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Performance Evaluation and Comparison of GRP Routing Protocol with Various Traffic loads for Grid and Circular Node Placement Models Over Mobile Ad Hoc Networks Using OPNET 14.5

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ABSTRACT

Due to the increased use of mobile devices with the high demand for applications , most companies have tended to pay attention to Mobile Ad hoc Networks . This type of network is characterized by multi-hop wireless networks where data packets are sent in a "store and forward" manner from the source to an arbitrary destination via intermediate nodes. The mobile nodes are connected by multi-routes routing as the nodes in this network not only serve as hosts but also as routers where data is routed to and from other nodes in the network and therefore the mobile node not only sends its data packets but also sends data packets of other mobile nodes . The network architecture changes dynamically, mainly because of Mobility of nodes , so we need routing protocols to establish the connection. Routing protocols are categorized into proactive routing protocols , reactive routing protocols and hybrid routing protocols .

So in this paper, we has been studied GRP routing protocol which is one of hybrid routing protocols with using grid node placement model and circular node placement model on the basis of Wireless LAN and GRP Statistics and evaluated the performance in a large network and in a small network.

Keywords: Mobile Ad hoc Networks, routing protocol , various Traffic loads, GRP, Node Placement Models.

I. INTRODUCTION

Routing Protocols : 1.1

Mobile Ad Hoc networks are characterized as networks with multi-hop topology that change continuously due to mobility, and therefore in this type of network we need efficient routing protocols capable of establishing communication routes between nodes without causing control messages load or computational surplus on mobile devices of limited power. [1][2][14][17][23].

Several solutions have been proposed, some related to calibration within the Internet Engineering Task Force (IETF) and others try to have the most recent route for all other nodes at all times by exchanging control information periodically when topology changes occur.These protocols are called proactive routing protocols , which are modified versions of traditional connectivity or distance vector protocols taken in wired networks that adapt to specific requirements of the dynamic mobile ad hoc network environment. [2][14][17][23].

Others do not have to have the most recent route to all the other nodes, and therefore we have interactive protocols that discover the routes on demand by means of the route discovery procedure and these routes remain in an active state as long as they are used and there is another type of protocol that merges the previous two types called hybrid protocols [2][14][17][23] The following figure (1) shows the structure of mobile ad hoc networks [3].

figure (1) structure of mobile ad hoc networks

2.1 Research problem and objectives:

Mobile ad hoc networks constitute a group of mobile nodes that share the wireless channel without any central administration [1][3][4][23]. The nodes in these networks function not only as hosts but rather as routers at the same time as the nodes in this type of network are able to move and thus the network topology changes frequently and this means that the communication between the nodes is difficult to manage. [1][3][4].

A distinction is made between three types of routing algorithms, which are: the first type is proactive protocols that exchange routing information between nodes continuously, the second type is interactive protocols in which the route is built on demand, while the third type is hybrid protocols in which the previous two types are combined, including the (GRP) geographical routing protocol to be studied [3][4] [15][23].

In this article, performance of (geographical routing Protocol) GRP routing protocol is evaluated, which is considered one of hybrid routing protocols with different traffic loads (Database, Email, FTP, HTTP, Video Conferencing, Voice) with use of grid node placement model and circular node placement model in terms of wireless local area network (WLAN) standards and GRP routing protocol standards, which are found in the simulator statistics, in a large network consists of 90

mobile nodes and in a small network consists of 30 mobile nodes. We can briefly summarize a definition of some performance metrics used in the simulation:

☒ Throughput: represents the amount of digital data sent per unit time from the source node to the destination node. It is measured by bits/sec [5] [7][11] [12][18][20][21].

☒ Load: The total load is expressed in bits / second, as all upper layers send it to all layers of the wireless network in the wireless nodes of the network [5] [7][12][20].

☒ Delay: represents the average time taken for packets to reach from the source node to the destination node [5][7][11] 12][21][18] [20][23].

3.1 Study methodology and tools:

OPNET 14.5 network simulator was used as it was installed on Windows 7, and 12 system variables were created and modified, and the process of installing this simulator was made sure of success [9]. After that, in this article, scenarios were implemented for studying and evaluating performance of the geographical routing protocol with different traffic loads (Database, Email, FTP, HTTP, Video Conferencing, Voice) with use of grid node placement model and circular node placement model in terms of wireless local area network (WLAN) standards and GRP routing protocol standards, which are found in the simulator statistics, in a large network consists of 90 mobile nodes where the network size is 1600x1600m, and in a small network consists of 30 mobile nodes where the network size is 800x800m. Firstly, a comparison was made between performance of geographic routing protocol in case grid node placement model (6 rows and 5 columns) and between its performance in case circular node placement model with database application in a small network consists of 30 mobile nodes in terms of Wireless local area network (WLAN) standards and GRP routing protocol standards. A comparison was also made between performance of geographical routing protocol in case grid node placement model (6 rows and 5 columns) and between its performance in case circular node placement model with video application in a small network consists of 30 mobile nodes in terms of wireless local network (WLAN) standards and GRP routing protocol standards. And also, a comparison was made between performance of the geographical routing protocol in case grid node placement model (6 rows and 5 columns) and between its performance in case circular node placement model with email application in a small network consists of 30 mobile nodes in terms of Wireless Local Area network (WLAN) standards and GRP standards. In addition, a comparison was made between performance of geographical routing protocol in case grid node placement model (6 rows and 5 columns) and between its performance in case circular node placement model with FTP application in a small network consists of 30 mobile nodes in terms of Wireless Local Area network (WLAN) standards and GRP standards. Then a comparison was made between performance of geographical routing protocol in case grid node placement model (6 rows and 5 columns) and between its performance in case circular node placement model with HTTP application in a small network consists of 30 mobile nodes in terms of wireless local area network (WLAN) standards and GRP routing protocol standards . also, a comparison was made between performance of geographical routing protocol in case grid node placement model (6 rows and 5 columns) and between its performance in case circular node placement model with voice application in a small network consists of 30 mobile nodes in terms of Wireless Local Area network (WLAN) standards and GRP standards. Secondly, a comparison was made between performance of geographical routing protocol in case grid node placement model (10 rows and 9 columns) and between its performance in case circular node placement model with database application in a large network consists of 90 mobile nodes in terms of Wireless LAN (WLAN) standards and GRP standards. A comparison was also made between performance of geographical routing protocol in case grid node placement model (10 rows and 9 columns) and its performance in case circular node placement model with video application in a large network consists of 90 mobile nodes in terms of wireless local area network (WLAN) standards and GRP routing protocol standards. And also, a comparison was made between performance of geographical routing protocol in case grid node placement model (number of rows is 10 and number of columnsis 9) and between its performance in case circular node placement model with email application in a large network consists of 90 mobile nodes in terms of Wireless Local Area network (WLAN) standards and GRP standards. In addition, a comparison was made between performance of geographical routing protocol in case grid node placement model (10 lines and 9 columns) and its performance in circular node placement model with FTP application in a large network consists of 90 mobile nodes in terms of Wireless LAN network (WLAN) standards and GRP standards. Then, a comparison was made between performance of the geographical routing protocol in case grid node placement model (10 lines and 9 columns) and between its performance in case circular node placement model with HTTP application in a large network consists of 90 mobile nodes in terms of wireless local area network (WLAN) standards and GRP routing protocol standards. In addition, a comparison was made between performance of geographical routing protocol in case grid node placement model (10 lines and 9 columns) and between its performance in case circular node placement model with voice application in a large network consists of 90 mobile nodes in terms of Wireless Local Area network (WLAN) standards and GRP standards. The results in the tables were obtained through the excel files of each chart obtained as a result of implementing Simulation over a time of 600 seconds by clicking on the chart with the right button and selecting (Export Graph Data to Spreadsheet), then moving to an excel file containing data Digital for the chart, and then the factor we want is calculated, for example: Average.

4.1 Classes of routing protocols:

The routing protocols of mobile ad hoc networks can be classified into three sections:

☒ **Proactive protocol:**

In this type, the nodes in the mobile ad hoc network keep routes entries to all possible destinations and this is important because when a node wants to send a data packet, the route is predefined, and thus it can be used directly. And when there

is a change in the network topology, this change is being deployed it to the entire network and on the basis of the information gathered, each wireless node changes its routing table, for example, when a change in the topology makes the original route unavailable, then any new route is established, and therefore all nodes will receive updates on the state of the route and in the absence of a change in the network topology, the node is ready and available on demand [3][23]. Distance vector protocols can also be considered proactive protocols [19]. Hence, proactive view is similar to UDP (non-established communication) communication and hence the presence of transport protocols is preferred in proactive routing protocols[10] . We mention Enhanced Link State Routing Protocol [2][3][11][15].

