

MESH NETWORK ACHIEVE ITS FUNCTION ON LINUX

Pei Ping, Yury N. Petrenko

Belarusian National Technical University, Minsk, Belarus,

ypetrenko@bntu.by, peiping123456.love@gmail.com

Abstract

In this paper, we introduce a Mesh network protocol evaluation and development. It has a special protocol. We could easily understand the Linux operation principles which are in use in mesh network. In addition to our comprehension, we describe the graph which shows package routing way. At last according to testing we prove that Mesh protocol AODV satisfy Linux platform performance requirements.

Key words: *Mesh network, protocol, structure, testing.*

1. Introduction of Linux System

Linux system is an open-source software which has strong stability, strong security, strong network load capacity, and small footprint. Linux system has become one of the mainstream operating system in the world. Due to these characteristics, this article will research around how does mesh network based on Linux system platform to achieve its function. Linux system has the following characteristics:

1. Linux is a multi-user and multi-platform operating system
2. Linux has a robust security system.
3. Linux system provides a shell command interpreter and programming language.
4. Linux system provides the kernel programming interfaces
5. Linux system meets the Internet industry TCP / IP network protocol

Linux system is composed from kernel, command interpreter (shell) applications, and utilities. The structure is shown Fig 1, [1]. kernel is the core of the operating system which directly to manage the hardware in Linux. System applications provide services to users through the interface by the kernel.

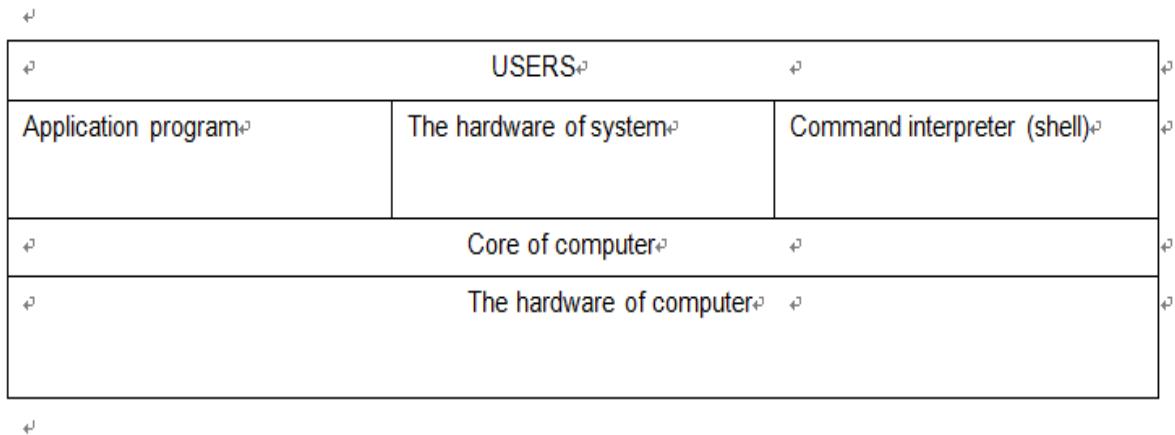


Figure 1 - Linux System structure

Linux system is very suitable for research of Mesh networking capabilities. Specific reason has:

1. Linux has a rich network functionality. network protocols and functionality both have a lot of selective in the Linux network architecture. Before the development of Internet services and Unix systems are inseparable, so the network communication protocol family property also could get better research and development in the Linux system.

2. Linux system is an open source code operation system which has easily be modified protocol function.

2. Linux Network Architecture

Linux network model can be divided into four layers in Fig 2, [2].

