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Multi-Manet Gateway Routing System for Heterogenous System

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***Abstract* - The growth of data over the cellular networks is increasing at an exponential rate as users download more video, transfer more data and use smartphones and tablets as their main access point for mobile communications. Effective network planning is essential to cope with the increasing number of mobile broadband data subscribers and bandwidth-intensive services competing for limited radio resources. Future wireless networks aim in ubiquitous computing that maintains connectivity between mobile units with none constraints on time, place and kind of media and connectivity. Connectivity in such networks needs to be maintained with less value and time. MANET, Associate in Nursing infrastructure-less wireless network is used to maintain connectivity in future networks with the assistance of Multi MANET entrance nodes (MMGW). MMGW can be wont to connect MANET with the other class of network particularly Cellular, WLAN, Satellite, WSN, Internet etc. This paper proposes Associate in Nursing integration model, that alter a mobile user to keep up property while mobile. MANET routing protocol AODV is changed to include entrance formatting, discovery and selection procedures. Link stability and path stability square measure the most two parameters used to realize the simplest entrance and path. A simulation model was developed and performance analysis was done to match the operating of MMGW underneath totally different networks.**

Index Terms: MANET; Heterogeneous Network; MANET Gateways; Integration ; Global connectivity ; Coverage;

I.INTRODUCTION

Since their look in 1970 within the type of ALOHANET, remote parcel radio systems have restore associate extended technique concerning numbers, applications, and moreover the list of capabilities, among elective things. the 2 biggest attractions of remote correspondence area unit quality and straight selfassertiveness of designing – giving birth links is not solely wearying and time exceptional, but their support is equally rankling. Remote correspondence of late encompasses us of America in a very few hues and flavors, every with its clear band, scope, and alter of applications. it's developed to a bigger than usual degree, and benchmarks have advanced for personal area Systems, native area Networks nevertheless as Broadband Wireless Access. Future wireless networks aim in present computing worldwide, wherever a mobile user will communicate with any device notwithstanding the situation, time, communication media and technology. Existing standalone communication technologies don't seem to be adequate to support such an attempt. New technologies specifically Machine-to-Machine communication, Device to Device networks, net of Things, Mobile cloud computing communication technologies [1,2,3,4]. These technical ideas will create a powerful modification within the field of rescue operations, disaster and management, communication throughout military attacks, good town implementation etc. In such situations, quite one class of networks are utilized in gathering and supported numerous problems that will arise. problems known in such situations area unit that will arise. problems known in such situations area unit concerning deficiency of obtainable spectrum, increase in preparation price variable transmission vary of act devices, the quality of wireless devices, security and addressing schemes. Heterogeneous networks offer product and services across each macro and tiny cells to optimize the combo of capabilities. As mobile broadband demand continues to grow dramatically, important will increase in capability are often achieved by adding little cells to enrich macro networks, forming heterogeneous networks, conjointly referred to as HetNets. A Edouard Manet could be a sort of spontanepous network which will modification locations and piece itself on the fly. as a result of MANETS area unit mobile, they use wireless connections to attach to varied networks. this may be a customary Wi-Ficonnection, or another medium, appreciate a cellular or satellite transmission. Some MANETs area unit restricted to space|a neighborhood} area of wireless devices (such as a gaggle of portable computer computers), whereas others could also be connected to the web. as an example, A VANET (Vehicular spontanepous Network), could be a sort of Edouard Manet that permits vehicles to speak with edge instrumentation.

whereas the vehicles might not have an instantaneous net association, the wireless edge instrumentation could also be connected to the web, permitting information from the vehicles to be sent over the web. The vehicle information could also be wont to live traffic conditions or keep track of transportation fleets. thanks to the dynamic nature of MANETs, they're usually not terribly secure, thus it's vital to use caution what information is shipped over a Edouard Manet. The projected approach are often utilized in a heterogeneous situation which mixes mobile spontanepous networks and different networks. mistreatment the projected methodology a mobile node will communicate with the mobile nodes in a very cellular network or different networks mistreatment multi-hop communication with the assistance of MMGW. The simulation model and performance analysis conjointly demonstrate the effectiveness of the new approach in several heterogeneous situations.