☒ **Reactive protocol:**

Where the source node builds the routes on demand, and thus the network topology is discovered on demand, that is, when a wireless node needs to send data to another wireless node, but there is no route to that node, then the source node will call the route discovery process as it begins to prepare to send the routing table and when a route is found and maintained by the routes maintenance procedure until the destination is no longer accessible or the route is no longer used[8][11][13] [15] [23] [24] .The route is deleted by the route delete procedure [24]. The nodes only maintain routes to effective destinations [13]. Hence the interactive view is similar to TCP (establish connection) communication [10]. We mention the dynamic source routing protocol(DSR) [3][11][24]. Table (1) shows a comparison between the interactive protocols and the proactive protocols [3]:

Table 1: Reactive and Proactive protocols

	Proactive protocols	**Protocols Reactive**
Routing Protocols	DSDV,CGSR,WRP,OLSR	AODV,DSR,TORA,ABR,SSR,CEDAR
Route acquisition delay	low	High
Load resulting from control messages	high	low
Energy requirements	high	low
Package bandwidth requirement	high	low

☒ **Hybrid Protocols:**

- This type of protocol includes or combines the advantages of the Proactive Routing Protocol (PRP) and the Interactive Routing Protocol (RRP) [7]. PRP is suitable for supporting delay-sensitive data such as audio and video, but it consumes a large portion of the network capacity while RRP is not suitable for real-time communication, but the positive with this view is that it can dramatically reduce the routing load when the network is static and the data is light but on In any case, the source node must wait until the route to the destination is discovered, and this increases the response time [7][20].
- Hybrid routing performs in two ways : greedy routing , face-2 algorithm or perimeter routing[16] . Using the concept of location-based routing, geographical routing protocols do not need to be set up or maintain connections [16]. In hybrid routing, nodes are not required to store routing tables, nor do they keep up-to-date routing tables for the purpose of sending information as they simply discover the destination node's location in the network and simply send or transmit information from the starting place to the destination as the method of sending information in these protocols is based on Location information for destination node and existing neighbors after one hop[16] . In hybrid routing there are two types of transmission strategies: Greedy forwarding, Face-2 Routing or Perimeter [16]. Figure (2) shows the types of hybrid routing [16].
- For Greedy forwarding , the sender knows the location of the receiver node by the GPS and the message is then passed to the neighbor closest to the receiver node [16][20] . As for the intermediate nodes, they send the data to a two-faced neighbor on their way to the receiver node and this process continues until the data reaches the receiver node [16][20]. Each node in the network maintains its own table in which the location of each node is listed [16]. The main difficulty in greedy forwarding is to choose the exact neighbor node into which the data will be sent[16][20]. The various routing strategies consider scalability, space and orientation towards the receiver node [16]. There are three different routing strategies in greedy routing for choosing which of the neighboring nodes to which data packets should be sent are Most Forwarded within R (MFR), Nearest with Forwarded Progress (NFP), Compass Routing [16]. Figure (3) shows Greedy routing strategies [16]. we notice from Figure (3) that there are different strategies for how the sender sends information from the source to the destination , where S refers to the source node and D refers to the destination node [16]. The area around with r denotes the coverage area or the maximum field of S [16].
- The main goal is to send the information from S to that node closest to the destination . In the given example, this node could be C, which could be closest to the destination node within the coverage area of the destination node D, and this strategy is known as Most Forwarded within R (MFR) and this The strategy tries to reduce the number of hops for sending information from S to D [16] . MFR is the most commonly used in those scenarios where the data packet does not change or Adjust the signal strength for communication between S and D [16]. However, in any scenario in which the data package adapts or modifies its signal strength, a different strategy is used, which is Nearest with Forwarded Progress (NFP), as in NFP the message is passed to the nearest neighbor of the sender who is closest to the destination . In the given example the node is A[16] .If all the nodes use the NFP strategy, the collision of data packets can be greatly reduced during transmission[16] .

- Another strategy used in greedy forwarding is compass routing, where you choose the sender node closest in the straight line between the source and the destination . In the given figure, the compass routing node is the B node [16]. This routing strategy is used to reduce the distance as the data packet travels from source to destination [16] .When the data packet arrives at a node that has not yet detected any of the neighboring nodes close to the destination in a forwarding routing method, the second method of hybrid routing is Face-2 routing or Perimeter Routing used to determine the destination address [16]. Figure 4 shows Greedy Routing Failure [16] . we find from Figure (4) the semicircle around D has a radius of the distance between S and D, and the circle around S shows the S field [16]. We notice from Figure (4) that there is no direct communication between S and D and therefore greedy forwarding fails in this case. To avoid the restrictions of greedy forwarding methods, there is another method used known as Perimeter Method or Face-2 Algorithm [16]. The face-2 algorithm is based on the planner graph traversal, where the node does not need to store any missing or additional information, as the greedy forwarding mode is continued when the node reaches the nearest node and then to the destination [16] . Figure (5) shows the planner graph traversal. Planner graphs can be defined as diagrams without intersecting perimeters, as the nodes are peaks and the edge is between two peaks in case they are the closest to direct contact with each other [16]. In a planner graph traversal, the data packet is sent along the route by using the right-hand rule, where the data packet is directed to the next hop counterclockwise from the edge it reached [16]. The line drawn in Figure (5) between the source node S and the destinaton node D intersects more than one edge, so these edges are not chosen for sending data [16].

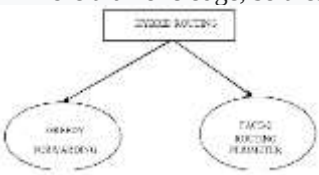

Figure (2) types of hybrid routing

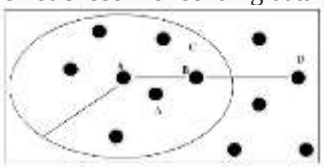

Figure (3) Greedy routing strategies

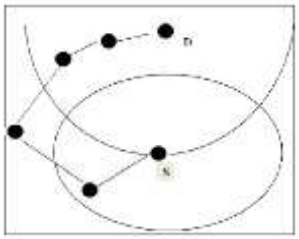

Figure (4) Greedy Routing Failure

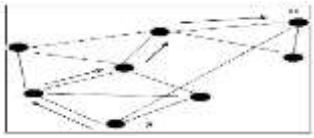

Figure (5) Planner Graph Traversal

5.1 Hybrid Protocols:

1.5.1 (Geographical Routing Protocol or Gathering-based Routing Protocol) :

☒ The function of the grouping-based routing protocol in mobile ad hoc networks is to rapidly collect network information in the source node without a large amount of loads by taking advantage of the strengths of the proactive routing protocol and the interactive routing protocol, and thus data packets are sent continuously even if the route is interrupted. The current with little transmission delay without compromising load or control performance[7] . That is, geographical routing protocols are more efficient when there is a dynamic change in network topology, high mobility and scalability, and thus geographical routing is used to remove restrictions related to topology-based routing as data packets are sent to their destination taking into account their location [16].

Geographical-routing protocol is a location-based routing protocol that is classified as a distance-based and proactive routing protocol as it is based on the Greedy algorithm where each node must maintain a table and this algorithm assumes that each node in the network knows its own location through GPS [5][12][15] [16][20][25]. That is, routing is based on the shorter geographical distance between the source node and the destination node [12] [25]. The location of the node is determined by GPS and the network flooding will be improved by dividing the network into quadrants [5] [12] [15].Where the process of network flooding occurs when the node travels a longer distance than the distance specified by the user or when the node crosses a quarter of a circle, and thus once the initial flooding process in the network is completed, each node becomes aware of the initial location of all other nodes that can be accessed [5][15][25] . Thus, the geographical-routing protocol sends data packets to the destination that is determined according to the shortest route that was calculated by the source node according to the aggregated information contained in the network information collection (NIG) packets that are broadcasted publicly by the destination node [20][25] . Fortunately, each node maintains one or more routing tables to update the neighbors' nodes information, so each node with its location can determine which quadrant it settles in, and it can also know the initial location of all the neighboring nodes [5][12] [25] . Likewise, each node broadcasts a public and periodically hello message to its neighbors so that the locations of its neighbors are updated after the initial preparation, as the rate of exchange of welcome messages depends on the advantages of the network, especially the mobility of the nodes [25] .

☒ Initially a hello protocol or hello message will be exchanged between the nodes to determine the neighbors and their locations[5][12][15]. The following figure (6) shows how to divide the network into several quadrants to reduce the flooding of the network with messages [5] [12][15][25]. The fully mobile ad hoc network is divided into quadrants and all quadrants of a circle are squares [5][12][15] . The size of the quadrant is specified by the user in meters[12]. From Latitude, Longitude (-90, -180) to Lat, Long (+90, +180) as Latitude, Longitude [12][15]. All four quadrants of a circle (square) form a higher level quadrant[12]. Aa1, Aa2, Aa3, Aa4 are individual quadrants in Level 1[12]. They form a quarter (Aa) in Level 2 and Aa, Ab, Ac, and Ad. are individual quadrants in Level 2 and they form a quarter (A) in Level 3[12]. Network flooding concepts in geographical routing protocol include knowing the initial location of each node and other nodes that can be accessed in the network [12]. When the node crosses the quadrant boundary, the flooding of the network occurs again, but the extent of the network flooding depends on the distance traveled by the node, taking into account the quadrant boundary[12]. If the node is only moving within its quadrant, then network flooding packets are sent only to nodes within the quadrant [12]. If the node is moving from quadrant Aa1 to Aa2 (within the boundary of quadrant level 2), then all nodes within quadrant Aa are sent them network flooding process packets [12]. If the node is moving from the quadrant Aa2 to Ac1 (within the boundary of the quadrant level3) then all the nodes within the quadrant A are sending them network flooding packets [12]. When network flooding process packets are received outside the intended boundary, these packets are discarded[12]. The number of attempts to network flooding in the geographical routing protocol is set to a value of 1 by default and can be set to a value of 3 as in the scenarios in my simulation. Therefore, number of times that the flooding process occurs is few, and this requires that the accessible nodes be discovered.

