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RESEARCH ARTICLE

DYNAMIC JOINT SCHEDULING AND CONGESTION CONTROL IN WIRELESS NETWORKS

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ABSTRACT- The network nodes that are connected by wireless data connections called as wireless networks. The devices are connected via wireless link to communicate with each other. In wireless networks, it is very difficult to maintain the trade-off between throughput and delay. This paper proposes a new joint scheduling and congestion control algorithm for multihop wireless networks with dynamic route flows. The proposed algorithm achieves a provable throughput guarantee and provable end-to-end delay of every flow. The new joint scheduling and congestion control algorithm improves throughput and delay for dynamic wireless network by changing scheduling scheme with virtual adaptation model. The proposed algorithm combines window-based flow control with a new rate based distributed scheduling algorithm and maximum weight scheduling algorithm. This approach adaptively selects a set of routes according to the traffic load. Furthermore this dynamic adaptation mechanism achieves better performance in terms of throughput, end-to-end delay and drop rate.

KEYWORDS- Joint scheduling and congestion, End-to-end delay, virtual adaptation, Throughput, Drop rate

1. INTRODUCTION

In recent years there has been lot of problems in congestion control of wireless networks. Congestion is an essential problem in wireless networks that leads to packet losses and increased transmission latency has a direct impact on energy efficiency and application Quality of services (Qos) . When one part of the subnet becomes overloaded, congestion results with the growing demand for real-time applications over wireless networks [1], [2]. The scheduling algorithm supports to maximize the total system utility. The optimal solution is used to increase the utility and to decrease the delay. The congestion control component is combined with maximum-weight back pressure algorithm to perform an efficient control process [3]. The distributed algorithms with provable throughput and lower complexity than the back pressure algorithm has been made with significant progress. The most existing works on joint scheduling and congestion control reflect only on the throughput performance and delay performance

Existing algorithms achieve different trade-offs among throughput, delay, and drop rate [3]-[8]. It is well known that the joint scheduling and congestion control can attain the low complexity region of the network based on which a large number of wireless congestion control algorithms have been developed to optimize the performance. The congestion-controlled sessions consider the packet delay for multimedia traffic.

The delay-performance of the back-pressure algorithm has two major issues. First, the end-to-end delay may grow quadratically with the number of hops for long flows. This entails that the back pressure algorithm may have significantly larger end-to-end delay for long flows. Second, it is difficult to control the end-to-end delay of each flow. The step size is the main parameter to refrain the joint scheduling and congestion control algorithm based on the back pressure algorithm [16], [17], [19], [22]. The smaller queue length may consequences due to the larger step size. The optimal- system throughput results in smaller step size. It is needed to ensure that the joint scheduling and congestion control is difficult to tune the throughput-delay trade-off on a per-flow basis.

In this paper a new class of dynamic joint scheduling and congestion control algorithms is provided and that can achieve both provable throughput and provable delay in multichannel networks. The algorithm consists of three main components: window-base flow control, Adaptive virtual rate computation, and scheduling. The main idea of the algorithm is to improve the performance of delay as follows. The numbers of packets are controlled by using window-based flow control. The rate- based scheduling algorithm with adaptive virtual rate as input to schedule packets in transmission. The closed-form solution with throughput and delay trade-off is difficult to maintain in analyzing the end-to-end services. The Markov chain analysis will no longer afford a closed-form solution.

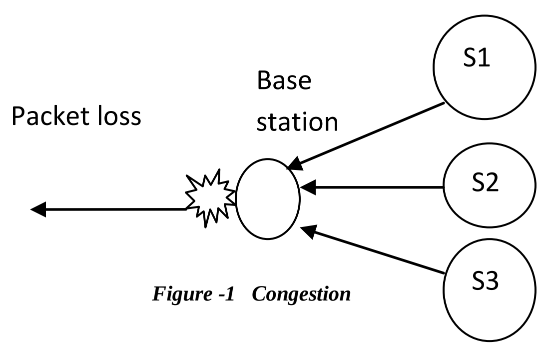

Figure -1 Congestion

The proposed algorithm is fully distributed and can guarantee order-optimal per-flow delay in wireless networks. Recently, there has been a number of papers that enumerate the delay performance of wireless networks in provisions of congestion or not in provisions of congestion. In [12] the authors propose methods to decrease the delay of the back-pressure algorithm. The algorithm proposed in is a shadow back-pressure algorithm, which maintains a single first-in-first-out (FIFO) queue at each link and multiple shadow queues to schedule the transmissions [7].

The organization of the paper as follows. In section II, the system model is defined. In section III, The basic scheduling algorithm is described in the paper. In section IV the proposed system is explained with new joint scheduling and congestion control. Section V describes the performance analysis using performance metrics.