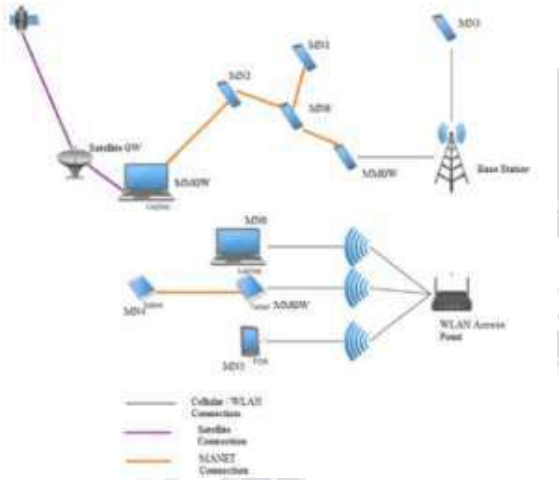

Fig 1: MANET Integration using MMGW

I. MANET

Over the previous couple of years, wireless pc networks have induced nice interest from the general public. Universities, companies, military, and governmental and nongovernmental organizations and agencies area unit currently mistreatment this new technology.

We can usually classify wireless networks into 2 categories:

1) Wireless networks with fastened and wired gateways, and

2) wireless networks that can be found out in associate degree

"ad hoc" fashion, while not the existence of fastened Access purpose (AP) and wherever all nodes within the network behave as routers and participate within the discovery and maintenance of routes to different nodes within the network.

A Mobile impromptu Network (MANET) may be a wireless network within which all nodes can freely and capricious move in any direction with any speed. Routing takes place without the existence of fastened infrastructure. The network will scale from tens to thousands of nodes in a commercial hoc fashion, providing the nodes area unit willing to require half in the route discovery and maintenance method. We can generally outline 2 main areas wherever Manet technology are often applied. The first space extends this wired and wireless networks by adding new mobile nodes that use Edouard Manet technology at the sting of the network. These may well be, for example, drivers in a very town United Nations agency will communicate with one another whereas getting traffic information, students on a university field, company staff in a very meeting space, and many different similar things. maybe someday MANETs, can replace the prevailing wireless telephone if each user is willing to store and forward information packets together with his wireless device.The second space wherever Manet technology are often applied is wherever a communication network is required, however there's no infrastructure offered, or the preceding infrastructure has been destroyed by a disaster or a war. MANETs are often utilized in any Framework that involves associate degree emergency, similar to search-and-rescue operations, military deployment in a very hostile surroundings, police departments, and plenty of others. Additionally, the lack of a wired infrastructure reduces the price of building such a network and makes MANETs a awfully engaging technology.

There are still many open issues concerning MANETs. They involve efficient routing due to frequent changes in the network topology over time, and security, because each node in the network operates also as a router that stores and forwards data packet from other nodes. Energy consumption is another open issue as nodes in the network transmit

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not only its data but also data from other nodes. Finally, lower data rates due to the limitation of the physical layer as compared to wired networks.figure 3 shows MANET networks

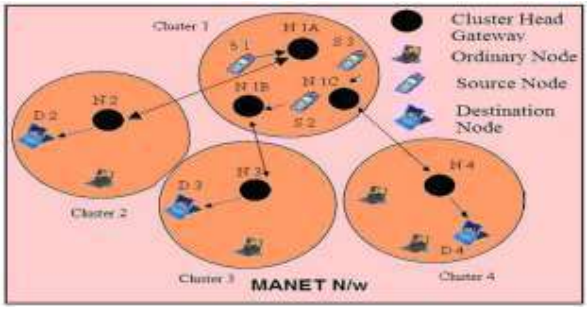

Fig 2:MANET network

II. HETEROGENEOUS NETWORKS

The word heterogeneous network is also used in wireless networks using different access technologies. For example, a wireless network which provides a service through a wireless LAN and is able to maintain the service when switching to a cellular network is called a wireless heterogeneous network.

A radio access network that comprises layers of different-sized cells ranging from big (macrocells) to small (picocells and femtocells).The concept has emerged in the context of Long Term Evolution (LTE) and LTE-Advanced. In order to reach the full bandwidth capacity of either protocol, it is thought that operators will need to supplement their traditional large macrocells with many different-sized small cells.Heterogeneous Network Wireless cellular systems have evolved to the point where an isolated system (with just one base station) achieves near optimal performance, as determined by information theoretic capacity limits. Future gains of wireless networks will be obtained more from advanced network topology, which will bring the network closer to the mobile users. Heterogeneous networks, utilizing a diverse set of base stations, can be deployed to improve spectral efficiency per unit area.