☒ The process of network flooding with messages about location and flooding angle plays a basic and important role in tuning geographical routing protocol, where the initial value of flooding angle with messages about location and dynamically network flooding with messages about location is changed in the intermediate nodes (increase the value of flooding angle with messages about location when the intermediate node knows that there are no neighbors nodes within the request zone defined by the flooding angle with messages of location that were completed in the connecting route request [12]. The value of the number of times during which the process of network flooding with the messages of location and the time intervals between them depends on the movement of the nodes [12]. The nodes are only allowed to travel 5 meters in my simulated scenarios. Therefore, it is easy to find a node when its last location in the GPS is known as the search area for a node is limited[12]. The flooding angle is represented by an integer called the request level which has the following meaning [12]:

Request_level = 1, flooding angle 90˚ 2, flooding angle 180˚ 3, flooding angle 360˚

☒ As for the backtracking technique used on blocked routes in geographical routing protocol, as the nodes that receive the backtracking packet calculate the next closest neighbor to the destination node and send it the new route [12][25]. if the node that received the backtrack packet does not have an alternate route , then it in turn backtracks to a previous node to find an alternative route , at the end if it is no alternative route is available after all the recursive backtracks till the source node, then the data packet is dropped or discarded [12].

Figure (6) Dividing the mobile ad hoc network into quadrants

6.1 Node Placement Models :

Node placement or node positioning: It is the method by which each node will be located in the network in an efficient manner in which no large amount of energy is consumed while sending the packets or data in the network [6]. There are three ways to define where each node is in the network or how the nodes are arranged in the network.

- Random node placement model : This model spreads the nodes in a random manner, that is, the nodes are distributed in the network unequal and uneven, and thus the coverage area is small if we have a large number of nodes that are far from each other unequal distances, and this leads to higher energy consumption and reduces the life time of the general network [6] [22] . Figure (7) shows the random distribution of nodes within the random nodes placement model[22].
- Grid node placement model: This model spreads the nodes in a grid manner, and thus the coverage area is large if we have a small number of nodes that are far from each other equal distances [6][22]. Figure (8) shows the equal distribution of nodes within the grid node placement model[22] .
- Circular node placement model: This model spreads the nodes in a circular manner, and thus the coverage area is large if we have a small number of nodes that are far from each other equal distances [6].

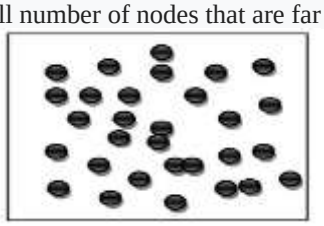

Figure (7) random nodes placement model

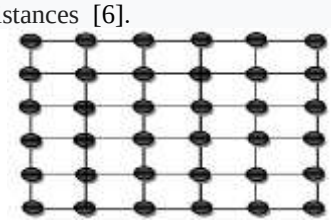

Figure (8) grid node placement model

II. SIMULATION ENVIRONMENT PARAMETERS:

We will evaluate performance of GRP routing protocol using OPNET simulator with different traffic loads (Database, Email, FTP, HTTP, Video Conferencing, Voice) with using grid node placement model and circular node placement model in terms of wireless local area network (WLAN) standards and GRP routing protocol standards and found in the simulator statistics in a large network consists of 90 mobile nodes and in a small network consists of 30 mobile nodes. Table (2) shows the simulation parameters used.

Table (2) simulation parameters

Number of nodes	30 and 60
Network size	800mx800m and 1600mx1600m
Simulation time	600 simulation seconds, seed=256,simulation kernel=optimized

Figures (9), (10), (11), (12), (13), (14) show properties of different traffic loads (Database, Email, FTP, HTTP, Video Conferencing, Voice) used in the simulation. Figures (15), (16), (17), (18), (19), (20) show properties of Profiles of different traffic loads (Database, Email, FTP, HTTP, Video Conferencing, Voice) used in the simulation. Figures (21), (22), (23), (24), (25), (26) show properties of mobility in a large network and in a small network, properties of RXGroup, properties of GRP protocol and properties of wireless parameters. (LAN), applications and services according to traffic load used on the server

Figure (9) database application propertiesused in simulation, whether network is large or small and also whether node placement is grid or circular .

Figure (10) email application properties used in the simulation, whether network is large or small, and also whether node placement is grid or circular

Figure (11) video application properties used in the simulation, whether network is large or small, and also, whether node placement is grid or circular

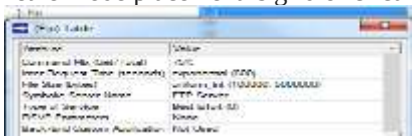

Figure (12) FTP application properties used in simulation, whether network is large or small, and also whether node placement is grid or circular

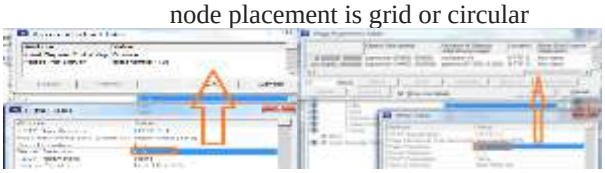

Figure (13) HTTP application properties used in the simulation, whether network is large or small, and also whether node placement is grid or circular

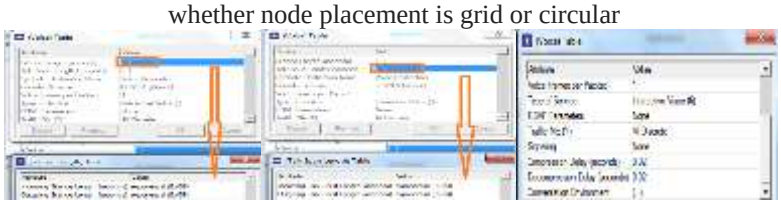

Figure (14) Voice application properties used in the simulation, whether network is large or small, and also, whether node placement is grid or circular

Figure (15) video profile properties used in the simulation, whether network is large or small, and also, whether node placement is grid or circular

Figure (16) database Profile properties used in the simulation, whether network is large or small, and also whether node placement is grid or circular

Figure (17) email Profile properties used in the simulation, whether network is large or small, and also whether node placement is grid or circular

Figure (18) FTP Profile properties used in the simulation, whether network is large or small, and also whether node placement is grid or circular

Figure (19) HTTP Profile properties used in the simulation, whether network is large or small, and also whether node placement is grid or circular

Figure (20) Voice Profile properties used in the simulation, whether network is large or small, and also whether node placement is grid or circular

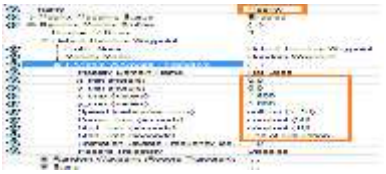

Figure (21) Mobility properties used in simulation in a large network, whether node placement is grid or circular

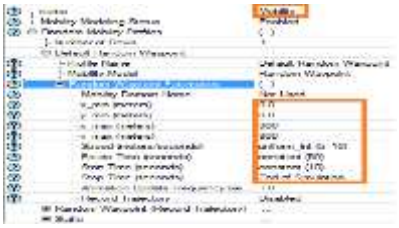

Figure (22) Mobility properties used in simulation in a small network, whether node placement is grid or circular

Figure (23) RXGroup properties used in the simulation, whether network is large or small, and also whether node placement is grid or circular

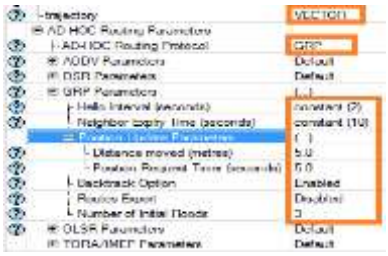

Figure (24) GRP protocol properties whether the network is large or small and also whether node placement is grid or circular used in all mobile nodes and the server

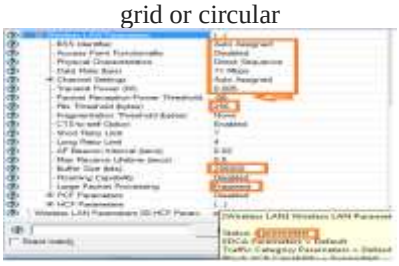

Figure (25) properties of Wireless LAN parameters whether network is large or small and also whether node placement is grid or circular used in all mobile nodes and the server

Figure (26) Applications and services according to traffic load used on the server, whether network is large or small, and also whether node placement is grid or circular

III. SIMULATION ENVIRONMENT:

1.3 Topology in case network consists of 30 mobile nodes and used protocol is GRP and network size is 800x800m and node placement is grid or circular regardless of used traffic load:

Figure (27) shows topology in case network consists of 30 mobile nodes, used protocol is GRP, network size is 800x800m, and node placement is grid regardless of used traffic load.

