PREMEDITATED POLICIES AND IMPLEMENTING ALGORITHM TO RESOURCE RESERVATION FOR PRIORITIZED QOS ENABLE TRAFFIC IN MANETS

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ABSTRACT

Real time audio and video streams and require absolute end to end guarantee for QoS. The key attribute these applications for guarantying for QoS is, they need routing path for connectivity like virtual leased line that is very difficult in the scenario of mobile ad hoc networks due to the mobility of nodes and changing topology conditions. With respect to transfer the contents, resources are required to be reserved along the selected path(s).Regardless of old load balancing and redundant path schemes in this paper we have introduced entirely a new approach in which we find multiple paths and select best three from all those as primary, secondary and ternary on certain criteria of maximum bandwidth and minimum hopes and these paths must be loop free and node disjoined. Resources are reserved on both primary and secondary paths and allocate those reserved resources to different categories of traffic according to their priority on the basis of service agreement made with network. We have designed the complete package of policies and their relevant algorithm for implementation mechanism for allocating the resources to different priority traffics and tried to avoid the route breaks.

Index Terms— *Premeditated Policies, Prioritized Traffic, Resource Reservation, Commercial Production*

I. INTRODUCTION

The nodes in ad hoc networks are mostly the PDA's, Laptops or sensors those have many constraints on them with respect to bandwidth, power, processing and other wireless capabilities. They share each other communication facilities in order to achieve overall system connectivity. One node by itself, with such limited characteristics, is not capable of large communication range, but when nodes collaborate helping each other in forwarding information from source to destination , the total value of network is much higher than the sum of communication span of each node [1].

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MANETs fashioned in conditions where mobile devices require network applications, while a fixed infrastructure and permanent network is not available or not ideal to be used. In these situations, mobile devices could set up possibly short-lived network for the communication needs split second [2]. Multi hop ad hoc networks may be connected through dedicated gateways or nodes to the other fixed networks.

There is a variety of fields where ad hoc networks are used such as cooperative information sharing, defense applications, disaster management but mission critical applications and commercial production applications are new, most demanding, attention appealing and market oriented fields of applications for these networks which mostly , contain real time audio and video streams and require absolute guarantee for QoS. QoS means minimum bandwidth, minimum delay and jitter guarantee and enforced service agreements. Different applications have different requirements regarding QoS and their associated parameters regarding routing and management conditions remain also different. For example as in above mission critical and commercial applications the key attribute for guarantying for QoS is, they need routing path for connectivity like virtual leased line that is very difficult in the scenario of mobile ad hoc networks due to the mobility of nodes and changing topology conditions. Therefore, it is a big challenge but it is very necessary to give affordable

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solution [3]. In MANETs Bandwidth, delay and jitter are commonly considered as the metrics for QoS enabled networks. From which again bandwidth reservation schemes can be categorized to work in two sections. One is about the bandwidth management and second is related to routing for suitable path [14]. Fig No.1 describes these two minimum basic set entities involved from source to destination according to steps of flow.

On the other hand here the second issue is occurrence of different types of traffic in the presence of those different traffics how one can be assured to get best service from the network, even if ready to pay extra. The most common solution to this is to classify the traffic in different categories and give certain priority levels to each type of traffic according to their service level agreement for that they pay. According to those priorities network will provide a specific type of service to that particular traffic. Further more network provide advance resource reservation for traffic type that will pay extra and give priority routing facilities to those prioritized traffics according to their service agreements with network.

In [4] authors, propose a framework for QoS model that was suppose to serve for different categories of traffic types according to specific condition of service contract. With many other features delay control, admission control, policy control, classification, shaping, feedback control, scheduling, traffic control and contract enforcement are distinguishing feature of the model. The authors conclude in paper that a good strategic traffic management approach is needed to handle different categories of traffic on their priority and fine resource reservation policy for routing is required to acquire the required end to end QoS in multi hop ad hoc networks. The current paper discovers the tentative solution to these issues.

The rest of paper is organized as follows: section 2 gives discussion of previous works on same issue done by different authors. Section 3 presents the premeditated policies and path selection criteria. Section 4 gives QoS enable RRP for Prioritized traffic. Section 5 describes the policies to resource reservation suggested by authors. Section 6 explains the algorithm and its design. Section 7 and 8 highlights conclusion and future plans respectively.

