ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 8, August 2015

Efficacy of IPv6 over IPv4 Addressing Protocol for Integration of Various Wireless Ad-hoc Networks

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Abstract: Many Computer Vision and Machine Vision researchers are working very hard to connect the world together by enhancing the standards of wireless communication. In this concept of globalization, Wireless ad hoc networks (WANET) plays an important role due to their infrastructure less and autonomous attributes. In this paper we presented a concept of auto assignment of addresses to ad hoc nodes for allowing efficient duplex communication with corresponding nodes of infrastructure based network. To work with heterogeneous network of nodes, we consider four different wireless networks for the purpose of simulation. These networks are WiFi, ZigBee, UMTS and Satellite network. We analyze the performance of IPv6 based addressing over IPv4 based addressing for mobile nodes on the basis of parameters Average Packet Drop (APD), Delay, Routing Overhead (RO), Packet Receiving Rate (PRR) with respect to simulation time. In our study we found the improved performance of IPv6 based addressing over IPv4 based addressing when communicating in between network containing networks of different standards.

Keywords: Ad hoc networks, Duplex Communication, Infrastructure less, WANET, RERR.

I. INTRODUCTION

Advancements in the area of networking and its issues attracted number of researchers towards this field. The main focus is either on Infrastructure based networks or Infrastructure less networks. Wireless Ad hoc network (WANET) is an infrastructure less network without the support of any base station or access point [5]. So it is an autonomous network. The mobile users in the network have to communicate by considering bandwidth constrained, wireless links due to the mobile nature of nodes, the change in network topology over time etc. Also there is no centralized point is considered in the WANET, every node itself perform operation for discovery of topology and delivery of message [6].

Different challenges in wireless ad hoc network are the need of dynamic topology due to mobility of nodes leaving/ joining the network, resource constraints (band width, device battery, memory, processing speed etc.) and the need to forward packets through several nodes. Further, the mobility of nodes may cause packet loss and route change effects. To handle all these challenges of wireless Ad hoc network dynamic routing protocols are required with the capability of dealing with the mobile nature of nodes present in the network. In this paper a comparison is done by assigning IPv6 addressing and IPv4 addressing to the wireless Ad hoc network. The next part of the paper presented the literature done in this field of wireless Ad hoc networks. After that the next section will present the proposed method which try to compare IPv6 addressing with IPv4 addressing. Result and discussion part will show the improved performance of IPv6 addressing over previous version. At the end, conclusion section will give a brief about the results obtained and the kind of methodology adopted.

II. RELATED WORK

Jeong et al. proposed an architecture of DNS service system for mobile Ad hoc network based on IPv6. They performed the DNS resolution of DNS names by multicast DNS through the auto configuration of recursive DNS server. Their proposed system allow mobile nodes within IPv6 MANET to resolve DNS name of internet into Global IPv6 address [1].

Fekri et al. presented a survey of solutions to integrate MANET's with internet. The limitations of all the solutions were also considered. They introduced a framework for the integration of the Cellular IP address network and MANET. Authors used IP mobility protocol [2].

Fazio et al. presented an innovative protocol for automatic configuration of IP addresses in ad hoc networks. Their protocol manages duplicate addresses instead of unique IP's due to the mobility of nodes. Their proposed protocol also provide the mechanism of Gradual Merging [3].

Han et al. studied the impact of addresses configuration and configuration procedure on IPv6. They presented a scheme to eliminate the latency method needed for address configuration and analyzed the handover latencies of IETF IPv6 mobility protocol and enhanced protocol with a DAD support [4].

Khan et al. devised a proactive gateway discovery algorithm which consider the length of the routing queue along with minimum hop count metric. It also select the routes to other mobile nodes. The main focus was to increase the throughput and reduce the routing overhead. They considered the improvement over parameters such as packet delivery ratio, end to end delay and routing protocol overhead [7].