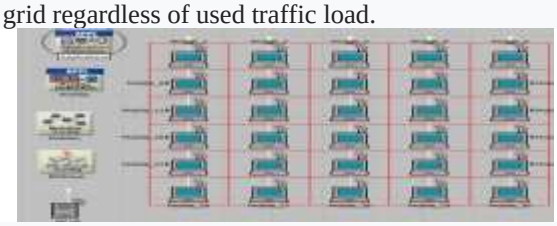

Figure (27) topology in case network consists of 30 mobile nodes, used protocol is GRP, network size is 800x800m, and node placement is grid regardless of used traffic load.

Figure (28) shows topology in network consists of 30 mobile nodes and used protocol is GRP and network size is 800x800m and node placement is circular regardless of used traffic load .

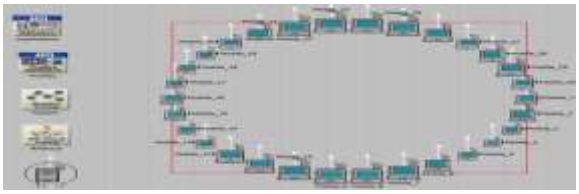

Figure (28) topology in case network consists of 30 mobile nodes and used protocol is GRP and network size is 800x800m and node placement is circular regardless of used traffic load

.2.3 Topology in case network consists of 90 mobile nodes and used protocol is GRP and network size is 1600x1600m and node placement is grid or circular regardless of used traffic load:

Figure (29) shows topology in case network consists of 90 mobile nodes, used protocol is GRP, network size is 1600x1600m, and node placement is grid regardless of used traffic load.

Figure (29) Topology in case network consists of 90 mobile nodes and used protocol is GRP and network size is 1600x1600m and node placement is grid regardless of the used traffic load.

Figure (30) shows topology in case network consists of 90 mobile nodes and used protocol is GRP and network size is 1600x1600m and node placement is circular regardless of used traffic load.

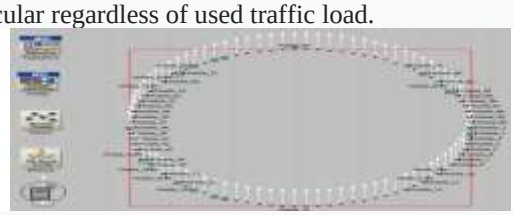

Figure (30) topology in case network consists of 90 mobile nodes and used protocol is GRP and network size is 1600x1600m and node placement is circular regardless of used traffic load.

IV. RESULTS AND DISCUSSION:

1.4 a comparison between performance of geographical routing protocol in case grid node placement model and its performance in case in case circular node placement model in a small network consists of 30 mobile nodes in terms of wireless local area network (WLAN) standards and GRP routing protocol standards for different traffic loads .

Figures (31), (32), (33), (34) show wireless local area network (WLAN) standards in case number of nodes = 30 / Database application / nodes are posited gridly or circularly. Figures (35), (36), (37), (38), (39) show GRP protocol standards in case number of nodes = 30 / Database application / nodes are posited gridly or circularly. The values in tables (3) and (4) will be explained later.

Figure (31) throughput in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

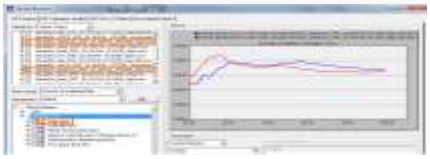

Figure (32) delay in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

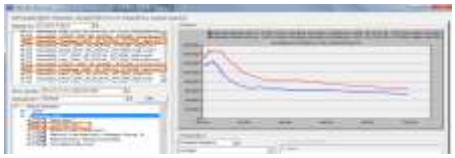

Figure (33) load in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

Figure (34) retransmission attempts in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

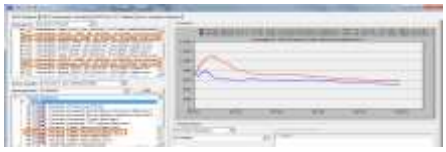

Figure (35) routing traffic received in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

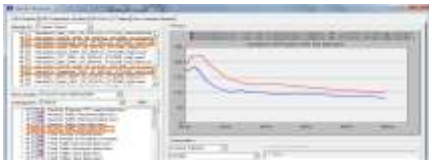

Figure (36) routing traffic sent in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

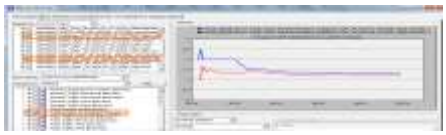

Figure (37) Total number of quadrant changes in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

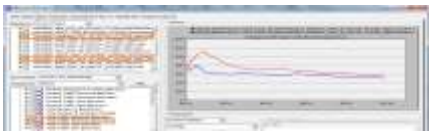

Figure (38) Total traffic received in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

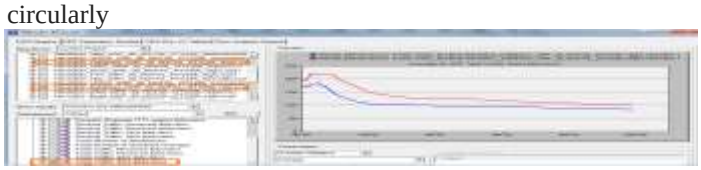

Figure (39) Total traffic sent in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

Table (3) wireless local area network (WLAN) Standards in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

Database Application						
Small network / number of nodes = 30						
Routing protocols		Node placement	throughput	delay	load	retransmission attempts
GRP	Aver.	Grid	481995.5875	0.001749195	87937.44437	1.741080949
		Circular	380351.1277	0.001761533	68382.61957	1.285020878

Table (4) GRP protocol Standards in case number of nodes = 30 / Database application / nodes are posited gridly or circularly

Database Application							
Small network / number of nodes = 30							
Routing protocols		Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
GRP	Aver.	Grid	723.9208676	133.8130061	1.308475872	723.9208676	133.8130061
		Circular	589.3651894	104.9118002	1.511756533	589.3651894	104.9118002

Figures (40), (41), (42), (43) show wireless local area network (WLAN) standards in case number of nodes = 30 / Video application / nodes are posited gridly or circularly. Figures (44), (45), (46), (47), (48) show GRP protocol standards in case number of nodes = 30 / video application / nodes are posited gridly or circularly. The values in Tables (5) and (6) will be explained later.

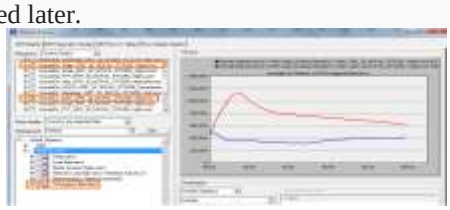

Figure (40) throughput in case number of nodes = 30 / Video application / nodes are posited gridly or circularly

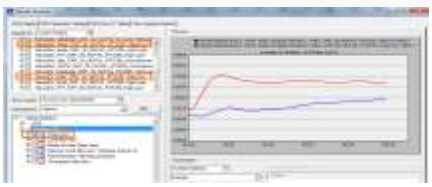

Figure (41) delay in case number of nodes = 30 / Video application / nodes are posited gridly or circularly.

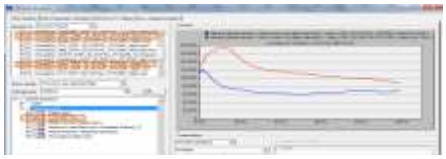

Figure (42) load in case number of nodes = 30 / Video application / nodes are posited gridly or circularly.

Figure (43) retransmission attempts in case number of nodes = 30 / Video application / nodes are posited gridly or circularly.

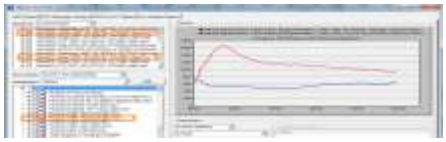

Figure (44) routing traffic received in case number of nodes = 30 / Video application / nodes are posited gridly or circularly.

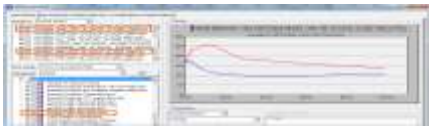

Figure (45) routing traffic sent in case number of nodes = 30 / Video application / nodes are posited gridly or circularly.

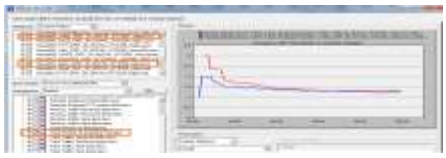

Figure (46) Total number of quadrant changes in case number of nodes = 30 / Video application / nodes are posited gridly or circularly.

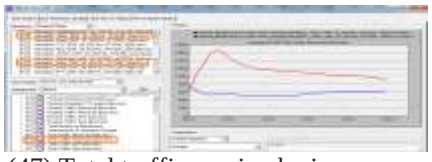

Figure (47) Total traffic received in case number of nodes = 30 / Video application / nodes are posited gridly or circularly.

