# New approach for multimedia flow transport over ad hoc network

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*Abstract:* - This paper is situated within the study context of the mobile ad hoc networks and introduces the concept of quality of service in order to convey the multi-media applications under the best conditions. In order to transmit a flow having quality of service requirements (QoS) in an ad hoc network, we proposed our' My priority' queue that convey the isochronous packets in the shortest possible time courts and also improves the non-isochronous packets flow while avoiding the introduction of additional load into the network. It eliminates the isochronous packets which its lifespan is exceeded and thus releases little load in the network for the non-isochronous packets (from where the rate increases).
Moreover in order to adapt as better as possible to the ad hoc environments, it privileges the routings packets considering their importance in case of change of topology.

*Key-Words:* - Ad hoc network, Multimedia flow, QoS, FIFO, PQ, MY Priority.

## 1 Introduction

In traditional IP networks the packets are transported without taking account of their nature but we see in [1] that each packet, according to its application must respect certain constraints. For example; during a queue transfer it is necessary to minimize the loss rate on the network. In the same way in videoconference communication, it is necessary to decrease the time of transmission and to increase the flow. Thus, it is necessary to treat differently the packets according to their applications types. The quality of audio flow is acceptable when the packets arrive before a certain delay, exceeded this time, the quality worsens quickly. With regard to the flow, we notices that quality increases very quickly with the increase in the transfer rate. However exceeded a threshold (40 kb/s) quality remains almost the same.
Several queue policies were installed in order to ensure these conditions [2]. These policies can for example introduce a priority for the real time traffics flows known as significant (audio, video...) (example PQ queue) with guarantees in delay and also in loss rate. They also prevent the congestions (example queue RED [3]) by controlling the traffics.

## 2 Related works

The following paragraphs describe a number of these policies.
FIFO (First In First Out)
This is the simplest management method, where packets are processed on a strict first come, first served basis [5].
Priority Queue (PQ)
This is a method where every service class has its own queue assigned and the packets in the queue with the highest priority are processed first. In fact, the packets in queues with higher priority are removed from the queues and processed before those in queues with lower priority [5] [4].
Class Based Queues (CBQ)
This is a method which subdivides the traffic into classes and allows bandwidth to be borrowed between the actual classes. The number of classes can be greater than the number of queues, while the queues available may be managed using the PQ method [5].

The majority of these queues introduce guarantees with regard to the delay or the rate. For example, PQ queue gives the priority to a flow to the detriment of other flows. CBQ is based on a bandwidth fair access. In these 3 scheduling policies, the quality of service guarantees must be respected. However, in the ad hoc networks, where the nodes are in perpetual movement, to impose guarantees are not desirable. Thus, this paper presents an alternative queue: the My Priority queue [1].
The remainder of this paper is organised as follows: section 2 describes the principle and

the implementation of this queue, section 3 details and introduces some experimental results followed by the conclusion in Section 4.

# 3 The My Priority queue

The multi-media applications adapt their injection rates and their coding parameters according to the characteristics of the network.
During the studies made on the ad hoc networks, several characteristics appeared fundamental. In our work we are being interested in the most significant which is the perpetual change of topology. Several routing protocols tried to minimize the impact of the change of topology in order to transmit under best conditions. In fact the routing packets have primordial importance to inform the nodes about the changes of the roads.
While taking these two remarks as a starting point, we decided to implement"the My Priority queue". This queue makes it possible on the one hand to improve the isochronous applications by reducing their delay, without requiring any additional load or control information. In addition"the My Priority queue" is a queue which gives priority to the routing packets considering their importance in AD hoc network.

### 3.1 Principle

Having the diversity of traffics sent on the network, it was necessary to choose between favoured the short delay with regard to the isochronous applications or an acceptable flow for the non-isochronous applications. In fact in our work the applications must choose between two types of packets:
-The packets which must arrive before a certain time, otherwise they are rejected by our queue, are the packets of isochronous flows.
-The packets which must maximize the flow, and which do not take into account the delay of each packet, are the packets of non-isochronous flows: example ftp, HTML...
Since our work is situated in context of the ad hoc networks, we have to give the priority to the routing packets which are put at the head of the queue. Indeed the mobile units of these networks without pre-existent infrastructure are obliged to behave like routers. Each mobile unit takes part in roads discovery or their reestablishments in case of movement. At this time the network is flooded by routing packets which allow the nodes a clear vision of the network in order to transmit after that the data packets.

### 3.2 Implementation

My priority introduces the concept of:
- Lifespan of the packets (deadline)
- A virtual queue.

