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Efficient Traffic Adaptation Solution in Wireless Mesh Networks using Fuzzy Technique

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Abstract-As wireless communication gains more advancement, significant research has been developed and adapted to support real time transmission which strengthens quality of services. Wireless mesh networks (WMNs) are considered as the next step towards providing a high-bandwidth network over a specific coverage area. Because of their advantages over other wireless networks, WMNs are undergoing rapid progress and inspiring numerous multimedia applications such as video and audio real-time applications. These applications usually require time-bounded service and bandwidth guarantee. Therefore, there is a vital need to provide Quality of Service (QoS) support in order to assure better quality delivery. In communication this technology are accepted to provide a wide variety of real time application, hence there is a QoS is need to be maintained. One of the key mechanism is to support quality of service in traffic regulation at network state e.g. Load in order to adapt the rate flow. In this paper we proposed a novel model called fuzzy wireless mesh network, used to implement traffic adaptation in wireless mesh network. The objective of this model is to calculate the rate adaptation according to current network state. It depends on two parameter 1) Packet delay between source and destination, 2) buffer occupancy of network nodes

Keywords— Wireless networks, quality of service, traffic adaptation.

I. INTRODUCTION

A. Wireless Mesh Network

A wireless mesh network (WMN) is a mesh network created through the connection of wireless access points installed at each network user's locale. Each network user is also a provider, forwarding data to the next node. The networking infrastructure is decentralized and simplified because each node need only transmit as far as the next node. Wireless mesh networking could allow people living in remote areas and small businesses operating in rural neighborhoods to connect their networks together for affordable Internet connections.A wireless mesh network (WMN) is a communications network made up of radionodes organized in a mesh topology. It is also a form of wireless ad hoc network. Wireless mesh networks often consist of mesh clients, mesh routers and gateways. The mesh clients are often laptops, cell phones and other wireless devices while the mesh routers forward traffic to and from the gateways which may, but need not, connect to the Internet. The coverage area of the radio nodes working as a single network is sometimes called a mesh cloud. Access to this mesh cloud is dependent on the radio nodes working in harmony with each other to create a radio network. A mesh network is reliable and offers redundancy. When one node can no longer operate, the rest of the nodes can still communicate with each other, directly or through one or more intermediate nodes. Wireless mesh networks can self form and self heal.

B. Need For Qos In WMN

Using fewer wires means it costs less to set up a network, particularly for large areas of coverage. Wireless mesh networks are ideal in environment where wiring is inconvenient. .They are useful for Non-Line-of-Sight network configurations where wireless signals are blocked. The network will find a clear path around obstacles. Once the network is up and running, mesh networks are "self configuring;" the network automatically accepts a new node into the existing structure without needing any complicated configurations by the network administrator ..Mesh networks are "self healing," in case a node loses connectivity, the network automatically finds the fastest and most reliable paths to send data. The data transfer in wireless mesh networks is de-centralized, meaning the data doesn't have to travel back to a central server. Wireless mesh nodes are easy to install and uninstall, making the network extremely adaptable and scalable.

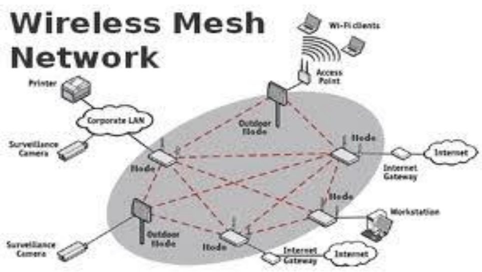

Fig 1.Wireless Mesh Network Architecture.

Wireless mesh networking consist of routers and client, where mesh routers have minimal mobility. It provides network access for both mesh and converting client. The integration of WMNs with other networks such as internet, cellular, IEEE 802.11, IEEE 802.15, IEEE 802.16 and sensor networks can be made possible through the gateway and bridging function in mesh router. It is expected that WMNs will carry various kinds of multimedia services, e.g. Multimedia streaming and VOIP, characterized by their stringent QoS requirement. Hence the mechanisms that provide QoS support must be deployed in WMNs. Adaptation of traffic is one of the key traffic management mechanisms that used for QoS support. The basic idea behind traffic regulation is to measure the networks state e.g. Load in order to adapt the rate of carefully selected application traffic flows. In a network with shared resource it is necessary to adapt the traffic rate used by each transmitter in order to complete for bandwidth and not to overload the network. Traffic packets that arrive at intermediate nodes and cannot be reach at destination due to congestion at nodes they

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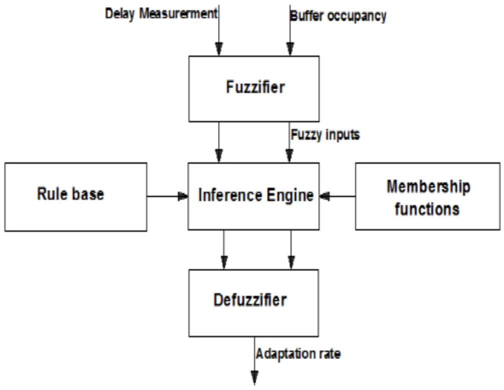
are dropped these packets might previously have travelled long way i.e. traversed nodes in the network and thus consumed unnecessarily bandwidth which result in network throughput and traffic delivery. While many traffic adaptation models e.g. have been proposed in the literature they are essentially based on traffic engineering mechanism which are based on TCP principle, end to end delay and packet loss rates, buffer occupancy in intermediate nodes.

