

A comparative study of wireless mesh and ad-hoc network : A Cross layer design approach

Yashpal Rohilla

M.Tech(C.S)

Department of computer science & application
M.D. university, Rohtak-124001, haryana,india
yashrohillartk@yahoo.co.in

Preeti Gulia

Department of computer science & application
M.D. university, Rohtak-124001, haryana,india
Preetigulia81@gmail.com

Abstract :

Due to Wi-Fi marketing 802.11 becomes a universal solution for wireless connectivity. A wireless network is that in which the performance of a network depends on the layering structure of protocol. A wireless network is many types like Ad-hoc, cellular and mesh network. A mesh is used to optimize performance in better way as compare to traditional approach . A network can be optimized using different –2 ways. Physical and mac layer are used for implementation. Physical layer consist of communication channel like TDMA, CDMA, OFDM, MIMO-OFDM etc each layer is designed independently and contain full transparency. A comparative study shows the best way of current technology in wireless network. Many algorithm are designed for QoS (Quality of services) in the wireless network. In this paper we compare ad-hoc and mesh network to show the pros & cons and their functionality on the basis of cross layer design approach.

Keywords- ad-hoc, mesh, QoS, cross layer, ofdm, Wi-Fi.

INTRODUCTION

In mesh network, radio within each node enables it to support multiple functions such as user access, backhaul services and scanning. Its reduction of radio size, cost and power has enabled the mesh node to be more modular. A mesh network consists of different-2 network protocol to get the suitable structure and performance of a network. The QoS that contain resources delivery between the nodes from source to destination with minimum delay a max throughput in a network. Traditional network structures are used in wired and wireless network Sanjay shakkottal [1] of layering. But in current generation network structure there is need of a new layering structure for a wireless network some researchers have been are suggested the Cross layer design for wireless network and at some places, this approach is used for better resource utilization in a network. Some channels used the OFDM techniques in wireless network for increasing the performance and spectrum utilization. An OFDM technique is that in which narrow band / multi-career or multiple subcarrier are used. Some approaches in wireless mesh network consist of different -2 routing algorithm and joint channel allocation, like other network (multihop, Ad-hoc network). According to some researchers cross layer design is implemented using theoretical and practical aspects. In practical implementation of physical and other layers are used, different-2 simulation software like: MATLAB, NS2, OPNET etc there software help in simulation of the entire network and performance optimization of channel. On the other hand these are helping in designing of Ad-hoc, mesh and different-2 network structure.

RELATED WORK

There are a number of approaches where wireless network and cross layer architecture is specified **Ian F. akyildiz** [3] has said that the cross layer architecture used in wireless mesh network to get the better performance. Wireless mesh network contain mesh router and mesh client that form multi-hop wireless network. There are two approach used in mesh network (i.e. theoretical and practical framework) for protocol design. The protocols are design with full transparency and independency of layer from each other. In theoretical framework, the problem is decompose according to the function of primal or langrage dual variable. In practical approach simulation software like opnet,matlab,ns2 etc. Cross layer design can significantly improve the network performance **R. Bhatia , U. C. Kozat, M. Chiang** [5-7] The Cross layer design performed in two ways

(i) loosely coupled and (ii) tightly coupled. In loosely coupled, optimization is carried out without Crossing layer but focusing on protocol layer. The information is passed from one layer to another layer in it. There are two method of utilizing the information. First, in which only reliable accurate parameter is used, but the algorithm of protocol is not modified. In another method, on the basis of information getting from layer e.g. routing algorithm. In tightly coupled, Cross layer design information shared between layer is not enough. The main objective is based on existing protocol stack to design new concept to get better optimization. A Cross layer design is used to merge different protocol layers into single layer.

Mac/physical Cross layer design:

Cross layer design between Mac/physical layers is more common as compare to other because in the wireless network the lower part of the Mac layer and the baseband of the physical layer are implemented on the same card or even same chipset. For example UWB[8].

Vinay kolar[9] congestion control in multi-hop wireless network need an anticipated algorithm. There are some algorithm on transport layer and mac layer for control the congestion in wireless ad-hoc network.

Hon[10] wireless mesh network used for routing and broadcast the packets with joint and scheduling algorithm. The s-expand used for maximum call acceptance in network.

Comparative study of wireless Ad-hoc and mesh network

There are number of differences between Ad-hoc and mesh network on the basis of that we can conclude which one is better than another.