In a homogeneous network, each mobile terminal is served by the base stations with the strongest signal strength, while the unwanted signals received from other base stations are usually treated as interference. In a heterogeneous network, such principles can lead to significantly suboptimal performance. In such systems, smarter resource coordination among base stations, better server selection strategies and more advanced techniques for efficient interference management can provide substantial gains in throughput and user experience as compared to a conventional approach of deploying cellular network infrastructure.

III. ISSUES IN INTEGRATING MULTIPLE NETWORKS:

The are various issues encountered during integration of multiple networks.the major issues that occur while integrating multiple networks are listed below

A. Dynamic Network Topology: Major issue identified while integrating multiple networks is related to the change in topology of mobile nodes. Due to the mobility of the participating nodes, the topology of the network changes, this results in finding new routes using different network technologies and gathers neighboring nodes information to maintain connectivity. This may result in high control overhead. So the integration model should be designed to reduce the control overhead.

B. Protocol Stack: Integration of different wireless technologies with MANET demands a modified protocol stack. Protocol stack used in different wireless communication technologies varies from MANET protocol stack. In homogenous networks, all network components utilize same protocol stack. Each layer in such a protocol stack has specific functions and also serves the upper layers. In the case of heterogeneous network protocol stack of different communication, technologies need to be efficiently handled. The protocol stack of a MANET gateway node with multiple interfaces requires a modified structure which can execute different protocols for a given layer to occupy with both MANET and other wireless communication protocols

Handoff: While a mobile node in heterogeneous network moves from one network to another the handoff occurs between gateways to support roaming among mobile users. Normally in such case vertical handoff are considered. Detection period is one constraint under handoff.

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C. Routing and Gateway Discovery and Selection: Routing packets in heterogeneous networks need of gateway node to transfer the packet from one network to another. The best gateway needs to be selected in case of handoff or best gateway needs to be selected in case of handoff or during initial transfer of data. Various gateway selection and discovery strategies were already considered.

IV. THE PROPOSED SYSTEM

A. Architecture: Figure 1 shows an integrated model which shows the presence of multiple networks like Satellite, WLAN, Mobile Cellular Network and MANET. In this architecture, a MANET node can act as a Multi MANET Gateway node as it comes under the coverage of more than one network. In such cases, MANET node can become the access point for other networks like mobile cellular, satellite, WLAN and MANET as in Fig 3. MANET node should have the capability to handle multiple interfaces as well as multiple networks. Such integration architecture can be used to support flexible, costless wireless communication-worldwide.

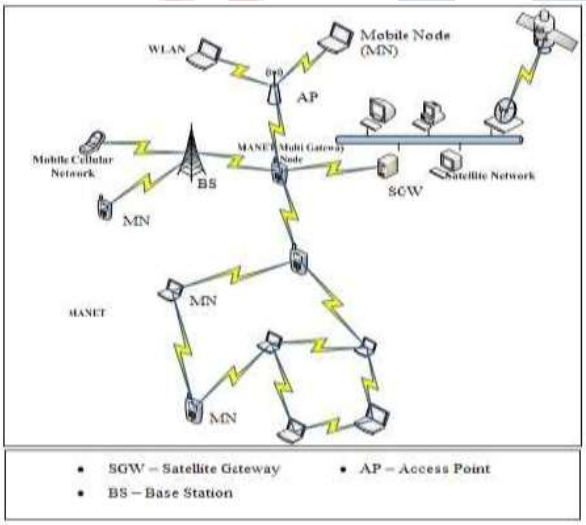

Fig 3: Multi-MANET-Gateway in MANET integration

B. Components: The main components included in the integrated structure are provided.

- MANET Multi-Gateway Node: A Multi-interface gateway node with the property of most networks explained. Here an IEEE 802.11u can be used for avoiding preauthorization. MANET node will be given the feature of the multi-interface node.
- Satellite Gateway Node: A gateway node member of the satellite network. It helps in interacting with MANET gateway node to forward the packet to the satellite network and vice versa.
- Access Point (AP): Access point serves as the link with Wireless LAN, WLAN for a MANET node. Normally, a WLAN member gets the facilities of LAN using a single hop connection to AP.
- Base Station (BS): Base station (BS) in the cellular network helps in the interaction of mobile nodes under its coverage area via single-hop communication.
- Mobile Nodes (MN): A mobile can be a member of MANET as well as other networks.

