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Allocating Addresses in Hybrid Mobile Ad-Hoc Networks

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Abstract: Mobile Adhoc Network (MANET) is a peer-to-peer wireless network that it transmits without the use of a central base station or access point. The Internet Protocol Ipv4 address allocation mechanism is the widely used address allocation technique in computer networks. Address allocation to mobile nodes is an important problem in MANET when IPv4 is used. Recently several schemes have been proposed for address allocation in pure MANET environment, but they do not consider the access requirements of mobile nodes to the global Internet. This problem has been rectified in the latest version of the Internet protocol IPv6 and it is the suitable choice for the networks in global connectivity environment. Since all networks cannot be switched to the latest internet protocol IPv6 at a stretch, there need to be a gradual switch over from IPv4 to IPv6. If one network switches over to IPv6 network environment, it will not be able to communicate with the IPv4 network environment. The application developed in this research enables IPv6 network to communicate with IPv4 network, thus easing the process of IPv4 to IPv6 conversion. This study has also consideration of the hybrid MANET where the pure MANET is interconnected to the external Internet by some gateways. For global-scope address allocation, the hybrid MANET is implemented with an address allocation scheme by enhancing the Ipv6 stateless address auto-configuration protocol. The proposed system decreases the latency of address allocation period by enhancing the Duplicate Address Detection (DAD) mechanism of the address auto-configuration protocol. The study proposes 2 types of address allocation mechanism for IPv4 and Ipv6 address groups. It is also designed to handle the interconnectivity between different types of address groups. The nodes that can allocated in IPv4 network group can be communicated with the IPv6 network group environment. This study will provide the reader with a detailed understanding of the address allocation in MANET.

Key words: Address agent, duplicate address detection, dynamic host configuration protocol, MANET adhoc network, neighbor advertisement, personal digital assistants

INTRODUCTION

The research is mainly deals with Wireless network environment is the main requirement for the system. But the current application has been developed as a simulation application for the wired network environment. The simulation application is built with the consideration of the MANET characteristics and the protocol specifications. The DHCP server application performs the roll of IPv4 address assignment process. The gateway application act as an interface between the client and the DHCP server. The client application can be run under any address group environment.

Mobile adhoc networks do not require any predefined infrastructures like base stations and redirection switches. Routing (Ana and Jean, 2004) from one node to another on such a network requires an "on-demand routing protocol," such as Dynamic Source Routing (DSR) or Adaptive On demand Distance Vector (AODV), which generates routing information only when a station initiates a transmission.

Nodes in mobile adhoc network are highly mobile which causes network topology to change rapidly and unpredictably. Key management is used to provide the trust relationship between nodes. In general, there are three classes of key management, namely key distribution, key agreement and key pre-distribution. When used in an adhoc network, each one has its limitations. An adhoc network (of wireless nodes) can be considered as a temporarily formed network, created, operated and

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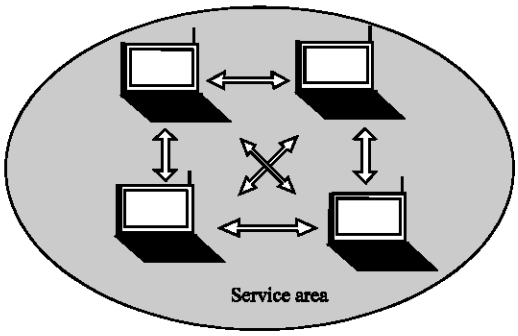

Fig. 1: Adhoc wireless networks

managed by the nodes themselves (Fig. 1). It is also often termed an infrastructure-less, self-organized, or spontaneous network.

INTERNET PROTOCOL

Different addressing mechanisms are used to identify a node in the network. They are physical and logical addressing schemes. The physical address is a unique address stored in hardware devices. The Internet protocol is used to form logical address for a client. Different versions of Internet protocol are released. But the IPv4 and the IPv6 are the suggested protocols for the logical address assignment process. The Address Resolving Protocol (ARP) is used to convert the physical address into the logical address. Most of the global networks are constructed with the IPv4. The IPv4 supports a minimum amount of networks and nodes but it is not sufficient for the current Internet growth rate. So there is a need for advanced IPv6 best suits this purpose and supports a wide range of networks.