My priority minimizes the waiting delay of the isochronous packets while respecting certain constraints:
- The waiting period of the isochronous packets within the queues should not exceed a certain delay T (time).
- The packets are treated according to their order of arrival.

My Priority supports the isochronous as well as non isochronous traffics. It is based on the use of a virtual queue where duplicates of the packets are stored in order to know the arrival order. The isochronous and non isochronous packets are put in separately queues. A lifespan is assigned with the entering packets. It represents for all the packets the time that the packet can remain in the queue.

### 3.3 Packet Arrival

When a packet arrives, My Priority sends a copy towards the virtual queue. The non-isochronous packets are refused only if the virtual queue cannot contain them. We take for example that the *Niso* packet is rejected because the plug of the virtual queue is full and cannot contain it. If they are accepted we affect them a lifespan while packets must be treated by the nodes.
Given $T$ the arrival time of non-isochronous packets, $Q(t)$ size of the queue, l the size of arrival packet and $C$ the rate which queue is been served. Lifespan of non-isochronous packets is time that they remain in the virtual queue.
We assign with the isochronous packets, if they are accepted (according to certain conditions) a lifespan is equal to the delay $D$ which is maximum lasted period that the packets can remain in the queue.

$$Lifespan\ (niso) = t + \frac{q(t) + l_{niso}}{c} \quad (1)$$

That is to say $T$ is arrival time of an isochronous packet and $D$ is the maximum delay.

$$lifespan\ (iso) = D + T \quad (2)$$

The isochronous packets are put in the queue according to certain conditions: acceptance tests.
Acceptance tests of the isochronous packets: either an isochronous packet (*Iso*) of $l_{iso}$ size which arrives at the" $T$ " moment. Given $Q(t)$ the number of bits in the queue before the arrival of the new packet. Given $C$ the rate with which the virtual queue is been served. The isochronous packet *(Iso)* is accepted in the queue under two conditions:
- If the queue is not full.
- If their end to end time is not exceeded.
- And if it satisfies the following condition:

$$q(t) + l_{iso} \leq c \times d \quad (3)$$

As soon as the packet is accepted, its duplicate is put in the isochronous queue. The isochronous and non-isochronous packets are put in two different queues.
The lifespan of the packets indicates which the next packet that should be served is. As long as there lifespan is not exceeded, the non-isochronous packets can wait. The isochronous packets are served in the virtual waiting interval. Given Lifespan *Niso1* is of 56s (lifespan (non isochronous) =56s) and its size is 512 octets. but given that the isochronous packet *Iso1* (of size 1024 bytes, has time constraints, and it can finish its execution before the *Niso1* lifespan ending (deadline) (condition 4), then *Niso1* is put on standby and leaves its place to *Iso1* packet, thus the isochronous packet will be the first served by the My Priority queue.

### 3.4 Priority for routing packet

Considering the importance of the routing packets in the ad hoc networks we gave the priority to these packets. The routing packets are put at the head of the queue since they have a paramount importance to inform the nodes about the changes of roads that's why their lifespan is null. They must be treated in priority without any waiting (figure1).


Fig. 1 — arrival of packet routing

If several routing packets arrive at the same time, they are immediately put at the head of the My Priority queue. Their order of service does not have importance since they are served one after the other as shown in figure2.

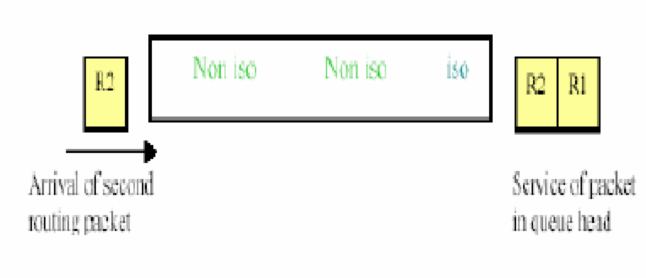


Fig. 2 — arrival of two routing packets

The use of the file My Priority offers many advantages compared to the traditional queues disciplines. It tries to decrease the delay of time sensitive data packets while increasing the flow of the others. For that, it eliminates the isochronous packets whose time is exceeded because these packets are only used to encumber the ad hoc network. The loss of part of the isochronous packets is rewarded by the priority that we give to the other isochronous packets. This fact the non-isochronous packets can leave their places to the isochronous packets under certain conditions (Eq. 4). The"My priority" queue has for advantages also to not introduce an additional charge in the AD hoc network.
Moreover this queue privileges the routing packets to adapt as better as possible the node mobility.
Before judging this file, it is necessary to compare it with the other queues such as FIFO and file PQ (priority).