C. Connectivity Framework: Consider two mobile nodes MN1 and MN2 in two different networks. In the case of new and MN2 in two different networks. In the case of new integrated model different connectivity, Framework are possible

- Framework 1: MN1 and MN2 interact through the cellular. interface using BS in single hop mode..
- Framework 2: MN1 and MN2 communicate through WLAN interface where Access point AP providesthe single hop communication.
- Framework 3: MN1 and MN2 communicate through Satellite Gateway Node (SGW) using satellite interface.
- Framework 4: MN1 and MN2 communicate through MANET interface using multi-hop communication.
- Framework 5: MN1 and MN2 communicate through WLANinterface via MMGW in ad hoc mode to communicate through multiple hops
- Framework 6: MN1 and MN2 communicate through Cellular interface via MMGW in ad

hoc mode to communicate through multiple hops.

- Framework 7: MN1 and MN2 communicate through Satellite interface via MMGW in ad hoc mode to communicate through multiple hops.

Integrated Routing Scheme for a generic heterogeneous network: A viable integrated routing solution, which supports routing among mobile nodes in an integrated network, is proposed in this section Routing packets in multi-hop mode may use different interfaces like cellular, satellite, WLAN or MANET. If the nodes are communicating using MANET interface only MANET routing protocol need to be utilized. If it is between any other interfaces like cellular, WLAN or Satellite, IP-based modified routing solution can be used and routing will be through Multi MANET gateway nodes. Multi MANET Gateway Node (MMGN) is the main functioning unit in the integrated scenario. MMGN can interact with other networks namely Satellite, WSN, Cellular, WLAN or Internet using multiple interfaces. Link stability factor of MANET node with any of the identified gateway nodes (BS/ AP) of external networks are used to initialize a MANET node as an MMGW node. The route discovery process will be handled using AODV routing protocol with modified gateway discovery and selection. Link stability factor is periodically identified by the MANET nodes with neighbor detection using a HELLO message. A mobile device intended to make smart decisions can depend on the link stability between identified multi-gateway node and the gateway node GW node (Access Point, Base Station, Satellite gateway, Internet gateway etc) in another network for forwarding packets.

D. Link Stability and Path Stability Estimation:
Linkstability between two nodes in the work is estimated based on signal strength/ transmission power and distance between two nodes. The equation for calculating link stability between MANET node and gateway node of another infrastructure-based network. Let SS be the signal strength between two nodes i and j. Let q be the link quality between two nodes i and j and calculated as the reciprocal of bit error ratio. Let d be the distance between nodes i and j and calculated using the Euclidean distance formula

D = v (x-x) + (y- y) (1)

The LS that represent link stability is calculated as

LS = SS * q / d (2)

Path stability is taken as the average of link stability between

each pair of nodes in a given path.

Let PS represent the path stability

Let P1, P2, P3,..,Pn be the link stability between each pair of nodes in the path from S to D.

$$ps(s,d) = \frac{\sum_{i=1}^{n} pi}{n}$$

Energy calculations formula is represented as Total energy= initial energy – reaming energy

E. Initializing a MMGW Node: A MANET node under the coverage of BS/AP will be chosen as the MMGM. A reliable MMGW node is selected based on link stability estimated using equation (2) between the MANET node and GW node. It is calculated when the distance between the two nodes is less than the transmission range R. In order to find the link stability, the MANET node can use periodic HELLO messages to acquire the information related to signal strength and position of each neighboring node. Based on the signal strength of the neighboring node, the MANET node's table is updated with the value as in table 2. Initially, the value of the table will be set as zero. The source node can further use this value to send data to the corresponding network.
Table 1: fields identified in HELLO packet

Field	Function
NID	ID used to identify a mobile node
NLOC	Location information
SS	Signal Strength

Table 2: service indication value stored in MMGM

Gateway Type	Value
Satellite Gateway	1
Cellular Gateway	2
Internet Gateway	3
WLAN Access Point	4
WSN BS	5