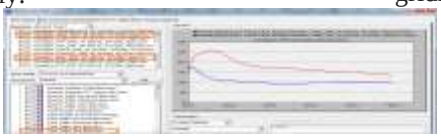

Figure (48) Total traffic sent in case number of nodes = 30 / Video application / nodes are posited gridly or circularly.

Table (5) wireless local area network (WLAN) Standards in case number of nodes = 30 / Video application / nodes are posited gridly or circularly.

Video Application						
Small network / number of nodes = 30						
Routing protocols	Aver.	Node placement	throughput	delay	load	retransmission attempts
GRP		Grid	775599.1321	0.002689287	118445.0554	1.568002658
		Circular	368940.0029	0.001578436	69273.1069	1.708430253

Table (6) GRP protocol Standards in case number of nodes = 30 / video application / nodes are posited gridly or circularly.

Video Application							
Small network / number of nodes = 30							
Routing protocols	Aver.	Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
GRP		Grid	1149.699563	178.6792049	1.519253955	1149.699563	178.6792049
		Circular	562.4540642	106.1970028	1.382790655	562.4540642	106.1970028

Figures (49), (50), (51), (52) show wireless local area network (WLAN) standards in case number of nodes = 30 / Email application / nodes are posited gridly or circularly. Figures (53), (54), (55), (56), (57) show GRP protocol standards in case number of nodes = 30 / Email application / nodes are posited gridly or circularly and the values in Tables (7) and (8) will be explained later.

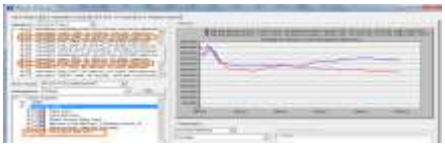

Figure (49) throughput in case number of nodes = 30 / Email application /nodes are posited gridly or circularly

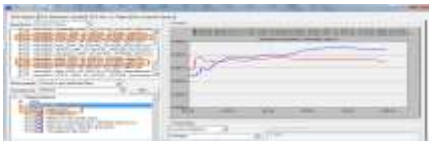

Figure (50) delay in case number of nodes = 30 / Email application / nodes are posited gridly or circularly

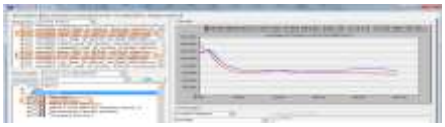

Figure (51) load in case number of nodes = 30 / Email application / nodes are posited gridly or circularly

Figure (52) retransmission attempts in case number of nodes = 30 / Email application / nodes are posited gridly or circularly

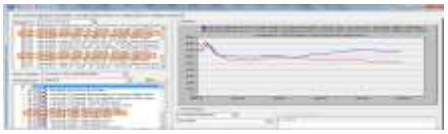

Figure (53) routing traffic received in case number of nodes = 30 / Email application / nodes are posited gridly or circularly

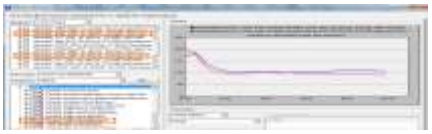

Figure (54) routing traffic sent in case number of nodes = 30 / Email application / nodes are posited gridly or circularly

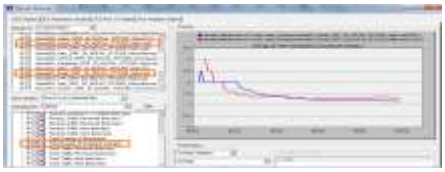

Figure (55) Total number of quadrant changes in case number of nodes = 30 / Email application / nodes are posited gridly or circularly

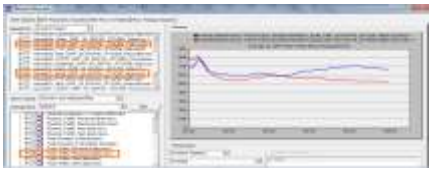

Figure (56) Total traffic received in case number of nodes = 30 / Email application / nodes are posited gridly or circularly

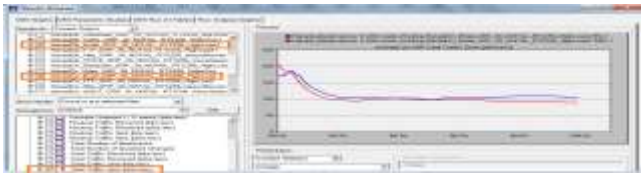

Figure (57) Total traffic sent in case number of nodes = 30 / Email application / nodes are posited gridly or circularly

Table (7) wireless local area network (WLAN) Standards in case number of nodes = 30 / Email application / nodes are posited gridly or circularly

Email Application						
Small network / number of nodes = 30						
Routing protocols	Aver.	Node placement	throughput	delay	load	retransmission attempts
GRP		Grid	371975.1963	0.001798249	68023.83618	2.286931523
		Circular	421065.589	0.001979538	73572.26611	1.608389511

Table (8) GRP protocol Standards in case number of nodes = 30 / Email application / nodes are posited gridly or circularly

Email Application							
Small network / number of nodes = 30							
Routing protocols	Aver.	Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
		Grid	576.239065	104.5377958	1.445167216	576.239065	104.5377958

GRP		Circular	647.3386995	112.5490729	1.43556397	647.3386995	112.5490729

Figures (58), (59), (60), (61) show wireless local area network (WLAN) standards in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly. Figures (62), (63), (64), (65), (66) show GRP protocol standards in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.The values in Tables (9) and (10) will be explained later.

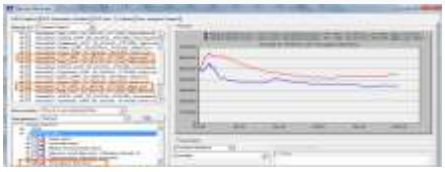

Figure (58) throughput in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.

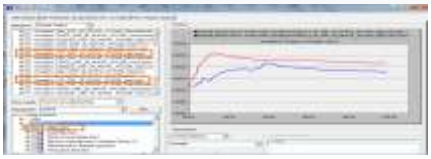

Figure (59) delay in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.

Figure (60) load in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.

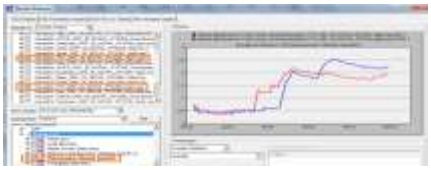

Figure (61) retransmission attempts in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.

Figure (62) routing traffic received in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.

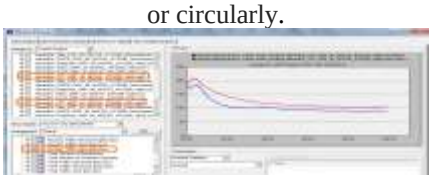

Figure (63) routing traffic sent in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.

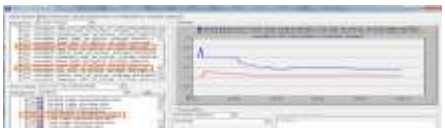

Figure (64) Total number of quadrant changes in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.

Figure (65) Total traffic received in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.

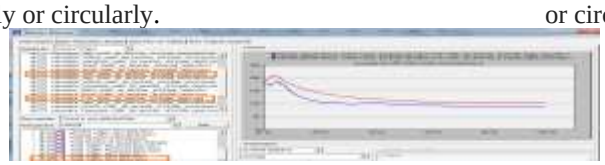

Figure (66) Total traffic sent in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.

Table (9) wireless local area network (WLAN) Standards in case number of nodes = 30 / FTP application / nodes are posited
gridly or circularly.

FTP Application						
Small network / number of nodes = 30						
Routing protocols	Aver.	Node placement	throughput	delay	load	retransmission attempts
GRP		Grid	475719.322	0.002253568	81666.45543	1.360530873
		Circular	379020.7491	0.001824617	68406.74509	1.385853893

Table (10) GRP protocol Standards in case number of nodes = 30 / FTP application / nodes are posited gridly or circularly.

FTP Application
Small network / number of nodes = 30

Routing protocols	Aver.	Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
GRP		Grid	722.6272726	124.611125	1.091110763	722.6272726	124.611125
		Circular	587.5287928	104.9577929	1.561682737	587.5287928	104.9577929

Figures (67), (68), (69), (70) show wireless local area network (WLAN) standards in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly. Figures (71), (72), (73), (74), (75) show GRP protocol standards in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly. and the values in Tables (11) and (12) will be explained later.