II. Related Work and Discussion

The routing protocol is the element responsible for determining the best route from source to

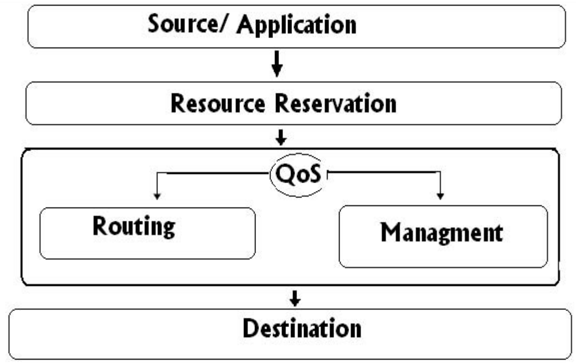

Fig. No: 1*: Basic set of Entities for transmission of an application from source to destination*

destination. After route is determined the forwarding mechanism processes the packets according to the information in the routing tables . Topology may change during session life time requiring the routing protocol to react and update routes between end points. Because the nature of ad hoc networks routing protocols should be highly dynamic and robust [5]. With respect to the approach for finding the route to the destination, protocols are classified as Reactive in which routes are found on demand at the time of requirement and the Proactive in which routes to destination are found in advance. Both categories have their own pros and cons. Researchers have designed and developed many routing protocols for both types as WRP, AODV, DSR, DSDV, CEDAR, Ticket Based, OSLR, AQOR, ADQR, TDR and many more to serve the routing purposes [6]. To discuss the protocols with respect to their design, path finding strategies, advantages and disadvantages is beyond the scope of this paper. Here our purpose is to look for those, which provide the facility to support some QoS metrics, provide the facility of resource reservation, predict route breaks and have availability of redundant paths to destination.

Authors propose to use some cluster based, OSLR, CEDAR or DSDV/TDMA type of protocols with little modifications from the proactive category to support the route break predictions, bandwidth estimations, resource reservations and having the facility to maintain more than one path available in advance to destination.

With respect to management of network regarding allocation of resources to different categories of traffic on their priority, it is necessary that one must define certain policy. A policy explains the rules defined a sequence of actions to be initiated when a corresponding set of conditions is satisfied [7]. In this regard DiffServ Architecture can be used in which traffic is classified in to different categories when entering to the network and are assigned to different behavior aggregates, in which each type of traffic will be given a specific forwarding authentication on per hope behavior (PHB) at the basis of Assured Forwarding (AF) and Expedited Forwarding (EF) [8].

III. PREMEDITATED POLICIES

Our idea is to find more than one routes from source to destination and then select three routes from those according to certain policy described below. According to our best knowledge, there is no such scheme proposed yet for ad hoc networks in which resources are reserved on more than one path in advance to serve the different categories of traffic according to their priority. This is new idea in to improve the QoS in ad hoc networks so that they can be designed to be deployed in business and commercial environment and especially in mission critical applications where connectivity is most important to all other attributes even having different constraints on network.

A. Path Selection

All traditional reactive routing protocols use a single path between the source and destination. When that path fails, they need to perform a potentially costly operation to locate an alternate route for the given destination. On other hand in case of proactive network pay a high premium in order to have alternative routes at hand. A promising approach is to use not just a single path, but set of redundant paths [9]. In this regard in literature have described two approaches: one in which multiple paths are selected and load balancing is performed to transmit the packets on all paths at the same time [5], in second approach every node have separate path to the destination and every node send its related packets directly to destination [10].

IV. QOS ENABLE POLICY TO RESERVE RESOURCES FOR PRIORITIZED TRAFFIC

A. Traffic Types

Traffic is categorized in four [11] types according to their practical usage and importance as:

1. Very High Priority Traffic (VHPT)

i.e.: Emergency Environment: Search and Rescue Operations, Online operation in Hospitals, Telemedicine and Earthquakes

2. High Priority Traffic (HPT)

i.e.: Military Environment: Army, Navy, air Force, Fire Fighting and Policing

3. Medium Priority Traffic (MPT)

i.e.: Academic and Business Environment: Video Conferencing, Online Classroom Lectures, meetings, Transmission of news, road conditions, meetings, stadiums, shopping malls and games operations.

