CHAPTER 8

DIFFERENTIATED SERVICES WITH ROUTING
AND BUFFER MANAGEMENT

8.1 INTRODUCTION

The concept of Message Ferrying is attractive not only in the common battlefield and disaster recovery scenarios where network partition often occurs, but it is also important in two emerging scenarios: sensor networks for habitat monitoring and remote village communication. In the case of remote village communication, several data kiosks can be installed at fixed locations in the village where the villagers can drop off their electronic messages. Even though the messages to be delivered in a message ferry system do not require real-time delivery, it is still useful to provide differentiated delivery services, similar to the regular and express mail features offered by the post office. Thus, in this case, messages can be divided into two classes, namely urgent and regular messages. Urgent messages have smaller delay requirements and need to be delivered quickly. In a constrained scenario, the message ferry delivers the urgent messages to the destination node immediately after picking them up from the source node.

A methodology for designing the ferry route is given such a constraint. In this work, the scenario where the nodes are mobile and the messages arrive according to a certain probability distribution, is investigated. The assumption in this scenario is limited to buffers available at the nodes and at the ferry. This research investigates how the buffer allocation scheme
impacts the satisfactory ratio of urgent messages that are delivered on time. It is also concerned with message dropping rates of both the urgent and regular messages as a result of buffer contentions at the ferry.

Sometimes people may want guaranteed service for their performance based critical applications. For such purpose, differentiated service can be used to provide low-latency, guaranteed service to critical network traffic such as voice or video. Providing best-effort traffic guarantees to non-critical services such as web traffic or file transfers. This classifies network traffic into different priority levels and applies priority scheduling and queuing management mechanisms to obtain QoS guarantees. A protocol is defined for supporting different priority services.

Traffic may be classified by many different parameters, such as source address, destination address or traffic type and it can be assigned to a specific traffic class. It relies on a mechanism that classifies and marks packets by including some flag bits into the packet as belonging to a specific class.

Some measure of precedence and proportional fairness is defined between traffic in different classes. If congestion occurs between classes, the traffic in the higher class is given priority. In such cases, rather than using strict priority queueing, more balanced queue servicing algorithms such as fair queueing or weighted fair queuing are likely to be used. If congestion occurs within a class, the packets with the higher drop precedence, are discarded first.

If congestion occurs and the buffer becomes full, when a higher-priority packet comes in, the ferry will drop low-priority packets in the queue and let the high-priority packet to enter the queue. In this kind of situation,
guaranteed-service packets may be marked as high-priority packets and best-effort packets may be marked as low-priority packets.

Packets may be dropped using any of the following packet dropping schemes:

- Overloaded drop – Packet is dropped only when the buffer is full.
- Early drop - when the buffer occupancy exceeds some threshold value, start dropping incoming/least recently received packets.
- Early random drop - When queue occupancy exceeds a threshold, start randomly dropping incoming/least recently received packets.
- Random early detection - A mechanism called RED (Random Early Detection) detects when a queue is about to overflow by monitoring several threshold levels.

8.2 ROUTING WITH BUFFER MANAGEMENT

In this work, two different priority levels of messages have been generated: high priority messages with priority 1 and low priority messages with priority 0. Here, a simple QoS mechanism is developed by means of integrating routing and buffer management, using modified early packet dropping function. Simulation results show that this routing achieves a better performance in terms of packet delivery ratio and average delay. If the buffer is almost empty, all incoming packets are accepted. As the queue grows, the probability for dropping an incoming packet increases. In this work, the following buffer management algorithm is implemented in the message ferry used in the routing scheme SMFGW.
8.2.1 Algorithm

1. If buffer occupancy is less than threshold value then almost all the incoming packets are put into the buffer.
2. If buffer occupancy reaches threshold value, only high priority incoming packets are allowed to be put into the buffer.
3. If buffer is full, then, the least recently received low priority packet is removed and the new incoming high priority packet is put into the buffer.

Figures 8.1 and 8.2 delineate differentiated services with routing and buffer management.

![Diagram](image_url)

Figure 8.1 Ferry operation in DiffServ (delivering packet to the nodes)
Figure 8.2 Ferry operation in DiffServ (receiving packet from the node)
8.3 RESULT ANALYSIS

The results show that the delivery ratio of the high priority packet has considerably improved without causing any degradation in the overall delivery ratio of the packets. From Figure 8.3 to 8.8 show that delivery rate of high priority packet is improved than low priority packets for varying parameters like node density, message density, mobility speed etc.

![Figure 8.3 Number of nodes vs Delivery ratio (Diffserv)](image)

![Figure 8.4 Mobility speed vs Delivery ratio (Diffserv)](image)
Figure 8.5 Transmission range vs Delivery ratio (Diffserv)

Figure 8.6 Transmit speed vs Delivery ratio (Diffserv)

Figure 8.7 Number of messages vs Delivery ratio (Diffserv)
In this analysis, data delivery rate of high priority message is defined as the ratio of number of successfully delivered high priority messages to the total number high priority messages generated. Data delivery rate of low priority message is defined as the ratio of number of successfully delivered low priority messages to the total number of low priority messages generated.

8.4 CONCLUSION

This work investigated how the ferry route design, integrated with buffer allocation algorithm, should be done for a message ferrying system. This system involves two message types, namely urgent and regular messages with different delivery deadlines. The simulation results indicate that the proposed scheme can achieve a higher delivery ratio and lower delay for urgent messages. This is done at the expense of a slight degradation in the delivery ratio of regular messages but without causing any degradation in the overall delivery ratio.

Figure 8.8 Buffer size vs Delivery ratio (Diffserv)