## 4 Simulation and results

We simulated My Priority in a mobile environment and we have to compare its performances to two another queue: the FIFO queue and the Priority queue for the isochronous packets. We have noticed that in the majority of the cases, My Priority gives the best results.

Description of the simulation environment

- The duration of simulation as well as the size of the network can be variable.
- The parameters of the simulation of the My priority queue are:

Duration of simulation 1200s, size of the network is of 700*700 m 2, the maximum speed of the nodes is of2m/s, the time of pause is of 1s, the bandwidth of the channels is 2 MHz and the number of the nodes is on average 20.

- The number of generated traffics is 20: to highlight the contribution of the My Priority queue, it is interesting to take the same portion of isochronous and non isochronous traffics. So, that a node can generate only one type of traffic either isochrones or non isochrones.
- 10 CBR traffics (constant Bit Rate). The size of the packets is of 1020 bytes (by default in NS [4]). The interval of time between the sending of 2 packets is of 0.2s.
- 10 FTP traffics (File Transfer Protocol). The size does not exceed 1460 bytes (by default in NS).
- We will use AODV [5] as the routing protocol (Ad hoc On demand Distance Vector). It should be noted that the My Priority queue is independent of the routing protocol used.
- The metric which was studied in what follows are the rate of the packets which arrive successfully at the destination and the end to end rate in order to show the contribution of the My Priority queue.

In order to make an initial assessment of the queue, Variation of mobility Variation of the number of flows and Variation of the rate of traffic of the isochronous packets are respectively measured against node speed, traffic number and rate of traffic. Results are shown respectively in figure 3 figure 4 figure 5 figure 6

## 4.1 Variation of mobility for the isochronous packets

Figure 3 shows the success rate of the isochronous packets arriving within delay according to the mobility of the nodes. It is noticed that the success rate for PQ queue is more significant than the success rate of the file My Priority. Indeed, PQ queue gives the priority to the isochronous packets. Thus they arrive at the shortest delays towards their destination. This (PQ) queue gives good results for the isochronous packets to the prejudice of the other packets (not isochrones). My Priority gives a success rate close to PQ because this queue makes preventive rejection and thus releases space in the network.

FIFO queue has the lowest success rate because, although the isochronous packets reach their destination, the end to end delay often exceeds 200ms. Thus these packets are eliminated when they arrive at destination.

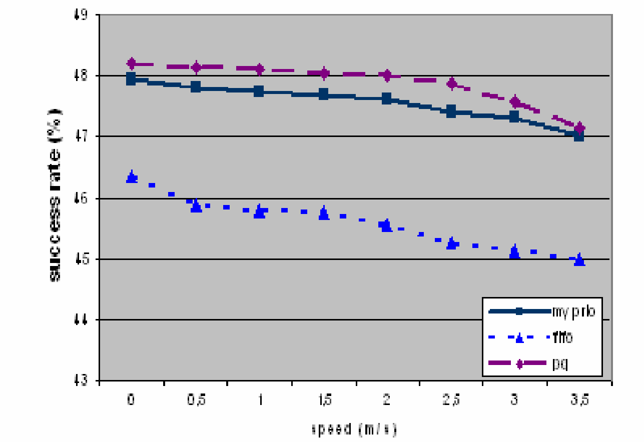


Fig. 3 — Success rates of isochronous packets according to the mobility of the nodes

## 4.2 Variation of mobility for the non isochronous packets

Figure 4 represents the rate of the non-isochronous packets compared to mobility. We note that the traffic of non isochronous flow in the case of the My priority queue, is more significant than in the case of 2 other files FIFO and PQ. It is clear that if the My priority queue eliminates the isochronous packets having exceeded their delay, it makes it possible that the other packets to reach their destination with a greater probability.