4. Low Priority Traffic (LPT)/ (BET)
   a. i.e.: Data and Voice Environment: Web access, audio and file transfer operations.
   b. i.e.: Entertainment Environment: e mail, chat and remote access operations

B. Route Categories

1. Primary Path (PP)
2. Secondary Path (SP)
3. Ternary Path (TP)

Fig No: 2 describe the idea of path selection and Fig No.3 describes the classification of different traffic types according to their priorities.

C. Route Policies

1. Primary Path Policy (PPP)
2. Secondary Path Policy (SPP)
3. Ternary Path Policy (TPP)

D. Services Offered

1. Premium Service (PS)
2. Gold Service (GS)
3. Silver Service (SS)
4. Metal Service (MS)

E. Traffics and Policies

1. VHPT will be assigned PS
2. HPT will be assigned GS
3. MPT will be assigned SS
4. LPT/BET will be assigned MS

V. RESOURCES RESERVATION POLICIES (RRP)

A. For VHPT

i. PPP

1. Required resources are reserved on the PP for full duration of transmission.
2. Pre-emption not allowed.

ii SPP

1. Required resources are reserved on the SP for full duration of transmission.
2. These resources may be allocated to lower priority traffic subject to the condition of pre-emption.
3. When traffic diverted from PP to SP, SP is designated as PP.
4. The TP becomes SP and action is taken accordingly.

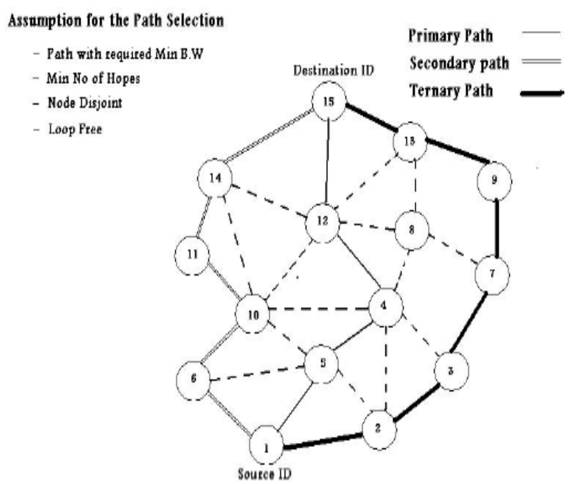

Fig No.2: *Route selection criteria (node arrangement is taken by courtesy of [13]*

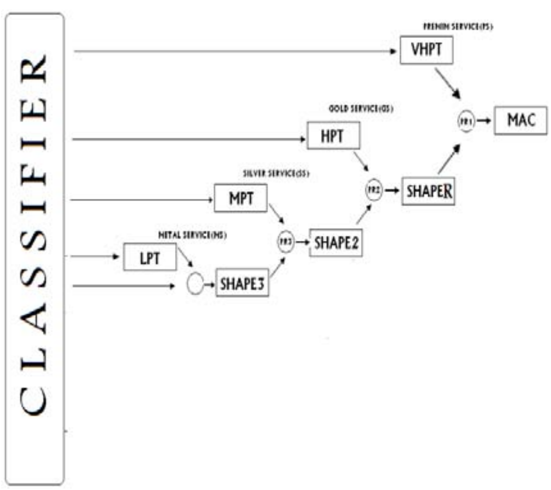

Fig No. 3: *Classification of different traffics*

iii. TPP

1. TR is found and identified but resources are not reserved.

B. For HPT

i. PPP

Same as VHPT.
Pre-emption not allowed.

ii. SPP

1. Required resources are reserved on the SP for 25% or lower of the duration of transmission.
2. But resources may be allocated to lower priority traffic subject to the condition of pre-emption.
3. If and when PP breaks with in this initial 25% of time, it is tried to make SP as PP. If sufficient resources are not available on SP other route with sufficient resources is searched.
4. The TP becomes SP and action is taken accordingly.

iii. TPP

1. The TP is found and identified, but resources are not reserved.

C. For MPT

i. PPP

1. Same as VHPT.
Pre-emption not allowed.

ii. SPP

Route is identified; resources are reserved but subject to the pre-emption.
If and when traffic is diverted from PP to SP, the SP becomes PP.
The TP becomes SP and action is taken accordingly.

iii. TPP

The TP is found, identified but no resources are reserved.

D. For LPT

i. PPP

Path is identified but no resources are reserved.

ii. SPP

Path is identified but no resources are reserved.

iii. TPP

Not Applicable.