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Hsu et al. studied the performance of different MANET (Mobile Ad-hoc Network) routing protocols in large scale networks. They considered the mixture of reactive, proactive and hybrid protocols by selecting AODV, DSR, OLSR and ZRP for study. They used QualNet for simulation purpose [8].

Wangi et al. studied the problems of addressing in wireless ad hoc networks. They considered both IPv4 and IPv6 protocols. They concluded that the choice of the protocol depends on factors such as routing protocol, the size of network, packet loss, network type, context and applications etc. [9].

Hamidian et al. presented the use of gateway as bridges for interconnection of WANET with internet. In this paper the MANET routing protocol Ad hoc On-Demand Distance Vector (AODV) is extended to achieve the interconnection between a MANET and the Internet. Further, the author investigates and compared the three approaches gateway discovery. They also discussed whether the configuration phase with the gateway should be initiated by the gateway, by the mobile node or by mixing these two approaches. [10].

III. PROPOSED METHODOLOGY

The proposed system explain the Auto-configuration process for allocation of addresses to nodes in different networks by executing the following steps and Figure. 1. illustrates the processing within the proposed system.

A. Auto-configure network Interface:

The first step is to define the range of addresses to be used for assigning to the nodes. In our case we use the maximum limit available in both the cases. For IPv4, NAT addresses range 10.0.0.0/24 is used and for IPv6, all addresses in the range of FC00::/64 are available for global communication. A function sets all the addresses as new addresses. All these addresses are stored in an array so that it can be searched for and later used for address application. In case of ipv4 the number of bits is also calculated so as for decimal to binary conversion and vice versa as IPv4 addresses are in the form of decimal. Also we set a flag for both the cases which toggles between 0 and 1 whenever an address is changed and also to determine the control of the addresses when new addresses are discovered. It returns the value w that is range of addresses that are stored in a widget which can be used for address assignment to the nodes. Now the next step is discovering a free network. For address allocation first there should be a procedure which will first determine if network exists or not, then only comes into picture the nodes in a network and type etc. so network discovery is performed. In network discovery additionally we also try to find out if the network has already any addressing scheme attached so that we can replace it with the addressing scheme that we want to apply to it. A Network is considered to be free if there are no simulated nodes attached to it. The procedure is bit different for both the addressing schemes.

For ipv4 first we perform decimal to binary conversion and count the number of bits and compare the bits with fixed standard values to determine if the addressing is assigned. Later we check all the nodes for the type of addresses assigned to them and if any, then we drop those addresses and return the values to the pool of addresses and make the network ready for auto configuration. For ipv6 the procedure is quite simpler as compared to ipv4 since we check here for prefixes and if any prefixes already assigned we determine its ipv6 network and drop the addresses and make it ready for auto configuration. So in short we can say that the network discovering process is mainly finding a free network or setting an intended network free so as to apply auto configuration for both ipv4 and ipv6 addressing scheme. in case of ipv4 it returns the free network in the form of a. b. c. d and in case of ipv6 it returns the free network in the form of a $i.

B. Assign tentative IP address

Now that we have all the addresses available and also the network we proceed to the next step that is address configuration. What this function does is take two inputs that is the node to which the address is to be assigned and the interface of the node. This function automatically assigns an IPv4 address to the interface $i face of the node $node. Here what we do is iterate through the pool to select an address which could be assigned. Once the address is given to the node it is then dropped from the array in order to avoid any duplicate address assignment.