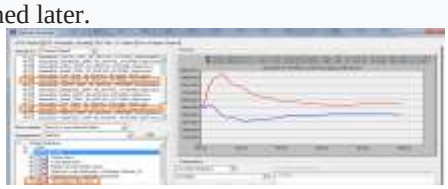

Figure (67) throughput in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

Figure (68) delay in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

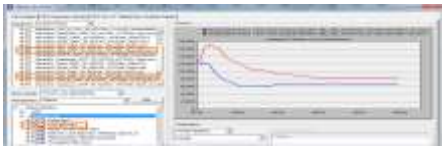

Figure (69) load in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

Figure (70) retransmission attempts in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

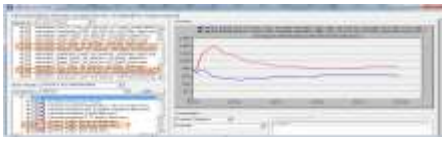

Figure (71) routing traffic received in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

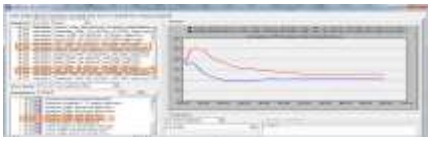

Figure (72) routing traffic sent in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

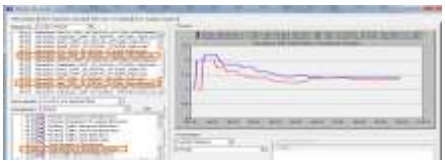

Figure (73) Total number of quadrant changes in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

Figure (74) Total traffic received in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

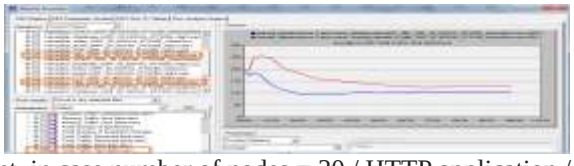

Figure (75) Total traffic sent in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

Table (11) wireless local area network (WLAN) Standards in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

HTTP Application						
Small network / number of nodes = 30						
Routing protocols	Aver.	Node placement	throughput	delay	load	retransmission attempts
		Grid	623069.378	0.00220492	101613.8008	1.430551004

GRP		Circular	393528.5107	0.001632584	71223.62725	1.693698139

Table (12) GRP protocol Standards in case number of nodes = 30 / HTTP application / nodes are posited gridly or circularly.

HTTP Application							
Small network / number of nodes = 30							
Routing protocols		Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
GRP	Aver.	Grid	929.6105115	153.9284744	1.408269231	929.6105115	153.9284744
		Circular	606.0620811	109.058604	1.57911534	606.0620811	109.058604

Figures (76), (77), (78), (79) show wireless local area network (WLAN) standards in case number of nodes = 30 / Voice / nodes are posited gridly or circularly. As for figures (80), (81), (82), (83), (84) show GRP protocol standards in case number of nodes = 30 / Voice application / nodes are posited gridly or circularly. The values in Tables (13) and (14) will be explained later.

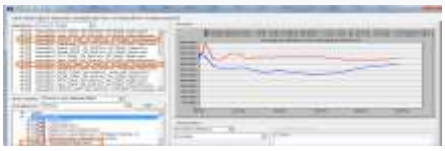

Figure (76) throughput in case number of nodes = 30 / Voice application / nodes are posited gridly or circularly.

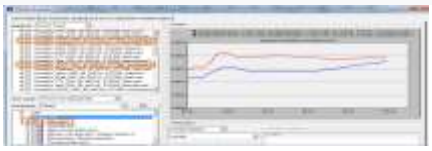

Figure (77) delay in case number of nodes = 30 / Voice application / nodes are posited gridly or circularly.

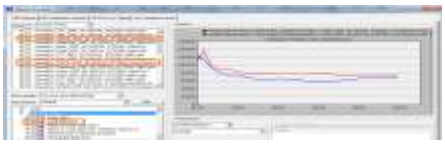

Figure (78) load in case number of nodes = 30 / Voice application / nodes are posited gridly or circularly.

Figure (79) retransmission attempts in case number of nodes = 30 / Voice application / nodes are posited gridly or circularly.

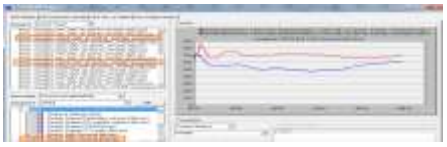

Figure (80) routing traffic received in case number of nodes = 30 / Voice application / nodes are posited gridly or circularly.

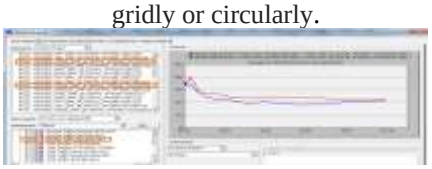

Figure (81) routing traffic sent in case number of nodes = 30 / Voice application / nodes are posited gridly or circularly.

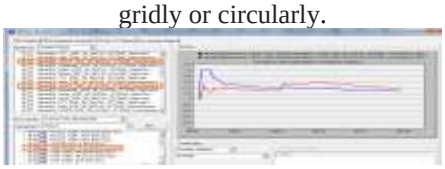

Figure (82) Total number of quadrant changes in case number of nodes = 30 / Voice application / nodes are posited gridly or circularly.

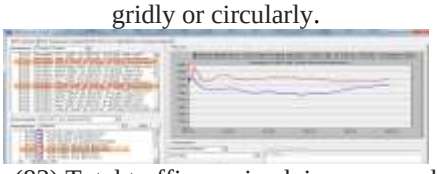

Figure (83) Total traffic received in case number of nodes = 30 / Voice application / nodes are posited gridly or circularly.

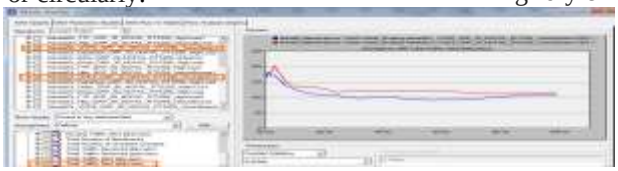

Figure (84) Total traffic sent in case number of nodes = 30 / Voice application / nodes are posited gridly or circularly.

Table (13) wireless local area network (WLAN) Standards in case number of nodes = 30 / Voice application / / nodes are posited gridly or circularly.

Voice Application
Small network / number of nodes = 30

Routing protocols		Node placement	throughput	delay	load	retransmission attempts
GRP	Aver.	Grid	461219.6788	0.001899566	81215.05345	1.435074778
		Circular	355416.8214	0.001461412	69287.59963	1.27881558

Table (14) GRP protocol Standards in case number of nodes = 30 / Voice application / / nodes are posited gridly or circularly.

Voice Application							
Small network / number of nodes = 30							
Routing protocols		Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
GRP	Aver.	Grid	697.8160591	123.9126551	1.413316876	697.8160591	123.9126551
		Circular	541.1021257	106.1971811	1.416610085	541.1021257	106.1971811

We note from Tables (3), (4), (5), (6), (9), (10), (11), (12), (13), (14) that performance of geographical routing protocol is better in case grid node placement model from its performance in case circular node placement model for applications (Database, Video, FTP, HTTP, Voice) and in case number of nodes = 30 mobile nodes, because throughput value in case grid node placement model is higher than its value in case circular node placement model for these applications . While in Tables (7), (8) we note that performance of geographical routing protocol is better in case circular node placement model than in case grid node placement model for email application, and in case number of nodes = 30 mobile nodes. Although load in case grid node placement model with applications (Database, Video, FTP, HTTP, Voice) is higher than load in case circular node placement model and with the same applications and in case number of nodes = 30 mobile nodes while load in case circular node placement model with email application is higher than load in case grid node placement model with the same application and in case number of nodes = 30 mobile nodes.

2.4 comparison between performance of geographical routing protocol in case grid node placement model and its performance in case circular node placement model in a large network consists of 90 mobile nodes in terms of wireless local area network (WLAN) standards and GRP routing protocol standards for different traffic loads .

Figures (85), (86), (87), (88) show wireless local area network (WLAN) standards in case number of nodes = 90 / Database application / nodes are posited gridly or circularly . As for Figures (89), (90), (91), (92), (93) show GRP protocol standards in case number of nodes = 90 / Database application / nodes are posited gridly or circularly. The values in tables (15) and (16) will be explained later.