The IPv4 is the current standard and it is the most basic protocol that a software developer can make use of. IP is what actually brings the data from one computer to another one. As a protocol (Droms, 2003), it is responsible for addressing and delivery. Saying that the protocol itself does this is not really easy to understand and it is not really correct anyway. Not the protocol, but the routers all over the globe transport the data by applying the Internet protocol. It is basically like this: Send a packet of data with an Internet protocol header and the next router routes this packet by the information he finds in the IP header. After some hops from one router to the next one, the packet finally reaches its destination. IP has a header just like any high-level protocol.

Ipv6 addressing scheme supports large sized networks. This system uses 16 byte of address code. The network id and the node id are the 2 major subdivisions of the address. This system supports huge number of networks and nodes. IPv6 provides the following benefits:

- Larger address space for global reach ability and scalability.
- Simplified header for routing efficiency and performance.
- Deeper hierarchy and policies for network architecture flexibility.
- Efficient support for routing and route aggregation.
- Server less auto configuration, easier renumbering and improved plug and play support.
- Security with mandatory IP Security (IPSec) support for all IPv6 devices.
- Improved support for Mobile IP and mobile computing devices (direct-path).
- Enhanced multicast support with increased addresses and efficient mechanisms.

ADDRESS ALLOCATION

The address in the network has hierarchical structure for efficient routing of the information, which is formed by packets. There are four address types in the Internet. When we consider/IP layer model, Domain Name and E-mail address are the addresses in the application layer. IP address is the one in the network layer. Interface identifier like MAC address and EUI is the one in the link layer (Ana and Jean, 2004). First of all, to know what problems on configuring hosts in Adhoc networks, investigate what Adhoc Network is. Adhoc network is a temporary network composed of fixed or mobile nodes without preexisting communication infrastructures such as AP (Access Point) and BS (Base Station).

The characteristics of the adhoc network are instantly deployable, reconfigurable, created to satisfy a temporary need, node portability like sensors, node mobility, limited battery power at wireless network and multi hopping to save power, overcome obstacle, enhance spatial spectrum reuse, etc (Thomson and Narten, 1998). Adhoc network can be applied to military, disaster and home networks which have same characteristics with ones of the adhoc network (Fig. 2). Because there is no infrastructure such as the access point in WLAN (Wireless Local Area Network), the mobile hosts cannot access to DHCP (Dynamic Host Configuration Protocol) server in infra-networks. So, the hosts have to cooperate with each other to configure themselves with unique addresses.

Address issues and existing protocols in adhoc networks: The scenario for the configuration of hosts in adhoc networks is that setting up network model, Allocating newly joining node with a unique address and maintaining the network such as duplicate address detection, address reuse and network partitioning and merging.

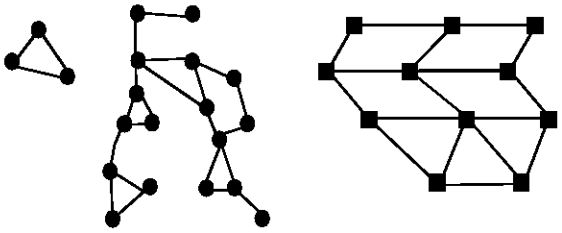

Fig. 2: Mobile adhoc network and wireless, fixed network

The address issues come out of the above scenario. The issues are that

- Network models
- Address structures
- Initial configuration
- Duplicate address detection
- Reuse of resource
- Maintenance of address pool
- Network partitioning and merging

Here, we just consider some protocols for auto configuration of hosts in adhoc networks. Before SAA (IPv6 Stateless Address Auto configuration) is explained, IPv6 stateful address auto configuration (or DHCPv6) relies on the administrator (Fig. 3). The administration has to know configuration information of the networks like current DHCPv4. Targets of SAA are requirement of no manual configuration of hosts and minimal configuration of routers, plug-and-play communication, the absence of a stateful address configuration server, graceful renumbering and both stateless and stateful auto configuration. Other attributes are single hop on a single link and use of ICMPv6 instead of ARP in IPv4 addressing (Thomson and Narten, 1998).

DCLA_DHCP (Dynamic Configuration of IPv4 Link local Addresses DHCP) describes a method by which a host may automatically choose an IPv4 address in the absence of a central service to maintain and hand out addresses. This protocol provides functionality in small networks. And addresses must not be routed by any network device this protocol was designed to work on a host that is running a DHCP client (Fig. 3).