In Fig No.:4 we have conceptually designed the criteria on which route selection and resource reservation will be made on different routes to prioritized traffic. Table No: 1 highlights the summary for schemes for resource reservation policies on different path selection criteria for different priorities of traffic [15] and Table No: 2

explain conditions for resource reservation.

VI. ALGORITHM DESIGN

A. Algorithm Criteria/ General Conditions

1. Request for route discovery will be flooded and at least three routes will be founded as Primary. Secondary and Ternary.
2. Route selection will be on the basis of "Best Chosen Criteria", that means minimum no. of hopes and availability of required bandwidth to start transmission.
3. Resources will be completely reserved for Primary and Secondary paths.
4. Route will be found and selected as Ternary path, but resources will not be reserved.
5. Route Break up (RB) will be predicted before the actual failure happens or will be tried, by some "Route Break Prediction Signaling Method (RBPSM)" [12].
6. "X%" of resources would be predicted, for "y" milliseconds before route break up.
7. On occurrence of signal for predicted route break up/ failure of Primary path, Secondary path will became Primary.
8. Network will look for already founded Ternary path, if it is still available then resources now will be reserved on that route and this will became Secondary. This will help to reduce control overhead on the network and also save the time for route finding procedure. This is specially appeal able in mission critical applications.

B. Naming

Name	***Description***
SR	Source
DS	Destination
P_{all}	Set of all paths from Source to Destination
P_{req}	Set of paths fulfilling QoS requirements
P_{pr}	Primary Path
P_{sc}	Secondary Path
P_{tr}	Ternary Path
P_{QoS}	Path with QoS requirements
Pi	Set of Paths selected as (Ppr, Psc, Ptr) from Preq in the ith path
T	Topology
Tn	Set of all Nodes
Tl	Set of all Links
VHPT	Very High Priority Traffic
HPT	High Priority Traffic
MPT	Medium Priority traffic
LPT	Low Priority Traffic
BET	Best Effort Traffic
Element	E

C. Algorithm

Assumption1

Set

$$P_{all} = \{P_1, P_2, P_3 \ldots P_n\}$$

Therefore

P*i is the path and is a linked list of nodes and links*

$$P_{req} \subseteq P_{all}$$

and

$$P_{QoS} \subseteq P_{req}$$

then

$$P_{req} = \{P_{re1q}, P_{req2}, P_{req3}, \ldots\ldots P_{re\,qn}\}$$

and

$$P_{QoS} = \{ P_{pr}, P_{sc}, P_{tr} \}$$

Where members of P_{QoS} *may vary from* ***0*** *to* ***3***

Assumption2

Set

T be the network topology

Then,

$$T = T_n \cup T_l$$

A. Route finding Algorithm

1. Find P_{all} from ***SR*** to ***DS***
2. Find P_{req}
3. ***If*** $\in P_{req}$ ***> 0,*** then find P_{pr}
4. ***If*** $\in P_{req}$ ***> 1,*** then find P_{sc}
5. ***If*** $\in P_{req}$ ***>2****, then find* P_{tr}

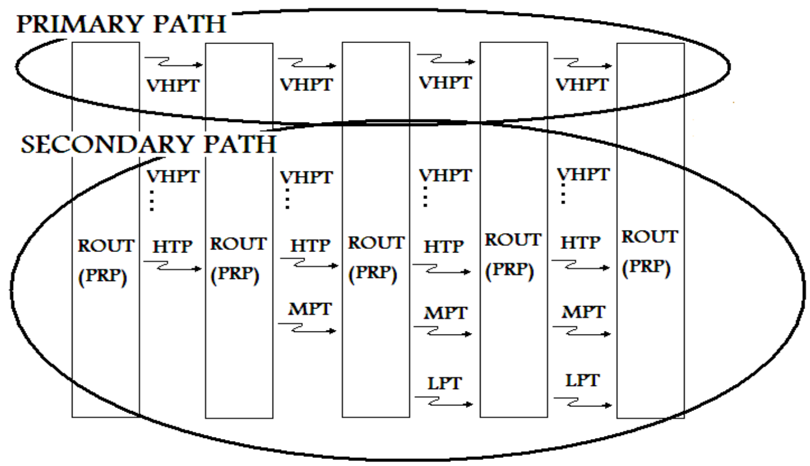

Fig No. 4: *Conceptual design for route selection and resource reservation on different routes to prioritized traffic.*