II. OUTLINE OF THE PROJECT

As wireless communication gains popularity, significant research has been devoted to supporting real-time transmission with stringent Quality of Service (QoS) requirements for wireless applications. At the same time, a wireless hybrid network that integrates a mobile wireless ad hoc network (MANET) and a wireless infrastructure network has been proven to be a better alternative for the next generation wireless networks. This technologies are becoming an essential part of our daily life. These technologies are expected to provide a wide variety of real-time applications; hence, there is a vital need to provide quality-of-Service (QoS) support. One of the key mechanisms to support QoS is traffic regulation. The basic idea behind traffic regulation is to measure the network state (e.g., load) in order to adapt the rate of carefully selected application flows. In this paper, we propose a novel model, called Fuzzy WMN, which can be used to implement traffic adaptation in Wireless Mesh Networks (WMNs).The objective of Fuzzy WMNs to compute the rate adaptation to apply to application flows according to the current network state. To help solving the congestion problem in WMNs since the measurements of the input parameters (i.e., feedback delay and buffer load information) can be imprecise due to the dynamic nature of traffic and to control congestion and thus increase network performance.

III. FUZZY ALGORITHM

The proposed traffic adaptation process is performed in three steps: fuzzification, rules evaluation and defuzzification. In the fuzzification step, real numbers representing the values of both buffer occupancy and the delay measurement parameters are converted into linguistic values, each of which characterized by its own membership function. In the inference step, a set of rules, called the rule-base, which emulates the decision-making process of a network, is applied to the linguistic values of the inputs so as to infer the output regulation rate set. This output is then defuzzified to the actual traffic rate to be applied on the flow.



A.Fuzzification

Real numbers representing thevalues of both buffer occupancy and the delay measurement parameters are converted into linguistic values, each of which characterized by its own membership function.

B.Inference

A set of rules, called the rule-base, which emulates the decision-making process of a network, is applied to the linguistic values of the inputs so as to infer the output regulation rate set.

Rulesbase

IF DM is small AND AF is small THEN TR is increased;
IF DM is small AND AF is big THEN TR is increased slowly;
IF DM is large AND AF is small THEN TR is decreased slowly;
IF DM is large AND AF is big THEN TR is decreased.

C.Defuzzification

This output is then defuzzified to the actual traffic rate to be applied on the flow.

IV. ARCHITECTURE DIAGRAM

The proposed fuzzy wireless mesh network model shown in figure 2 atoms to study the traffic adaptation with the objective of improving network performance which is based on packets delay measurement and buffer occupancy. The packet delay shows the time it takes to send a packet from the sours eth the destination. Where buffer occupancy has a major impact on QoS provided by the network. It has to be continuously monitored at each intermediate node, along the path from source to destination. When a packet arrives to a node with a lightly loaded buffer, it will rapidly forward to its next hop; if it arrives to node with a highly loaded buffer it has to wait until all existing packets are processed before forwarded. Thus by keeping buffer lightly loaded will load to bounded end to end delays. In order to update/adjust the sending rate, buffer occupancy along the path can be communicate to the source using either a) Time based scheme b) Decision based scheme. In (a) buffer occupancy is measured by nodes along the path and sent to the source periodically. But in this paper we use decision based scheme where
each node, along the path measures its buffer occupancy but it notifies the source only when changes occur in the decision of its local fuzzy controller.

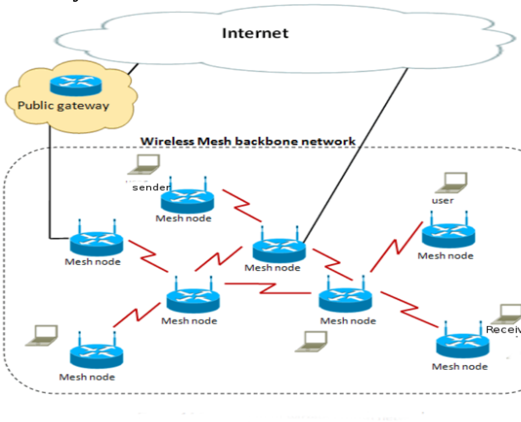


Fig 2. Architecture Diagram of implement the fuzzy algorithm using taffic adaptation .