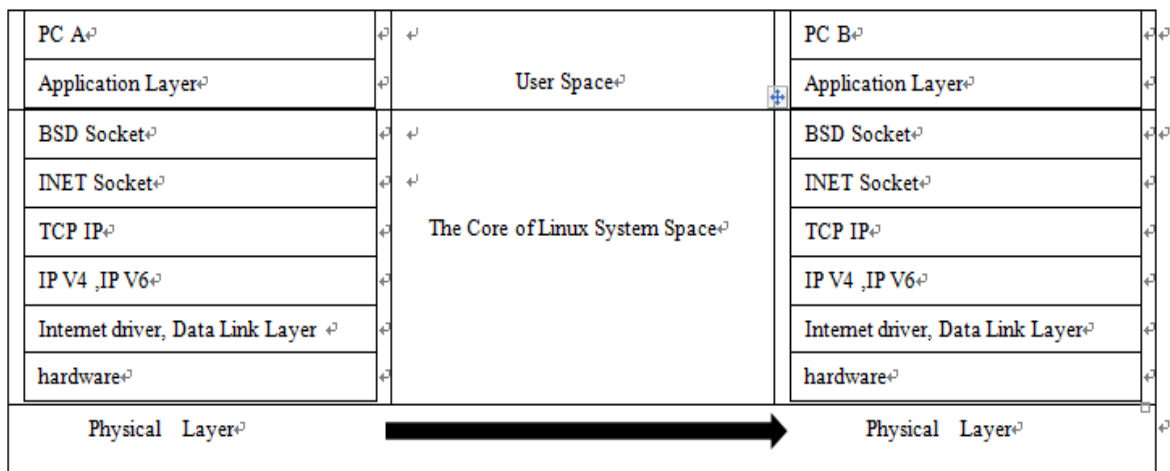


Figure 2 - Networking Communication in Linux System

This diagram from top to bottom are communicating hosts, application layer, INET Socket layer, IP layer, data link layer and physical layer. All processes in the user space could switch to kernel space by BSD Socket network interface. Data need to establish a connection judgment TCP or UDP when the data is transferred to the kernel space INET Socket Layer. After choosing to complete the transfer type, the process going to the IP layer. IP layer are looking for signs of communication which namely routing. Data link layer select the device According to IP address of the sending. The communication protocol which from the top down is sender, while the recipient is a communication protocol from the bottom-up.

3. The Routing of Linux System

The routing of Linux system divided into two parts: packet forwarding and packet - routing. Packet forwarding implemented in the Linux kernel. Forwarding is one of the tasks belong to IP layer which according to the routing table information set the correct address, then sent the packet to the corresponding network interface. And corresponds forwarding packets is packet – routing. The process of packet routing handled in the user space. Packet routing is the process result of logic calculation (based on the host and other hosts exchange routing information, then calculate the routing which source node to destination node). packet – forwarding and packet – routing functions are maintained by a database which storing a large amount of forwarding information.

4. Mesh AODV Protocol Implement in Linux Platform

As mentioned earlier, Mesh AODV protocol is a special communication protocol developed for Mesh Networks. The main frame structure of Mesh AODV routing protocols include: Mesh AODV routing algorithm, Mesh AODV kernel space, interface module, and calling back module. Mesh AODV routing algorithm module is part of the main communication in needs of establish a correct routing Fig 3, [3]. Mesh AODV grouping machine which according to the structure of the data has included: Hello module, RREQ module, RRER module, RERR module, and routing table module to module provide services, the timer module, AODV-SOCKET module, message processing module and check list module.

Mesh AODV kernel space module using hook function algorithm to monitor the packets which coming to network interface. Kernel space module controls the order of routing discovery program and maintain data. According Mesh AODV protocol principle which works in the kernel space divided into: K-NETFILTER module and K-ROUTE module.

Interface module is mainly responsible for communication between the Mesh-AODV routing algorithm module portion of the kernel. Netlink Socket achieve user space and kernel space of message delivery.

The debug module is responsible for statistical the information of Mesh AODV. It including status information, routing information, protocol control information.

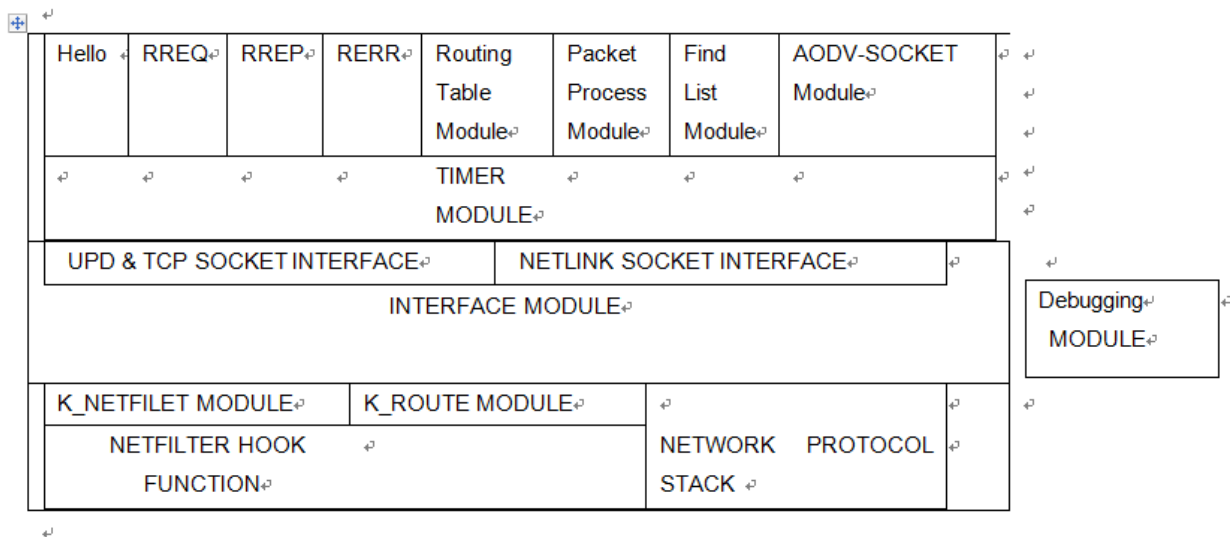


Figure 3 - Mesh – AODV Structure

Mesh AODV algorithm module part is executed Mesh AODV routing protocols. Each node in the network require be participated of establish the route. Specifically divided into:

1. Established routing. Establish a routing achieve based on the packet routing. The original node gets network status information via RREQ and RREP, then calculated specific feasibility routings which according to algorithm to the destination node. The feasibility of the routings will be saved to the database. then according to the method of Mesh AODV agreement to calculated a proper routing.
2. Routing table maintenance. In the Mesh AODV program implementation, there also presence of a detailed agreement for Mesh AODV routing table space module in the algorithm. Each Mesh AODV routing table not only storing the appropriate routing

information, but also storing a number of timers. In the timer trigger event to maintain the entire routing table, thus could forwarding packets based on Linux system. Mesh AODV routing table is constructed according to mesh AODV agreement which recording the purpose of IP address, destination IP serial number, the number of routing ways to reach the destination IP, and survival. Mesh AODV algorithm module using these information for routing table maintenance.

3. Link detection. mesh AODV routing protocol use HELLO message, RERR message and neighbor node list for link detection. Link Test is periodically broadcast HELLO packets information to maintain neighbor list node. HELLO message corresponds to a timer. If the timer not receive HELLO packets from a neighbor node. The neighbor link will be considered has been broken by original node. Timer trigger event going to maintenance operation in this moment. (send RERR to whole network nodes in packet announcement this link is disconnected).

5. Mesh AODV Protocol Testing and Analysis

The limited network equipment is the most difficult in testing environment. network topology usually affected by hardware and human factors to changing. Therefore, it is difficult to build a multi-hop scene in actual testing environment. In order to effectively monitor the protocol function, we use self-made test environment.

The purpose of this article is to test mesh AODV protocol software performance under Linux operating system. A part of mesh network will be simulation in testing environment. The node equipment in experiment has: 1 laptop (equipped with wireless LAN), 4 desktop computers (with wireless LAN), 1 Switch. All wireless card working in ad hoc mode with 802.11 protocol. Protocol software running on Linux operating system. Laptop and desktop computers are running Linux operating system. Switch with an embedded Linux operating system Fig 4, [4].

Protocol software which is Mesh AODV running on computer (in Linux system). Compiling and debugging after installation. Finally transplanted the protocol software into switch establish cross-compiler environment. AODV file and the PC kaodv.o module will be generated under the current directory after properly compiled. Finally using zmodem downloaded to the switch. Mesh AODV routing protocols can be executed correctly in the testing