Wireless ad-hoc network: an ad-hoc network is a joint optimization approach of Cross layer. an Ad-hoc network is design for handling for temporary communication to get the information and crate a communication link. Ad-hoc is wireless communication system and it is used in different -2 application and mainly the focus is on Ad-hoc sensor network application. Like any other system Ad-hoc network have some limitation also which are following :

- Wi-Fi(wireless fidelity) devices in ad hoc mode provide minimum security against unwanted incoming connections or request . For example, ad-hoc Wi-Fi devices cannot disable SSID broadcast like infrastructure mode devices can. Attackers generally will have little difficulty connecting to your ad-hoc device if they get within signal range.
- The best Signal strength indications indicate the access of data when connected in infrastructure mode will be unavailable to you in ad-hoc mode. Therefore, you will face some difficulty whenever change the position an ad-hoc device to achieve a better signal.
- The Wi-Fi networking standards (including 802.11g) require only that ad-hoc mode communication supports 11 Mbps bandwidth. You should expect that Wi-Fi devices supporting 54 Mbps or higher in infrastructure mode, will drop back to a maximum of 11 Mbps when changed to ad-hoc mode. Ad-hoc mode should generally be viewed as "slower" than infrastructure mode for this reason.

wireless mesh network: wireless mesh network is similar like a regular wireless network. The only difference between two is that a wireless network may spread throughout a building or a neighborhood, and a wireless mesh network covers a much larger area, such as a city. A wireless mesh network has several advantages over other kinds of network like Ad-hoc which are following:-

Simple to installation

Since a wireless mesh network is simply a bigger wireless network and uses the same protocols and equipment, it is easy to set up and expand a wireless mesh network. The cost of the equipment is lower compared to other networking solutions, and the ease of installation clearly outscores other methods, since there is no need to mount cables around an entire city to obtain a huge network.

Best Coverage signaling

A wireless mesh network consists of multiple nodes that communicate with each other. If, for whatever reason, a node is blocked and separated from the network for a while, other nodes in its locality cover the respective area and take the load.

Self-Management

Once set up, a wireless mesh network can manage its load to avoid congestion a certain network node. If one node becomes very busy, the network traffic is redirected through other nodes, maintaining a good balance of the network load. The self-management feature, which allows for the system to find the best traffic paths when congestion occurs, provides a system that may experience less failure and downtime.

Fast access Speed

Unlike a traditional network, where a device acts as a server, which handles all data, and requires all data packets to run through it, in a wireless mesh network each node acts as an individual server. This allows for greater speeds for local connection, which run directly from the source to their destination, without needing to pass through a server. Even the local data transfer take less time in resource sharing.

Connectivity between networks

Since wireless mesh networks use the same protocols as regular wireless network, it is easy to establish connectivity between your own local networks and a wireless mesh network. A wireless mesh network can be a good method to connect two local networks, situated in opposite parts of a city, without using the Internet. This way, the data speeds are increased and the chances of a network drop are very low.

Another Key Benefits of a Wireless Mesh Network over ad-hoc network are:-

1) Less Expensive than Traditional Networks

Using fewer wires means it costs less to set up the wireless mesh network. The wireless mesh network is used particularly for large areas of coverage. Using wireless mesh networks we can eliminate the cost and complexity of installing fiber / wires between buildings, on campus grounds and business parks etc.

2) Wireless Mesh is mostly adaptable and expandable

As more or less coverage is needed, wireless mesh nodes can be added or removed. Wireless Mesh is very useful for those areas where there is lack of sight or where network configurations are intermittently blocked. With wireless mesh, adding more wireless mesh nodes will adjust to find a clear signal. Wireless Mesh is also extremely suitable where wall connections may be lacking, such as in outdoor environments, warehouses or transportation settings.

3) Wireless Mesh Networks Support High Demand

Public Safety and emergency response demand wireless connectivity that supports coverage of large geographic areas, high speed mobility and high quality video surveillance. Wireless Mesh Networks are ideal to deliver high throughput and highly reliable wireless connectivity.

On the basis of comparative study we can say that wireless mesh network is better than ad-hoc network the main difference between these two is that clients on mesh networks are dedicated to the role of routing by relying on an infrastructure of sorts, while ad hoc clients are generally user to user and not fixed to any kind of infrastructure.

Conclusion

In the field of wireless communication different network are used e.g ad-hoc, mesh and cellular. In this paper we specify the comparative study of wireless ad-hoc and wireless mesh network based on cross layer design

where we describe the pros and cons of both the network and on the basis of comparison we specify which one is better to get the optimization result. This paper also give the idea regarding future scope where we can use the cross layer design to get the maximum possibility of accurate result in quality oriented resource sharing and routing mechanism. In future we can used cross layer design for better optimization because of its independent modification of a module in the layer and transparency between layers.

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