F. Gateway Discovery and Selection: Gateway discovery in integrated scenarios is divided into three categories namely proactive, reactive and hybrid. In proactive approach gateway nodes periodically broadcast the information to other nodes in MANET. In reactive approach source node sends GWSOL, a solicitation message to gateway nodes. On receiving the solicitation message the gateway node reply with its information to the source node. In the case of hybrid gateway discovery, both proactive and reactive approaches are combined to find nearby gateway nodes [17]. In the proposed routing scheme, the initial phase in the routing is related with finding the best MMGW connected to an external network. The proposed routing strategy uses a reactive gateway discovery approach in finding available MMGW for transmitting messages to other network using multi hop communication path. The source sends a GWSOL message to the neighboring nodes announcing its need for service from other networks. Available MMGN replies with its information and service mode it offers to the source node. The mode indicates the type of external networks connected to a particular MMGW. The source node on receiving the information about multiple MMGWs use equation (3) and the service indication value send by the multiple MMGW for finding MMGW with the stable path

G. Routing: A modified version of Ad Hoc on Demand Vector (AODV) routing protocol is used to design the whole routing scheme, which includes gateway discovery, selection and routing. If the destination node is a member of MANET, an RREQ message is forwarded to neighboring nodes from the source node S to destination node D. If the destination address denotes a mobile node outside the MANET, it requires the service of a gateway node. In such case, GW-RREQ is forwarded to find a gateway node.GW-RREP format is changed to incorporate the details regarding MMGW node. On receiving multiple GW-RREPs regarding the same MMGW, the best path towards D will be chosen based on the path stability. The packet is forwarded through the selected path to selected MMGW, which further forwards the packet to GW node of the external network.

H. Advantages of New Integrated Routing Scheme: Helps routing in heterogeneous environment Path reliability is given more importance. Enables cost effective communication in disaster areas, emergencies, conferences etc where existing telecommunication facilities fail. MANET node with multiple interfaces used to connect with other external networks. Every node in MANET can be connected to any other mobile device using different communication technology.

V. SIMULATION MODEL

The integrated routing strategy is tested in a simulated model developed using NS2. The heterogeneous network is simulated with wireless nodes ranging from 10 to 50. Three categories of GW nodes with varying features are used to represent Bases stations in the cellular network and Access Points in WLAN. Each MANET node is assigned three wireless interfaces. Multiple interface support is incorporated in NS2 to add multiple interfaces to each mobile node.One interface are used for a wireless link between two MANET nodes. The second interface represents the wireless link for MANET node and Base station (home gateway); Third interface represents the wireless link between MANET node and Access point (home gateway). The simulation area is set as 2000 X 2000 m2 area. Duration of each simulation is set as 1000 seconds. Free space propagation model is assumed. Mobility model used is the random way-point model. Traffic model used is constant bit rate. Exponential traffic generators are also used as application [18-20].

A. Analysis: Network behavior is analyzed based on following performance metrics.

- Packet Delivery Ratio: It is defined as the sum of a number of packets received at each GW nodes to the product of a number of packets sent from the source node and a number of GW nodes.
- Average End to end delay: It is defined as ratio between thesum of time interval between data packet sent time andthe time all packets are received at each node and sum of data packets received by all nodes
- Performance Analysis: In the performance evaluations working of three categories of

gateway nodes are analyzed. The simulation scenario analyzed working of gateway nodes connected to access points, base stations and satellite gateways. In the case of packet delivery ratio analysis from the figure 3, best performance is shown by MMGW node connected to WLAN access points when compared to cellular gateways and satellite gateways. The Average end to end delay as in figure 4 shows improvement in the case of WLAN gateway connection compared to Cellular and Satellite connection [11-20].

In the proposed we have included one more parameter that is the energy parameter and the scalability is increased when we select the source to send the data it starts sending signals to find its suitable neighbors and with the help of its neighbors it selects the best gateway available to transfer packets to the desired destination. The software used is NS2 ubuntu software the output nam window graph is shown in the fig. 4 Then the desired graphs are plotted and the values of the graphs are observed and compared.

