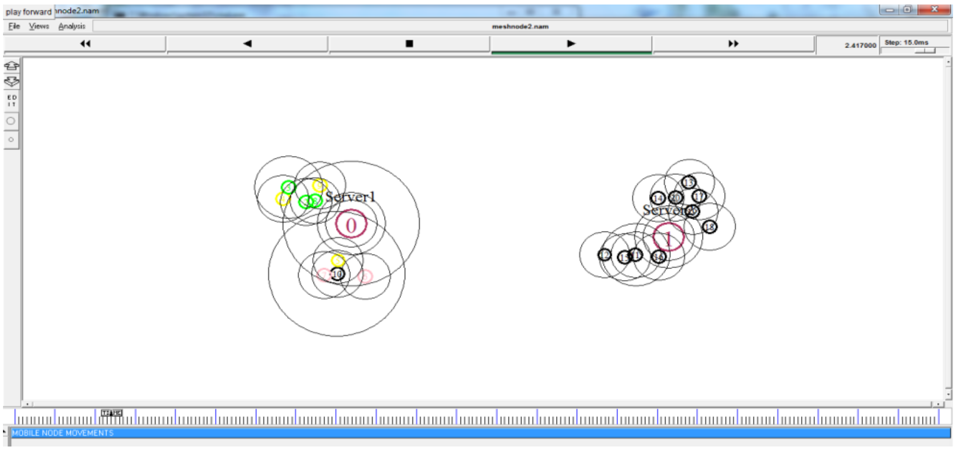
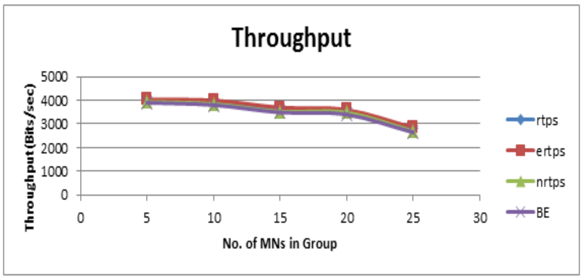


Figure 4.1 With Group Leader Mobile nodes Moving in to Groups

A) Throughput (With Group Leader Concept)

Figure 4.2 says that throughput for ertps and rtps classes are higher compared to the other service classes. As the Traffic in network increases by increasing the MNs in a network thus the throughput drops when the network traffic is increased. From Figure 4.3 we can say that due to network congestion there is decrement in Throughput value as the number of groups in a network gets incremented.



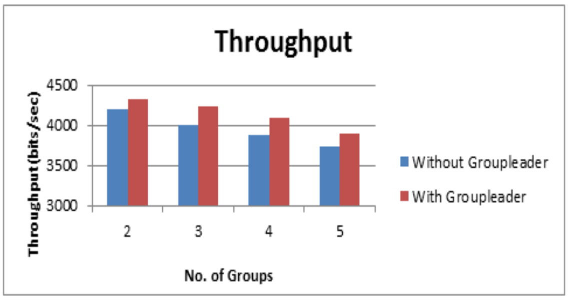
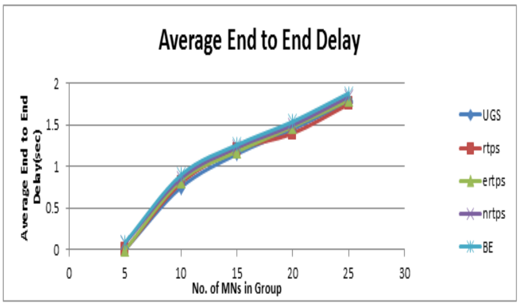


Figure 4.2 Throughput for various service classes in WiMAX network using VoIP
Figure 4.3 Throughput comparisons for RWPM & RPGM with ertps service class

B) Average End to End Delay

Figure 4.4 it shows that UGS, rtps and ertps have low End to End delay. But ertps having less delay compare to the rtps and UGS. So, ertps service class is selected. Figure 4.5 shows that delay comparison of the network without leader MN is having large delay compare to the network with group leader MN.



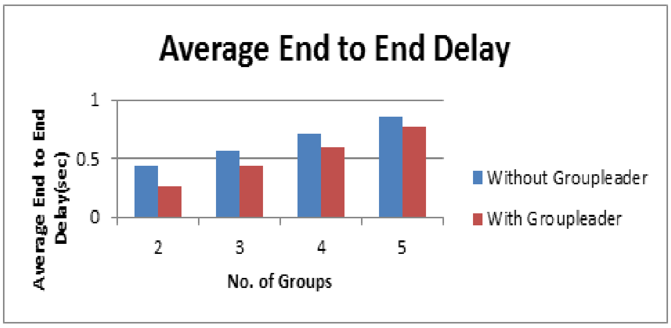
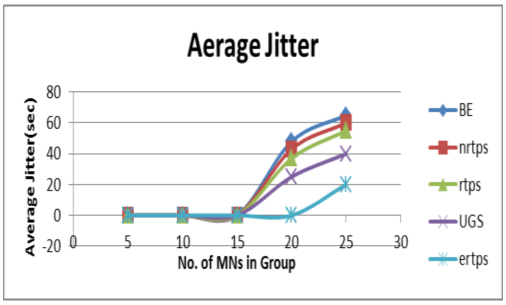


Figure 4.4 Average End to End delay for various service classes in WiMAX Network using VoIP
Figure 4.5 Average End to End delay comparisons for RWPM & RPGM with ertps service class

C) Average Jitter

Figure 4.6 shows that BE services introduces more jitter when compare to the other service classes. It is analysed that average jitter is almost similar when a group involves up to 15 number of nodes. When a group tends to get highly populated by 20 numbers of nodes. Figure 4.7 tells that there is greater variation in delay as the number of groups in network is increases.