Table No: 1: *Scheme for Resource reservation policies on different path selection criteria for different priorities of traffic [15]*

Traffic Categories	Primary Path	Secondary Path	Ternary Path
VHPT	1. Required resources are reserved on the PP for full duration of transmission. 2. Pre-emption not allowed.	1. Required resources are reserved on the SP for full duration of transmission. 2. These resources may be allocated to lower priority traffic subject to the condition of pre-emption. 3. When traffic diverted from PP to SP, SP is designated as PP. 4. The TP becomes SP and action is taken accordingly.	1. TR is found and identified but resources are not reserved.
HPT	1. Required resources are reserved on the PP for full duration of transmission. 2. Pre-emption not allowed.	1. Required resources are reserved on the SP for 25% or lower of the duration of transmission. 2. But resources may be allocated to lower priority traffic subject to the condition of pre-emption. 3. If and when PP breaks with in this initial 25% of time, it is tried to make SP as PP. If sufficient resources are not available on SP other route with sufficient resources is searched. 4. The TP becomes SP and action is taken accordingly.	1. The TP is found and identified, but resources are not reserved.
MPT	1. Required resources are reserved on the PP for full duration of transmission. 2. Pre-emption not allowed.	1. Route is identified; resources are reserved but subject to the pre-emption. 2. If and when traffic is diverted from PP to SP, the SP becomes PP. 3. The TP becomes SP and action is taken accordingly.	1. The TP is found and identified, but resources are not reserved.
LPT	1. Path is identified but no resources are reserved.	1. Path is identified but no resources are reserved.	1. Not Applicable.

B. Resource reservation Algorithm

Table No: 2 *Resource Reservation Policies*

P_{QoS}	RRP for P_{pr}	RRP for P_{sc}	RRP for P_{tr}
VHPT	***Yes***	***Yes***	***No***
Pre-emption	***No***	***No***	***No***
HPT	***Yes***	***Yes***	***No***
Pre-emption	***No***	***No***	***No***
MPT	***Yes***	***Yes***	***No***
re-emption	***No***	***No***	***No***
LPT	***No***	***No***	***No***
Pre-emption	***No***	***No***	***No***

Pre –requisites:

Refer Table No:2

For
I = 1,2,……,n are no of $\mathbf{E}$ *in* $\mathbf{P_{QoS}}$
{
If $\mathbf{E}_i$ *of* $\mathbf{P_{QoS}} =$ ***True***
Then
Reserve bandwidth on relevant port of each node in $\mathbf{E}_i$ ***of*** $\mathbf{P_{QoS}}$
For i= 1,2,3,….. no of elements of $\mathbf{P_{QoS}}$
{
If PRP for $\mathbf{P}i$ *of* $\mathbf{P_{QoS}} =$ ***Yes***
Then
For *each Node* $\mathbf{N_i}$ *in* $\mathbf{P}i$
{
Reserve Bandwidth on relevant port of $\mathbf{N_i}$
}
}

VII. Conclusion

In this paper we have highlighted the ad hoc networks with respect to their use in commercial production, emergencies, mission critical and broadcasting scenarios where real time transmission require guaranteed QoS. To service these environments we have designed a full package to provide QoS starting from the traffic categories, their route selection and most important resource reservation on different paths for different categories of traffics on their priority. We have designed complete premeditated policies with full implement able simple algorithm.

VIII. Future Work

At present we consider "pre-emption not allowed" (see Table No: 1), for all traffic categories for the sack of simplicity and clear understanding. How ever in future we intend to consider pre-emption also. It would be very interesting to do performance comparisons in terms of QoS parameters as bandwidth, jitter and delay etc with pre-emption "Enabled and Disabled" conditions

In future authors also wish to simulate the design according to algorithm given so for in this paper, to verify the correctness, evaluate the resource reservation policies and determine the effect on QoS with respect to transmission of real time traffic as audio and video plus to check end to end QoS guarantee. In this regard we intend to design a bandwidth broker and test the bandwidth brokerage and distribution to its legitimate customers according to their contract with network .We are also thinking for developing the simulation environment and test it on any simulator like NS-2 or OPNet. To ensure the reliability of the results we have planned to use different traffic models and highly dynamic network topology.

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