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```
1---Congestion Window Size = 1
1.1000000000000001---Congestion Window Size = 6
1.2000000000000002---Congestion Window Size = 14
1.3000000000000003---Congestion Window Size = 20.05
1.4000000000000004---Congestion Window Size = 20.1993
1.5000000000000004---Congestion Window Size = 20.592
1.6000000000000005---Congestion Window Size = 21.0725
1.7000000000000006---Congestion Window Size = 21.4025
1.8000000000000007---Congestion Window Size = 21.6351
1.9000000000000008---Congestion Window Size = 22.0022
2.0000000000000009---Congestion Window Size = 22.4525
2.100000000000001---Congestion Window Size = 22.7625
2.2000000000000011---Congestion Window Size = 23.1116
```

Fig 3 sample congestion window size for traffic adaptation.

It shows annotation of Congestion Window size periodically during the execution of Additive Increase Multiplicative Decrease. The window size increase from value one.

V.EXECUTION STEPS

- Additive-Increase/Multiplicative-Decrease
- Network state measurement
- Traffic rate Adaptation
- Congestion management
- Performance Evaluation

VI.EXPERIMENTAL SCRESHOTS

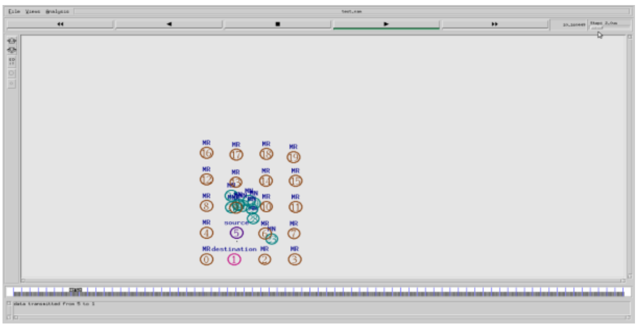

Fig 4 Nam file for AIMD.

This screeshot shows the start the traffic adaptation framework in the client environment. Initially install the Ubuntu 14.0 in client system. After installing the NS 2.0 framework start the client system using command shown in the figure 4.

```
soft17@user17: ~/Desktop/soft17/SINDHUJA/project 2015/Toward Fuzzy Traffic Adapta
True average queue: 0.998 time: 10.928
True average queue: 0.997 time: 10.913
True average queue: 0.999 time: 10.916
True average queue: 0.997 time: 10.927
True average queue: 0.997 time: 10.936
True average queue: 0.995 time: 10.936
True average queue: 0.998 time: 10.940
True average queue: 0.997 time: 10.921
True average queue: 0.997 time: 10.938
True average queue: 0.998 time: 10.939
True averag  queue: 0.996 time: 10.931
True average queue: 0.999 time: 10.913
True average queue: 0.996 time: 10.926
True average queue: 0.996 time: 10.920
True average queue: 0.826 time: 10.935
True average queue: 0.836 time: 13.922
True average queue: 0.996 time: 10.918
True average queue: 0.997 time: 10.917
True average queue: 0.174 time: 10.914
True average queue: 0.700 time: 13.924
end simulation
soft17@user17:~/Desktop/soft17/SINDHUJA/project 2015/Toward Fuzzy Traffic Adapta
tion Solution in Wireless Mesh Networks/Coding/phase1/module2/traffic adaptation
/delay & buffer occupancy$
```

Fig 4 Execution of Buffer Occupancy Measurement .

From the above figure 5 shows the execute the fuzzy algorithm based delay measurement values.

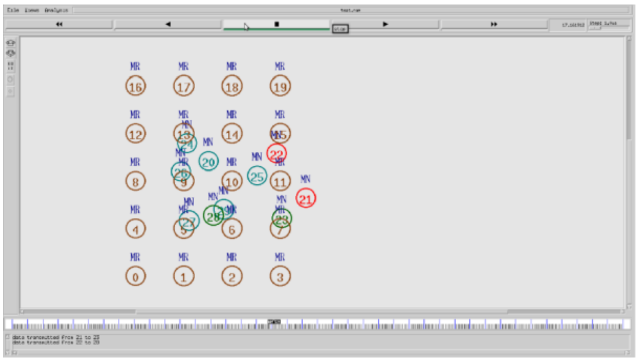

Fig 5 Execution of Nam for Delay

V. CONCLUSION

New traffic adaptation model in WMN based on fuzzy logic theory. The model called, Fuzzy WMN aims to regulate traffic to adapt to thenetwork state (delay between sources and destinations and buffer occupancy of nodes) with the objective to improve the performance. Extensive simulations show that Fuzzy WMN outperforms AIMD with respect to delay, throughput and packet delivery ratio.

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