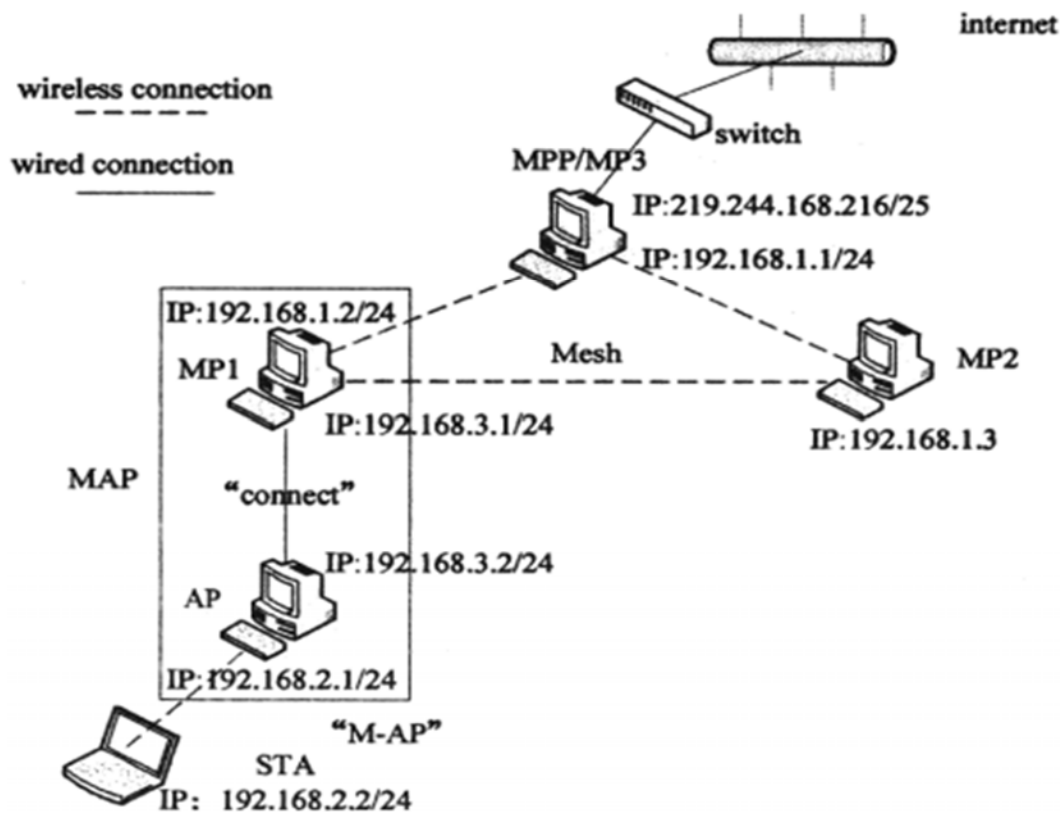


Figure 4 – The Topology of Mesh Networking in Testing

This test is about mesh AODV protocol interoperability and multi-hop routing established. Laptop as a mobile node, MP1, MP2, MP3 representing mesh router in this testing. IP address assigned as follows:

Laptop: 192.168.2.2/24
 PC: 192.168.2.1/24 && 192.168.3.2/24
 PC 1: 192.168.1.2/24 && 192.168.3.1/24
 PC 2: 192.168.1.3 /24
 PC 3: 192.168.1.1 /24 && 219.224.168.216 /25

By responding about ping information to verify the correctness protocol of reality. Two directly adjacent node laptop and pc periodically send HELLO packet message. It determined to neighbor node and establish routing if both test nodes are received each other's hello packet message. Each node should ping each other's and determine receive a reply in the testing Fig 5, [5].

```

C:\Documents and Settings\Administrator>ping 192.168.2.1

Pinging 192.168.2.1 with 32 bytes of data:

Reply from 192.168.2.1: bytes=32 time=4ms TTL=64
Reply from 192.168.2.1: bytes=32 time=1ms TTL=64
Reply from 192.168.2.1: bytes=32 time=2ms TTL=64
Reply from 192.168.2.1: bytes=32 time=48ms TTL=64

Ping statistics for 192.168.2.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 48ms, Average = 13ms

```

Figure 5 – networking in ping testing

The results indicated that the testing results as: two nodes periodically send hello packets of information some debugging information is as follows:

```

Hello_start: Starting to send Hellos
Hello_send: sending Hello to 255.255.255.255

```

```

Hello neighbor nodes receive information
Laptop debugging information:
Hello_process : rcv Hello from 192.168.2.1, seqno 0
Hello_process: rcv Hello from 192.168.2.2 , seqno 0

```

```

Neighbor nodes establish routing information in the routing table:
Laptop debugging information:
Rt_table_insert: New timer for 192.168.2.1, life=6000
Hello_process: 192.168.2.1 new neighbor

```

```

pc computer debugging information:
Rt_table_insert: New timer for 192.168.2.2, life = 6000
Hello_process: 192.168.2.2 new neighbor

```

Conclusion

Now we can understand the basic structure of Linux system and how does Mesh network achieve its function on Linux system. Mesh AODV protocol appropriate analyzed to proved Mesh AODV routing protocol has been verify correctness according to the testing results which by establishing mesh network structure in the Linux operating system platform environment. It has achieved that mesh AODV satisfy Linux platform performance requirements.

References

1. HaiTao, Y. The Mesh Network Routing Protocol Development Based On Linux System / Y. HaiTao, Z. JieYing, Sun Yat – Sen University. 2014. 30 – 65 pp.
2. ZongKui, F. Wireless Mesh Network Embedded Platform Development. / F. ZongKui “Silicon” No.4, 2015
3. LiHui, Z. The Development of Wireless Mobile Mesh Network Routing Protocol. / Z. LiHui, South China University Of Technology. 2010. – 54 pp
4. WenFang, J . The AODV Algorithm Development in Wireless Mesh Network. / J. WenFang, Li. Z, M. JinWang “Computer Engineer And Design” No.15. 2010.
5. Ping, P. Mesh networks / P.ping // [электронный ресурс]. режим доступа: [https:// rep.bntu.by/handle/data/12210](https://rep.bntu.by/handle/data/12210) - дата доступа:15.01.2015.
6. Ping, P. Mesh Network Simulation / P.Ping // [электронный ресурс]. режим доступа: [https:// rep.bntu.by/handle/data/122208](https://rep.bntu.by/handle/data/122208) - дата доступа:15.01.2015.
7. Ping, P. Mesh Network Simulation / P.Ping – Belarusian National Technical University. 2015.