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Sang-Yong Kim, Joohyun Kim

PII: S0167-6377(16)30043-8
DOI: http://dx.doi.org/10.1016/j.orl.2016.06.002
Reference: OPERES 6108

To appear in: *Operations Research Letters*

Received date: 4 December 2015
Revised date: 26 May 2016
Accepted date: 9 June 2016

Please cite this article as: S.-Y. Kim, J. Kim, Channel-independent throughput-based fair queueing in wireless packet networks, *Operations Research Letters* (2016), http://dx.doi.org/10.1016/j.orl.2016.06.002

Channel-independent throughput-based fair queueing in wireless packet networks

Sang-Yong Kim[1], Joohyun Kim[2*]
[1]Korea Information Society Development Institute (KISDI)
[2]Naveen Jindal School of Management at the University of Texas at Dallas

ABSTRACT

We propose a new fair queueing scheme which we call Channel-Independent Throughput-based Fair Queuing (CITFQ) without using virtual time system. In our CITFQ scheme, each flow is equipped with a counter that measures the weighted throughput achievement if it has a backlog of packets. Our CITFQ scheme achieves fairness guarantees, short term fairness for error-free flows, long term fairness for error flows, and graceful degradation for flows which have received extra service.

Keywords: fair queueing, generalized processor sharing, packet scheduling, wireless packet network, virtual clock

* Corresponding author, e-mail: jxk161630@utdallas.edu

1. Introduction

Traffic scheduling is one of the major issues to be solved in order to offer fairness for all traffic. The design of traffic scheduling algorithms involves an inevitable tradeoff between delay, complexity of implementation, and fairness [15]. Various approaches to fair queueing have been proposed. One of these is scheduling, which allocates fair amounts of bandwidth to competing backlogged flows, regardless of their arrival rate, packet size or type of application.

The cornerstone of fair allocation is generalized processor sharing (GPS) [5]. However, it is difficult to implement the GPS in routers of packet networks, since it assumes bit-based service scheduling for each flow. In order to solve this problem a number of packet fair queueing (PFQ) algorithms have been proposed which emulate the ideal GPS [1],[2],[3],[4],[8],[9],[10] [12],[14],[15].

GPS can be emulated by maintaining a system virtual time and virtual start/finish time tag for every packet. The scheduler selects the packet with the minimum virtual finish time tag for service. However one of the weak points of PFQ is that the packet scheduler has to manage the system virtual time and calculate the virtual start/finish time tag for every packet. In order to overcome this problem some algorithms have been proposed which reduce the complexity of maintaining the system virtual time [4], [14], [15].

Many PFQ algorithms are not directly applicable to wireless packet communication networks [10]. The main reason is that there are channel errors in the wireless environment. Thus some PFQ algorithms, which take into account channel errors, have been proposed for wireless packet networks [8],[9],[10]. However, these algorithms still maintain a virtual time for mobile nodes. Therefore we have proposed a channel-aware throughput-based fair queueing (CATFQ) algorithm that is applicable to both wired and wireless packet networks and is computationally efficient [6]. As described in [6] however, the CATFQ still has the problem that it degrades the services of other flows due to its compensation scheme for lagging flows. This is not desirable from the point of view of providing the fairness property.

In this paper, we propose a new fair queueing scheme, which we call *Channel-Independent Throughput-based Fair Queueing* (CITFQ) which does not have a without virtual time system. In this