DRCP_DAAP (Dynamic Registration and Configuration Protocol _ Dynamic Address Allocation Protocol) is combination DRCP and DAAP. This protocol is concerned with registration and auto configuration in dynamic networks such sensor array, fast moving platoon and airborne communication. Binding and routing protocols are independent of auto configuration. Goal is that all host and router in the quasi-dynamic domain will be plug-and-play. The only restriction on the

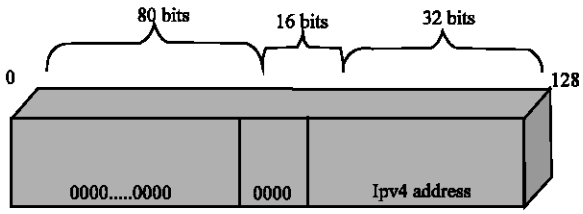

Fig. 3: IPv4-compatible address

number of nodes would be the size of the address pool (David and Isaac, 2005).

DRCP_DCDP (DRCP _ Dynamic Configuration and Distribution Protocol) is just evolved from the DAAP. DCDP has many features such as auto configuration of additional IP-related parameters and capabilities like the location of DNS, distributed configuration information, operation without central coordination or periodic messages for dynamic wireless battlefield, independence on a routing protocol and reliance on the DRCP to actually configure the interfaces. DRCP_DCDP apply subnet concept.

SAAA (IPv6 Stateless Address Auto configuration in Adhoc networks) is just the extension of SAA for adhoc networks. The network model of SAAA is the multi-hop network. This uses clustering concept for network portioning and merging and modifies NS message of IPv6 for MANET.

MANETconf (Nesargi and Prakash, 2002) does not assume the availability of reliable broadcast and multicast protocols in MANETs and has salient features such as use of a two-phase address allocation mechanism, return of released IP addresses to the pool of available address, soft state maintenance, concurrent IP address allocation for multiple requesters and prioritization among concurrent initiations to avoid deadlocks and thrashing. However, this protocol is not scalable because almost protocol messages are based on broadcast or flooding. The requirement for the nodes to reply positively creates extra traffic and is superfluous. Moreover, the time for affirmative replies in the entire network is very long and the maintenance of a common address pool at all nodes in the network may be complex and bandwidth consuming. In addition, there is also no solution for group initialization.

SYSTEM DESIGN

The system is divided into 2 major modules. The address allocation module is designed to allocate the Ipv6 address for the nodes in the mobile adhoc networks. The inter connectivity module is designed

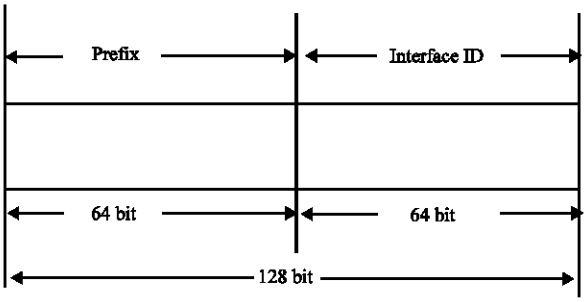

Fig. 4: IPv6 packet structure

to carry out the communication between the Ipv4 and Ipv6 network nodes (Fig. 4).

Address allocation module: The address allocation is done at the time of connection establishment process. The network id and the node id are assigned with the support of the DHCP and SAAP protocols. The duplication deduction is applied to check the duplicate address allocation. The address table is maintained for each node in the Internet and MANET environment.

The address allocation module is designed to allocate the logical address for the nodes that are connected to the Internet environment from the mobile adhoc network environment. The mobile adhoc network environment can be constructed with the two different nodes. They are IPv4 and IPv6 address groups. All the address allocation activities are performed with reference to the base address groups for the nodes.

The address allocation process is initiated by the client login operation. All the client details are transferred to the gateway. The gateway application performs client authentication process. The base network group is verified after the completion of the client authentication process. The user id and the password are used for the client authentication process. The gateway system maintains a set of user id and corresponding passwords.

The gateway application performs three major tasks in the address allocation process. They are client authentication, base address group verification and address assignment process. The address group verification is performed to select the relevant address assignment protocol for the node. If the client address group is IPv4 network environment then the client's request is redirected to the Dynamic Host Configuration Protocol Server. The DHCP server maintains the two lists for the address maintenance process. They are the assigned address list and free address list. An address is assigned to the new user list from the free list during the address assignment process. When ever a user is disconnected from the list then the allocated address is updated.