Figure (85) throughput in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

Figure (86) delay in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

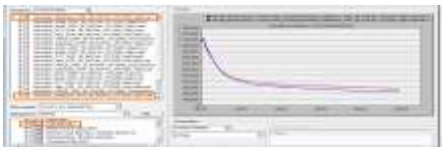

Figure (87) load in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

Figure (88) retransmission attempts in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

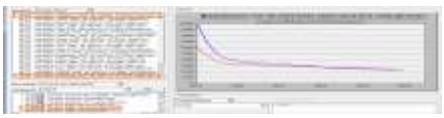

Figure (89) routing traffic received in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

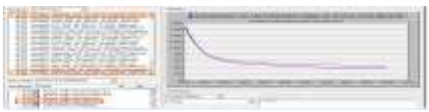

Figure (90) routing traffic sent in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

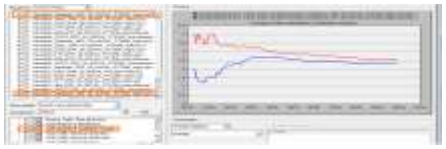

Figure (91) Total number of quadrant changes in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

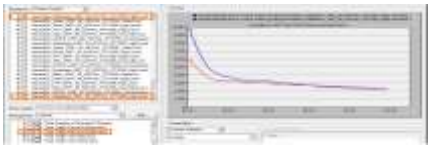

Figure (92) Total traffic received in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

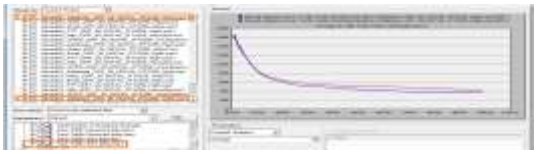

Figure (93) Total traffic sent in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

Table (15) wireless local area network (WLAN) Standards in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

Database Application						
Large network/ 90 nodes						
Routing protocols	Aver.	Node placement	throughput	delay	load	retransmission attempts
GRP		Grid	1996372.304	0.001856713	401559.8832	1.330872963
		Circular	2264907.14	0.002039279	361780.6632	0.963985848

Table (16) GRP protocol Standards in case number of nodes = 90 / Database application / nodes are posited gridly or circularly

Database Application							
Large network/ 90 nodes							
Routing protocols	Aver.	Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
GRP		Grid	3002.686064	601.2204836	2.986263598	3002.686064	601.2204836
		Circular	3413.80655	543.2976453	2.30559127	3413.80655	543.2976453

Figures (94), (95), (96), (97) show wireless local area network (WLAN) standards in case number of nodes = 90 / Video application / nodes are posited gridly or circularly . Figures (98), (99), (100), (101), (102) show GRP protocol standards in case number of nodes = 90 / Video application / nodes are posited gridly or circularly and the values in Tables (17) and (18) will be explained later.

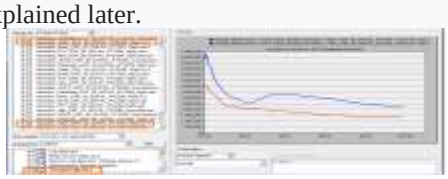

Figure (94) throughput in case number of nodes = 90 / Video application / nodes are posited gridly or circularly

Figure (95) delay in case number of nodes = 90 / Video application / nodes are posited gridly or circularly

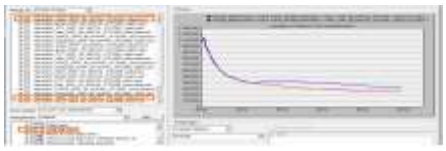

Figure (96) load in case number of nodes = 90 / Video application / nodes are posited gridly or circularly

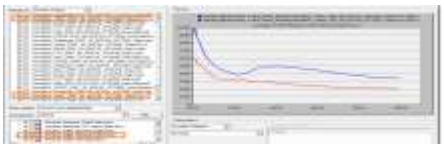

Figure (97) retransmission attempts in case number of nodes = 90 / Video application / nodes are posited gridly or circularly

Figure (98) routing traffic received in case number of nodes = 90 / Video application / nodes are posited gridly or circularly

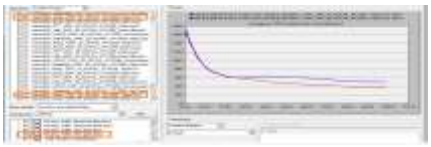

Figure (99) routing traffic sent in case number of nodes = 90 / Video application / nodes are posited gridly or circularly

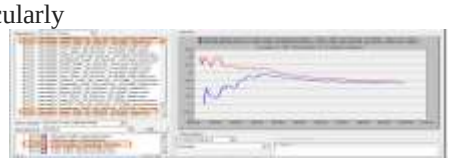

Figure (100) Total number of quadrant changes in case number of nodes = 90 / Video application / nodes are posited gridly or circularly

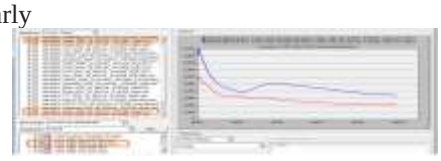

Figure (101) Total traffic received in case number of nodes = 90 / Video application / nodes are posited gridly or circularly

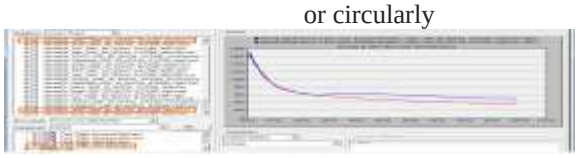

Figure (102) Total traffic sent in case number of nodes = 90 / Video application / nodes are posited gridly or circularly

Table (17) wireless local area network (WLAN) Standards in case number of nodes = 90 / Video application / nodes are posited gridly or circularly

Video Application						
Large network/ 90 nodes						
Routing protocols		Node placement	throughput	delay	load	retransmission attempts
GRP	Aver.	Grid	1851231.918	0.001784348	376302.7568	1.360087386
		Circular	3044224.286	0.002327332	437877.0384	1.13043186

Table (18) GRP protocol Standards in case number of nodes = 90 / video application / nodes are posited gridly or circularly

Video Application							
Large network/ 90 nodes							
Routing protocols	Aver.	Node placement	routing traffic	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
GRP		Grid	2799.037371	564.0879863	2.920288151	2799.037371	564.0879863
		Circular	4546.90894	655.0716442	2.413144098	4546.90894	655.0716442

Figures (103), (104), (105), (106) show wireless local area network (WLAN) standards in case number of nodes = 90 / Email application / nodes are posited gridly or circularly.Figures (107), (108), (109), (110), (111) show GRP protocol standards in case number of nodes = 90 / Email application / nodes are posited gridly or circularly and the values in Tables (19) and (20) will be explained later.

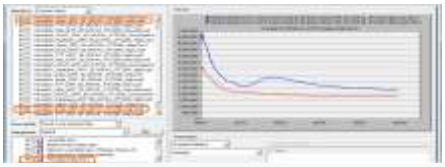

Figure (103) throughput in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

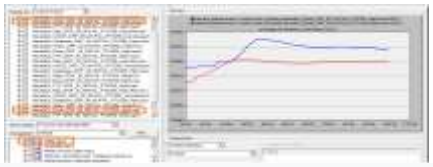

Figure (104) delay in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

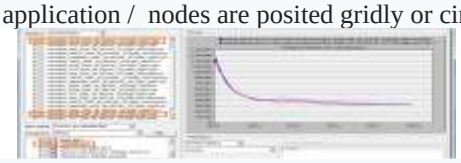

Figure (105) load in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

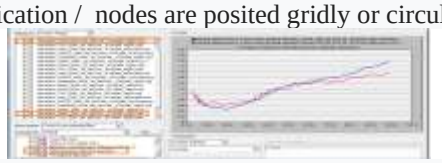

Figure (106) retransmission attempts in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

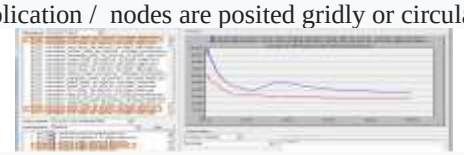

Figure (107) routing traffic received in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

Figure (108) routing traffic sent in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

Figure (109) Total number of quadrant changes in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

Figure (110) Total traffic received in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

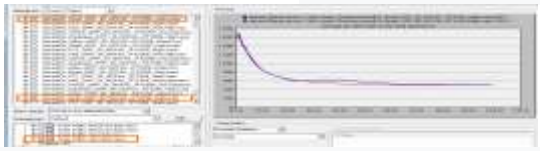

Figure (111) Total traffic sent in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

Table (19) Wireless Local Area Network (WLAN) Standards in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

Email Application						
Large network/ 90 nodes						
Routing protocols	Aver.	Node placement	throughput	delay	load	retransmission attempts
GRP		Grid	2068808.949	0.001896934	413148.1909	1.194760895
		Circular	2976723.87	0.002356598	428005.3988	1.243357071

Table (20) GRP protocol Standards in case number of nodes = 90 / Email application / nodes are posited gridly or circularly

Email Application							
Large network/ 90 nodes							
Routing protocols	Aver.	Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
GRP		Grid	3107.589971	618.2573127	3.024289521	3107.589971	618.2573127
		Circular	4450.233154	640.5951473	2.453327821	4450.233154	640.5951473

Figures (112), (113), (114), (115) show wireless local area network (WLAN) standards in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly.Figures (116), (117), (118), (119), (120) show GRP protocol standards in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly and the values in Tables (21) and (22) will be explained later.