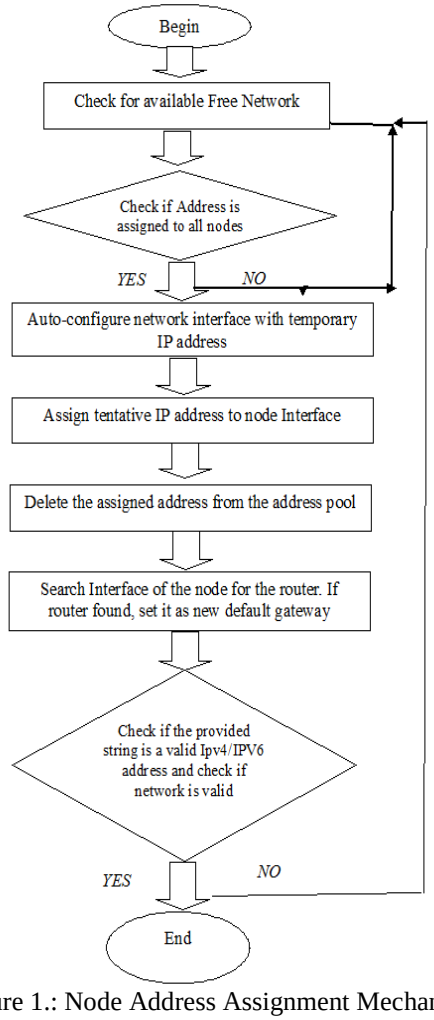

Figure 1.: Node Address Assignment Mechanism

DOI 10.17148/IJARCCE.2015.48100

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CFA (Conflict Free Allocation) allocation method is used to avoid duplicate addresses to keep the approach simple and less complicated.

C. Next available free address

Once the address is assigned to the node we perform a small procedure to check the next available free address. This function automatically searches for free IPv4 addresses within a given range defined by $addr, containing $peers. $addr is the address of a node within the range, $start is the starting host address for a specified node type; and is ignored if the net mask is bigger than 24; and $peers is the list of peers in the current network. If the situation arises that no addresses are left to be assigned to the nodes as the address pool becomes empty, this may cause duplicate addresses and entire network won't work correctly and it will create ambiguity. To avoid any such situation what we do is first check if such situation is going to arrive and if yes then a warning is given stating that the address pool is out of addresses so we may have to take address from another pool or increase the range or last solution is to drop the nodes if the addresses are not available.

D. Setting up a default gateway

Since our network contains many sub networks of different standards, we need to make sure that a router (default gateway) is present in between two networks for smooth communication so as to transfer the packets from one network to other network. For this, function is defined to search the interface of the node for a router, if a router is found then it is set as a new default gateway. So once a node of the network say A wants to transmit the data to the node of another network say B then that node A is set as a default gateway. This improves the flexibility of the network.

E. Check IP address valid or not

The next step is to check if the network is assigned with a valid ipv4 or ipv6 addresses. It checks the address assigned if it is in correct form and if it is not in correct then it assigns that node a valid IP address. The entire steps for after the searching for free network is performed again and again till all the nodes have been assigned correct and valid addresses.

F. Check IP network valid or not

Once all nodes have been assigned the addresses then it performs a check on the network depending on the type of addressing used whether the network is a valid ipv4 or ipv6 network. Then again the network discovery step is performed and address assignment till the entire network have been assigned valid IP address. Once all this is done we move on to communication between the nodes.

IV. RESULTS & DISCUSSION

In the proposed work, address range 10.0.0.0/24 is used for simulation of IPv4 NAT addressing and for IPv6 FC00::/64 address range is used for global communication. Firstly the discovery of a free network is done and then apply the addressing scheme on it. After that in proposed system CFA (Conflict Free Allocation) method is used for configuration of IP addresses. Table 1 depicts the various parameters taken into account for simulating the congregation of four different networks. In this work many sub networks of different standards are used for the purpose of simulation so the main network require a default gateway to communicate. In the next step, checking of valid IP address and IP network is performed.