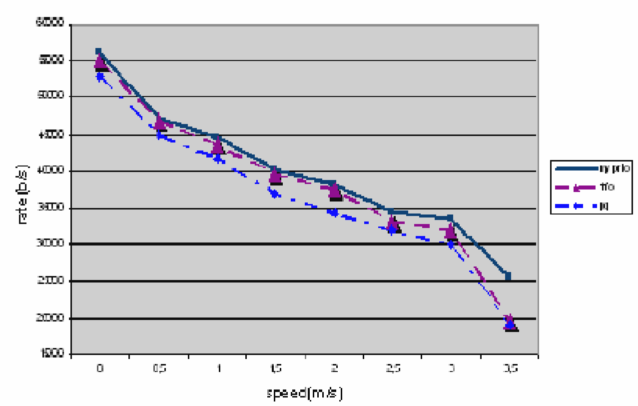


Fig.4 — Rate of non isochronous packets according to the mobility of the nodes

## 4.3 Variation of flow number

We increase the number of flows from 4 to 20. The number of isochronous flows is equal to the number of non isochronous flows. We sends initially 2 flows CBR and 2 flows FTP, then 3 flows CBR and 3 flows FTP to finish with 10 flows CBR and 10 flows FTP. The network comprises 20 nodes having for maximum speed of 2m/s. We studied the percentage of the non-isochronous packets which arrive successfully at their destination.
Figure 5 shows that whatever the number of traffics circulating in the network, the My priority queue gives better results relating to the success rate of the non isochronous packets. The difference between My priority and other queues FIFO and PQ increase appreciably with the increase in the number of traffics. Indeed, since the My priority queue makes preventive rejection, then the network is charged. In addition, by increasing the traffics, we increase the number of packets residing in the buffers of the queues. The action of My priority becomes considerable and the non isochronous flows are thus better.

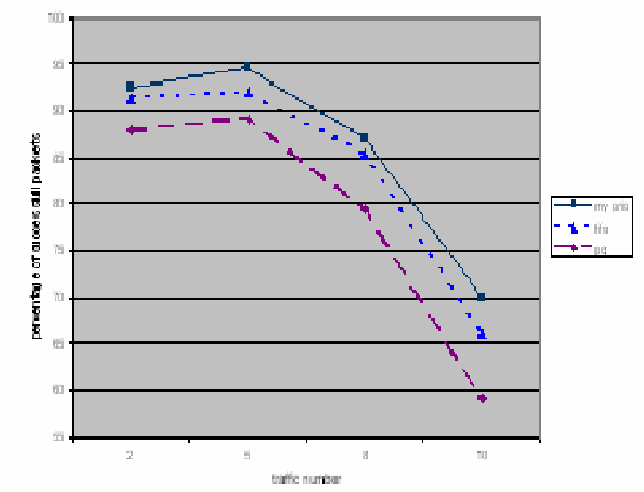

Fig.5 — Percentage of successful of non isochronous packets compared to the number of traffic.

## 4.4 Variation of traffic rate of isochronous packets

This part concerns impacts it rate of sending of the isochronous packets. We thus increased this frequency from 0.02 to 2 pkts/s (given arrive a τ varying between 0.5 and 100). The network comprises 20 nodes having for maximum speed 2 m/s. The number of flows which circulate in the network is 20: 10 traffics CBR (Constant Bit Rate) are marked isochronous and 10 traffics FTP (File Transfer Protocol) which will be marked non isochronous.
Thus we study the success rate of the isochronous packets according toτ.

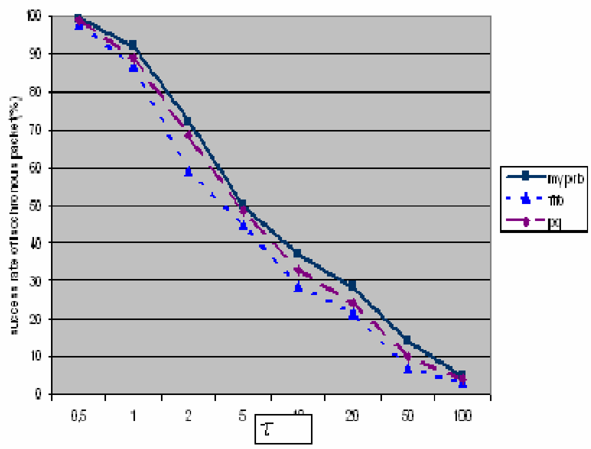


Fig. 6 — Success rates of isochronous packets according to τ

With the increase in the frequency, the queues will receive more packets than they can send. They quickly will be congested (starting from t = 10 for figure 6) given that the My priority queue rejects the isochronous packets having exceeded the delay, the success rate is higher than the of FIFO queue.

## 5 Conclusion

We could show that in presence of isochronous and non isochronous applications, the My Priority queue gives better performances in the ad hoc environment than FIFO and PQ queues. Moreover it is better adapted to the nodes mobility and the increase in the traffics in the network. The advantage of this queue is to keep the simplicity of the 'Best effort' queue while trying to help flows having time constraints. This queue can be introduced without adding additional load. It does not impose guarantees in the quality of service which cannot be respected in the networks that are in perpetual movement such as the ad hoc networks.

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