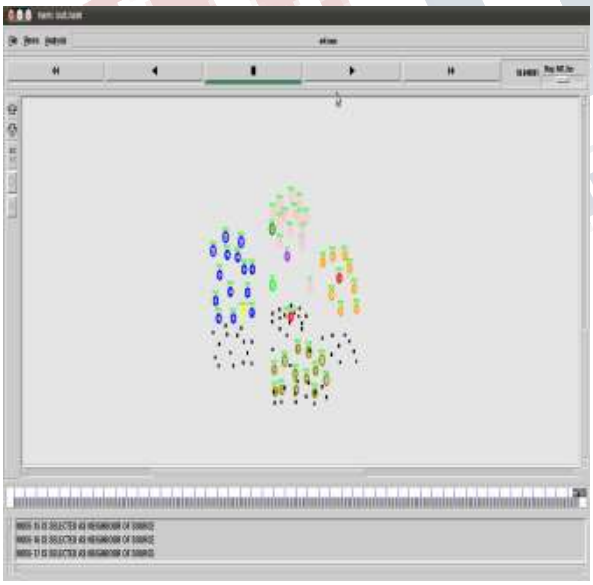

Fig.4: Nam window output

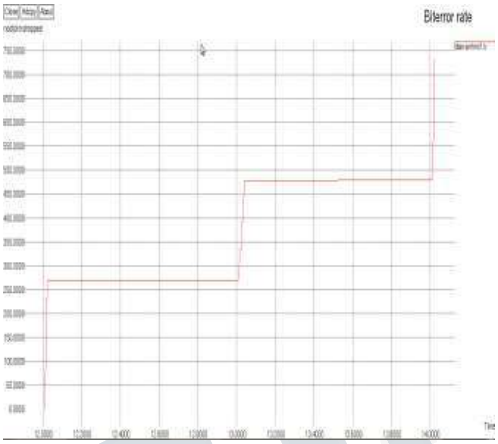

Fig. 5 : Bit error rate graph

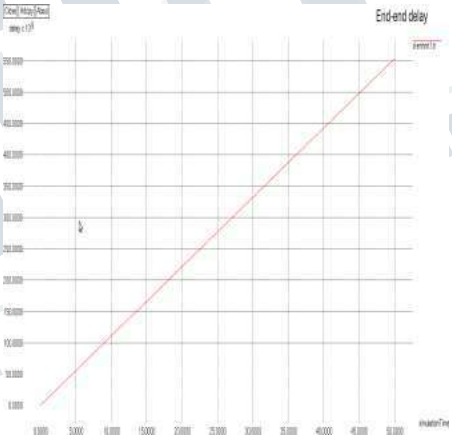

Fig 6: End to End delay graph

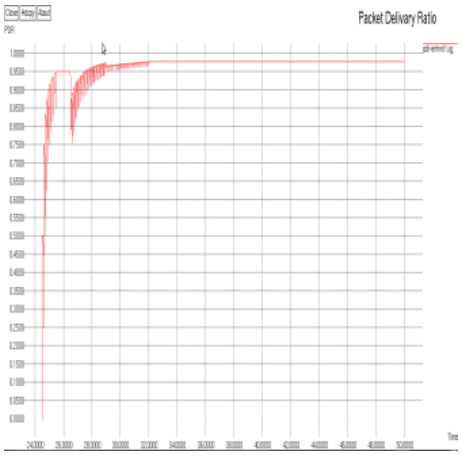

Fig 7: Packet Delivery Ratio Graph

CONCLUSION

An integrated routing solution has been proposed in this paper, which helps in integrating MANET with other category networks like cellular, WLAN, Satellite, WSN etc. In the proposed model, MANET nodes with multiple interfaces will work as Multi MANET Gateway node (MMGW) which helps in interconnecting with other networks. The work includes gateway initialization, discovery and selection followed by routing. Existing AODV protocol is modified to include gateway initialization, discovery and selection. Gateway initialization is done based on link stability between MMGW and gateway of other networks. A reactive gateway discovery approach is used and gateway selection procedure depends on path stability from the source node to MMGW Packet Delivery Ratio and delay parameters were considered to check the efficiency of routing strategy with related to different networks connected to MMGW. Most of the other works focus either on integrating MANETwith any one network namely Cellular or WSN or Internet or Satellite. In this integration model, more than one network can be connected using same MMGW node. By integrating different networks coverage and connectivity of next generation networks can be improved. Such endeavors can also help in molding new models which will be useful in developing latest technologies like Iota which support MANET-WSN integration, Device to Device (D2D) communication which supports MANET Cellular and Green Communication which all aim in the availability of telecommunication facility which is faster, cost less and available anytime and anywhere.

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