Table No. 1: Simulation Parameters

Parameters	**Values**
Number of Nodes	75
Simulation time (for IPv4)	10,20,30,40,50,60,70,80,90 (seconds)
Simulation time (for IPv6)	10,20,30,40,50,60,70,80,90 (seconds)
Simulation area	1000m*1000m
Routing protocol	AODV
MAC protocol	802.11, Sat, UMTS, 802.15.4
llType	LL
ifqType	Queue/DropTail
ifqLen	100
antType	Antenna/OmniAntenna
propInstance	Propagation/TwoRayGround
phyType	Phy/WirelessPhy
channel	Channel/Wireless Channel

Figure 1. shows the improved performance of IPv6 addressing scheme over IPv4 addressing for average packet drop parameter against simulation time.

Figure 2. shows that, the packet drop rate of IPv6 is very low as compared to IPv4 addressing scheme.

Figure 3. shows that, the packet generation rate aspect is bit similar in both addressing schemes.

Figure 4. explain the fact that the routing overhead decreases over time for both IPv4 and IPv6 addressing strategies and reflect almost same performance.

Figure 5 shows the improvement in packet receiving rate w. r. t. simulation time for IPV6 addressing scheme as compared to IPv4 addressing.

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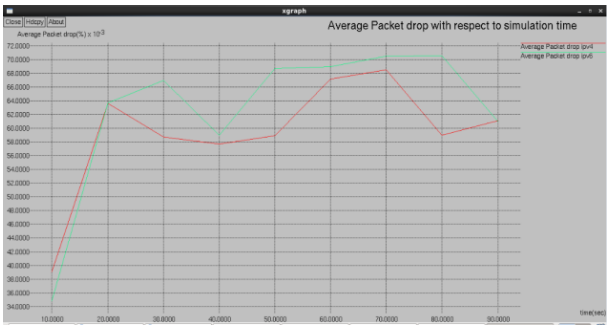

Figure2: Average Packet Drop w. r. t. Simulation Time

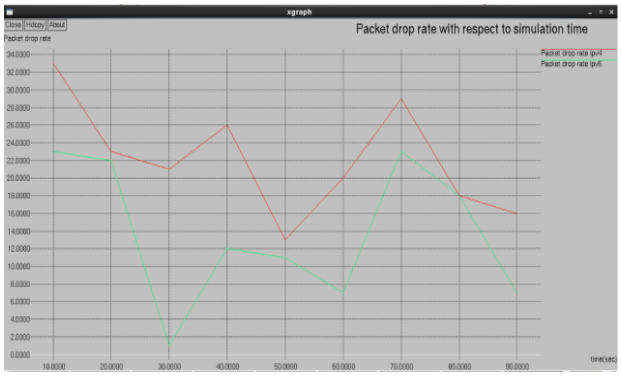

Figure3: Packet Drop Rate w. r. t. Simulation Time

Figure4: Packet Generation Rate w. r. t. Simulation Time

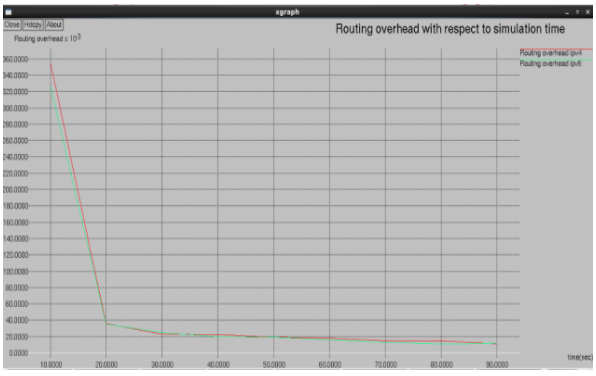

Figure5: Routing Overhead w. r. t. Simulation Time

Figure 6: Packet Receiving Rate w. r. t. Simulation Time

V. CONCLUSION

In this paper a simulation environment is prepared by considering four networks belonging to different standards. Two different addressing schemes such as IPV4 and IPV6 are used for addressing and the comparison on the basis of parameters like average packet drop, packet generation rate, Routing overhead and packet receiving rate is performed using both type of addressing schemes. IPv6 addressing scheme worked well as compared to same heterogeneous network following IPV4 addressing scheme.

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