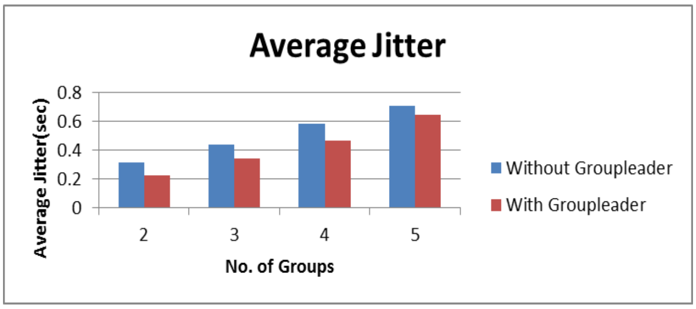
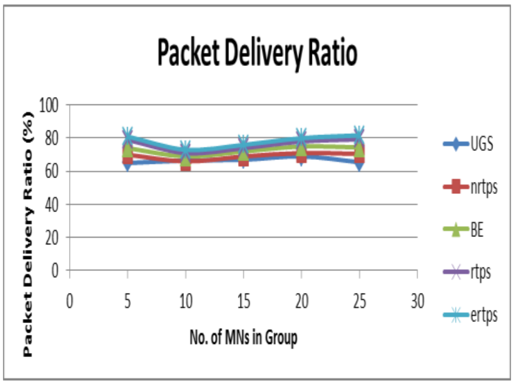


Figure 4.6 Average End to End delay for various service classes in WiMAX Network using VoIP
Figure 4.7 Average Jitter comparisons for RWPM & RPGM with ertps service class

D) PDR (Packet Delivery Ratio):

Figure 4.8 tells that ertps and rtps have good voice packet delivery ratio as they are real time service classes. Also it depends on that increases the network traffic declines PDR value due to the collision occurring in network because of congestion. Figure 4.9 shows that PDR comparison to the network with leader concept found to high in compare with network without leader MN concept.



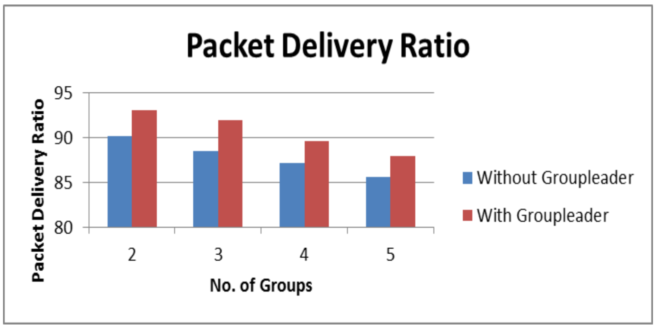
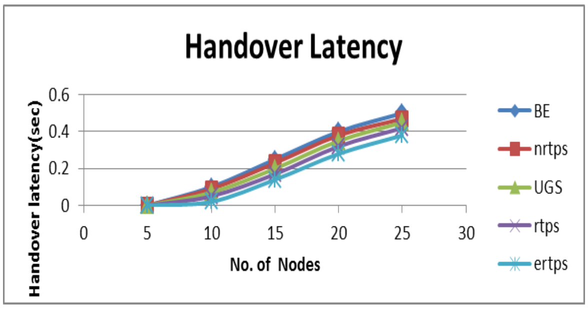


Figure 4.8 Average End to End delay for various service classes in WiMAX Network using VoIP
Figure 4.9 Average Jitter comparisons for RWPM & RPGM with ertps service class

E) Handover Latency

From Figure 4.10 it is analyzed that handover latency for BE and nrtps as high in comparison to the service classes. From figure 4.11 it is analysed that the introduction of the leader MN concept in a network without leader MN by reducing the handover Latency. As the number of groups increases, it takes more time to handover and thus the handover latency is found to be high.



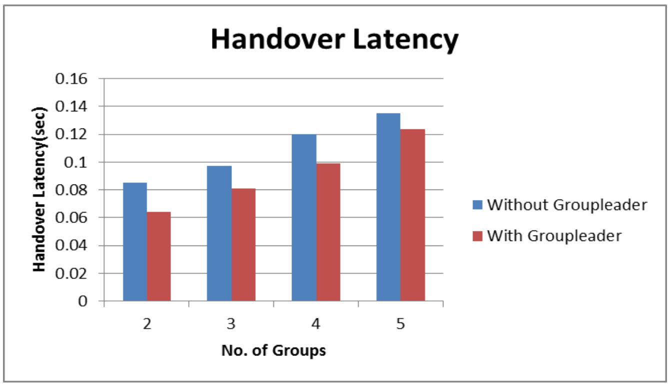


Figure 4.10 Handover Latency for various service classes in WiMAX Network using VoIP
Figure 4.11 Handover Latency comparisons for RWPM & RPGM with ertps service class

V. CONCLUSION

From this Paper conclude that, Group Handover Scheme in WiMAX Networks using VoIP Application for Military environment Group Leader MN (Mobile Node) introduced in the Mobile WiMAX network. Some of QoS Parameters like Average Throughput, Average Jitter, End to End Delay, PDR (Packet Delivery Ratio) and Handover Latency are analyzed. Throughput, End to End Delay and PDR is increased with Group Leader MN (RPGM) and Jitter & Handover Latency is reduced when network size is increased. Also comparing throughput between Routing Protocol AODV and DSDV for RWPM model AODV gives better performance and Nodes in group gives higher value of Throughput compare with single nodes moving.

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