The Ipv6 address allocation process uses the Stateless Address Auto configuration Protocol (SAAP) for the address assignment process. In the Ipv6 address allocation process all the address assignment activities are done in the gateway application. The gateway application selects the general network id and a node unique id.

Interconnectivity module: The interconnectivity module maintains the communication between the nodes in two different network environments. The IPv4 and IPv6 packets are converted vice versa. The original address and temporary address are assigned for each node. Using both the address does all the communications

This system supports 2 types of message communication process. They are Message communication under the same network group environment, Message communication under different network group. The message communication under same network group environment is performed in the IPv4 or IPv6 network group environment.

The message id initially segmented as packets. Each packet is constructed with the source, destination and message details. If the source or destination nodes are located in the same network environment then the packets are directly transmitted. Otherwise the packets updated for the destination group network structure. The packet is delivered after the packet updation process.

SYSTEM IMPLEMENTATION

Wireless network environment is the main requirement for the system. But the current application has been developed as a simulation application for the wired network environment. The simulation application is built with the consideration of the MANET characteristics and the protocol specifications. The DHCP server application performs the roll of IPv4 address assignment process. The gateway application act as an interface between the client and the DHCP server. The client application can be run under any address group environment.

The system execution requires some initial settings. Four data files are used in this system. The user data file is used to maintain the list authorized users. The GateIP data file refers the address of the gateway in the DHCP server (Fig. 5). Type 4 and Type 6 data files are used to maintain the IPv4 and IPv6 address list. The user should update all these data files with reference to their network architecture. The user can split the current network as two address group areas. The client applications can be run under these address group environment.

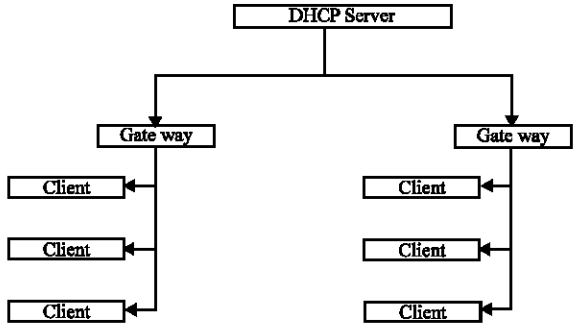

Fig. 5: System architecture

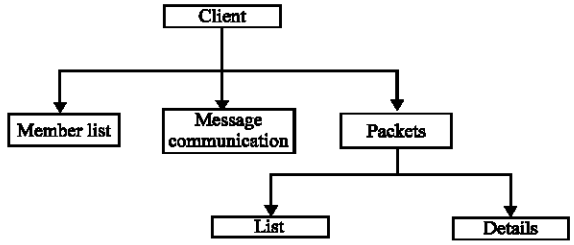

Fig. 6: Architecture of the client application

The DHCP server and the gateway application should be run in only one machine. The client application can be executed in any number of machines under different address groups. The client application is started with the login process. The address assignment is performed after the completion of the user authentication process. The gateway application represents all the connected host details. The DHCP server maintains the actual address list and also the duplicate addresses.

The client application displays the entire connected user list with their addresses (Fig. 6). The user can perform the message communication with any selected client. The destination node can be located in the same or different address group. The same address group communication does not require any additional packet conversion activity. But, the communication between different address groups requires packet updating process for the duplicate address. The client application also displays the list of packets and their structure for the message communication process. The address reassignment process is done by monitoring the client application termination.

The gateway application is designed with only one window. All the gateway processes executed at the background so the gateway application does not require any menu. The client application connects the client side processes with the help of buttons. The client application does have a separate menu form. The forms are connected one by one. The login form transfers the client control to the member selection form. The member selection form connects the message communication form. The packet transmission report is connected with the message communication form. The packet details form is connected with the packet transmission list window.

CONCLUSION

The address allocation and interconnectivity management system for the mobile adhoc network is designed to handle the message communication between the devices that are connected under different address group environment. The system has the following advantages:

- The system reduces the delay in the address allocation process.
- Packet transmission list and packet details are displayed separately in the system.
- The system is integrated applications that handle the user authentication process, address allocation and access log management process.
- The system supports 3 types of communication mechanisms communication between IPv4 network group, communication between IPv6 network group and communication between the IPv4 and IPv6 network group nodes.
- The application has been designed to run under all platforms. It also supports the cross platform execution of the servers and the client applications.
- The system has been designed to handle the address allocation for any number of clients in all type of networks.

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