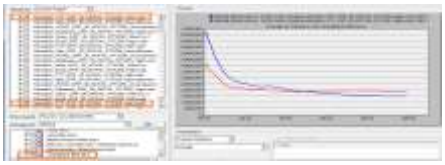

Figure (112) throughput in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly

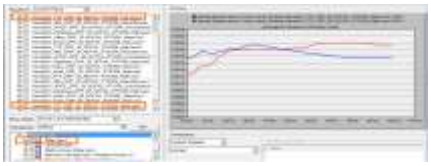

Figure (113) delay in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly

Figure (114) load in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly

Figure (115) retransmission attempts in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly

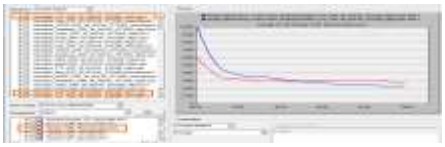

Figure (116) routing traffic received in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly

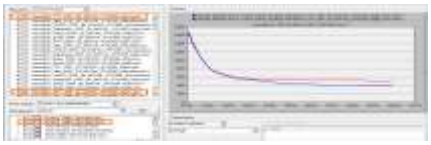

Figure (117) routing traffic sent in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly

Figure (118) Total number of quadrant changes in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly

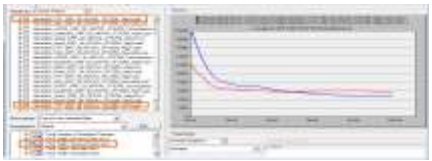

Figure (119) Total traffic received in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly

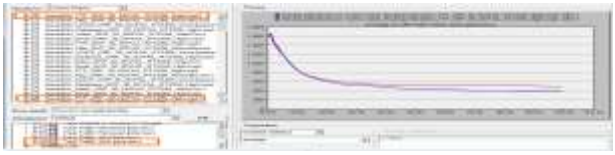

Figure (120) Total traffic sent in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly

Table (21) wireless local area network (WLAN) Standards in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly.

FTP Application						
Large network/ 90 nodes						
Routing protocols	Aver.	Node placement	throughput	delay	load	retransmission attempts
GRP		Grid	2115378.619	0.001990158	414428.5456	1.352121428
		Circular	2264862.815	0.001903775	366326.2372	1.110681344

Table (22) GRP protocol Standards in case number of nodes = 90 / FTP application / nodes are posited gridly or circularly.

FTP Application							
Large network/ 90 nodes							
Routing protocols	Aver.	Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
		Grid	3177.879784	620.0630027	2.96344689	3177.879784	620.0630027

GRP		Circular	3409.12357	550.0677372	2.274907021	3409.12357	550.0677372

Figures (121), (122), (123), (124) show wireless local area network (WLAN) standards in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly. As for Figures (125), (126), (127), (128), (129) show GRP protocol standards in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly and the values in Tables (23) and (24) will be explained later.

Figure (121) throughput in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

Figure (122) delay in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

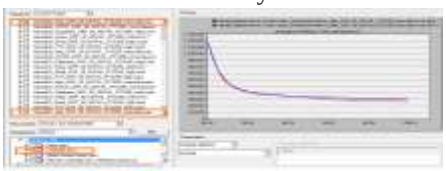

Figure (123) load in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

Figure (124) retransmission attempts in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

Figure (125) routing traffic received in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

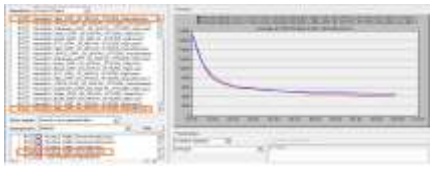

Figure (126) routing traffic sent in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

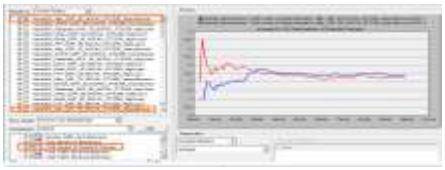

Figure (127) Total number of quadrant changes in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

Figure (128) Total traffic received in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

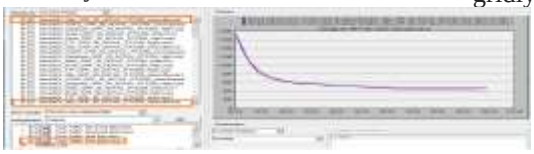

Figure (129) Total traffic sent in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

Table (23) wireless local area network (WLAN) Standards in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

HTTP Application						
Large network/ 90 nodes						
Routing protocols	Aver.	Node placement	throughput	delay	load	retransmission attempts
GRP		Grid	1865215.776	0.001833308	383522.2179	1.3332325
		Circular	2481757.071	0.002144385	400283.3804	1.381688709

Table (24) GRP protocol Standards in case number of nodes = 90 / HTTP application / nodes are posited gridly or circularly.

HTTP Application
Large network/ 90 nodes

Routing protocols		Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
GRP	Aver.	Grid	2812.26428	575.0016949	2.490032036	2812.26428	575.0016949
		Circular	3716.765192	600.0766125	2.323124652	3716.765192	600.0766125

Figures (130), (131), (132), (133) show wireless local area network (WLAN) standards in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.Figures (134), (135), (136), (137), (138) show GRP protocol standards in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly and the values in tables (25) and (26) will be explained later.

Figure (130) throughput in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

Figure (131) delay in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

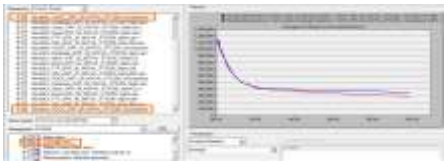

Figure (132) load in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

Figure (133) retransmission attempts in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

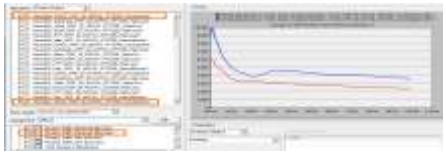

Figure (134) routing traffic received in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

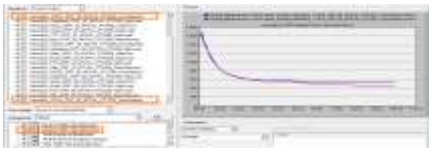

Figure (135) routing traffic sent in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

Figure (136) Total number of quadrant changes in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

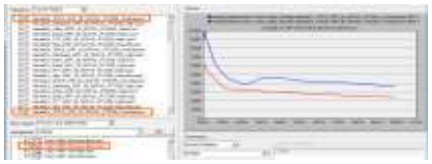

Figure (137) Total traffic received in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

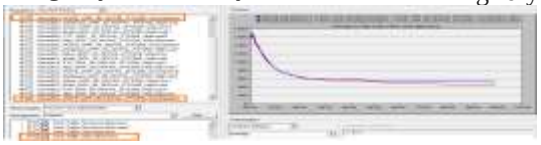

Figure (138) Total traffic sent in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

Table (25) wireless local area network (WLAN) Standards in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

Voice Application						
Large network/ 90 nodes						
Routing protocols		Node placement	throughput	delay	load	retransmission attempts
GRP	Aver.	Grid	2021435.013	0.001875247	404033.6278	1.195115103
		Circular	3000575.148	0.002439789	432374.3814	1.108191283

Table (26) GRP protocol Standards in case number of nodes = 90 / Voice application / nodes are posited gridly or circularly.

Voice Application							
Large network/ 90 nodes							
Routing protocols		Node placement	routing traffic received	routing traffic sent	Total number of quadrant changes	Total traffic received	Total traffic sent
GRP	Aver.	Grid	3039.395452	604.7779771	2.979600426	3039.395452	604.7779771
		Circular	4485.257539	647.0468313	2.456455909	4485.257539	647.0468313

As for increasing number of nodes to come 90 mobile nodes, we note from tables (15), (16), (17), (18), (19), (20), (21), (22), (23), (24)), (25), (26) that performance of geographical routing protocol is better in case circular node placement model than it is in case grid node placement model for (Database, Video, Email, FTP, HTTP, Voice) applications, and in case number of nodes = 90 mobile node, because the throughput value in circular node placement model is higher than its value in case grid node placement model for these applications.

V. CONCLUSION:

In the first part of this article a comparison was made between performance of geographical routing protocol in case grid node placement model and its performance in case circular node placement model with different traffic loads (Database, Video Email, FTP, HTTP, Voice) respectively in a small network consists of 30 mobile nodes, where network size was 800x800m in terms of wireless local area network (WLAN) standards and GRP routing protocol standards , as it was found that performance of geographical routing protocol is better in case grid node placement model than in case circular node placement model for Applications (Database, Video, FTP, HTTP, Voice).

As for the second part of the article, a comparison was made between performance of geographical routing protocol in case grid node placement model and its performance in case circular node placement model with different traffic loads (Database, Video Email, FTP, HTTP, Voice) respectively in a large network consists of 90 mobile nodes where network size was 1600x1600m in terms of wireless local area network (WLAN) standards and GRP routing protocol standards, so it was concluded that performance of geographical routing protocol is better in case circular node placement model than in case grid node placement model for Applications (Database, Video, Email, FTP, HTTP, Voice).

VI. FUTURE WORKS:

In the future, we can think of studying effect of increasing number of nodes by comparing the performance of geographical routing protocol in case grid node placement model for 30 mobile nodes where network size was 800x800m and between its performance when number of nodes increased in case grid node placement model also to become 90 nodes mobile with same network size (800x800m) with different traffic loads (Database, Video Email, FTP, HTTP, Voice) respectively in terms of WLAN standards and GRP routing protocol standards

And also to perform comparison of performance for geographical routing protocol in case circular node placement model for 30 mobile nodes where network size was 800x800m and between its performance when increasing number of nodes in case circular node placement model also to become 90 mobile nodes with same network size (800x800m) and with different traffic loads (Database, Video Email, FTP, HTTP, Voice) respectively in terms of WLAN standards and GRP routing protocol standards.

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