2. SYSTEM MODEL

The model of a wireless network is set by a graph with set of nodes and set of links. The Graph is denoted as G = (V, E) where V is the set of nodes and E is the set of links. We assume a time slotted wireless systems that can be used to transmit the packets within time slots of unit length. The capacity of the link represents the number of packets that can transmit in one time slot. This models the node constraints where two links sharing a common node. The links are close to each other cannot be active simultaneously. A schedule is represented by a vector for decision function. The scheduling algorithm is a procedure to be used in every time slot for data transmission [6], [7]. The capacity region of the network is the set of all arrival rates for the scheduling algorithm. We say that the scheduling algorithm is throughput –optimal and the consideration of window based flow control and joint max-weight scheduling achieves the maximum throughput and delay

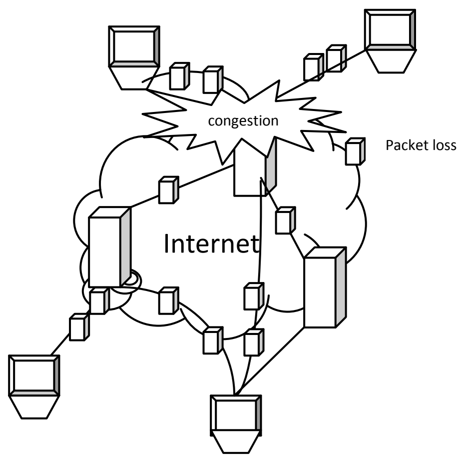

Figure – 2 System model for general congestion

The design constraint has been used to model the adaptive virtual rate based computation function at high degree. Each flow is associated with a source node, destination node, and a fixed route between them.

3. JOINT CONGESTION CONTROL AND SCHEDULING ALGORITHM

There are many approaches available in the wireless systems do not consider the delay performance. In this algorithm, whenever the packet arrives at a heavy traffic router, the packet is fetched at random manner from the FIFO based buffer with the arrived packets are compared. Both of the packets are dropped if they arrive at the same flow. The congestion level is used to choose the packets randomly and keep it aside in the buffer. The buffers also have the newly collected packets. It is really a simple and good algorithm that does not require any special data structure [11]. This algorithm does not deliver good performance when the large number of flows compared with its buffer space.

The low complexity and distributed scheduling algorithms replace the centralized back-pressure algorithm with good throughput performance. The queue length based scheduling algorithm is used to measure the end-to-end delay performance. The window based flow control algorithm and an adaptive virtual rate based scheduling algorithms that are different from back-pressure algorithm.

3.1 MAX-WEIGHT SCHEDULING ALGORITHM

The study of the Max-weight algorithm with joint congestion control performs effectively for the multichannel wireless networks. The Max weight rule results in service allocation rule with particular rule.In every time slot, each server separately picks a queue that maximizes the product of queue length and channel rate in favor of the smallest queue index. The allocation rule provides throughput-optimal for the system. The max-weight rule results in at least a constant probability for the small buffer overflow event for large number of packets. The max-weight algorithm is very efficient at keeping the per-user queues small with rate based flow control.

3.2 WINDOW BASED FLOW CONTROL

The rate of transmission is managed between the two nodes by using window based flow control to prevent from a fast sender. The transmission speed is controlled by the receiver. The flow control is used to control the flow of data from the congested networks. The classification of flow control process is determined by the receiving node which is sending feedback to the sending node. The flow control is mainly used to transmit the information at a faster rate.

3.2.1 Window Based Flow Control Algorithm

The congestion control component is described for this algorithm. The approach is based on window based flow control.

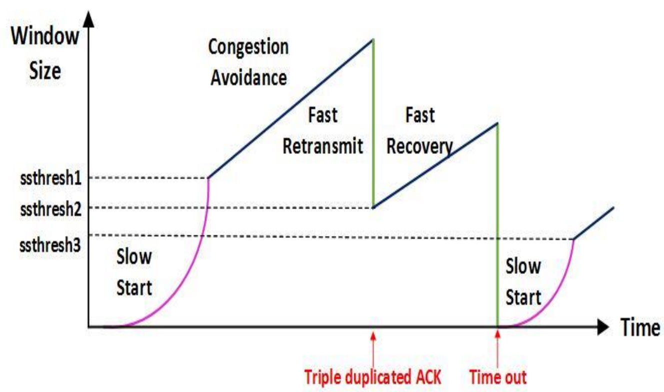

Figure-3 Congestion control

At source node a window is maintained for each flow. When the total number of packets inside the network is smaller than the window size, the source node allows new packets to inject. An efficient transmission is achieved by letting the destination node send an acknowledgement back to the source node whenever it receives a packet. The advantages of this approach are: first, for each flow the maximum numbers of packets are controlled in each node along the route. Second, for each flow the tradeoff between throughput and delay will be individually controlled by the window size.

4. PROPOSED SYSTEM

4.1 ADAPTIVE VIRTUAL RATE BASED COMPUTATION

The new joint scheduling and congestion control algorithm will guarantee for each flow with provable throughput and provable throughput delay. The optimization solution to a standard convex - optimization problem in wireless network with linear constraints as follows:

$$max \sum_{m=1}^{M} Um(rm)$$

The m-flows of packets are maintained for the decision vector value (rm). The virtual rate is calculated using this rm value.

4.2ADAPTIVE VIRTUAL RATE COMPUTATION ALGORITHM

At time t the source node of flow m updates the decision vector for each link with greater step size. The variables are the virtual rates and indirectly they are used to inject the packets in our proposed algorithm. In general a packet must traverse the links in a hop-by-hop fashion. An additional flow control algorithm is needed to order this hop-by-hop packet flow. The adaptive virtual rate computation algorithm did not produce the schedule for link transmission. The scheduling algorithm is used to the schedule computation [8]-[12]. It supports for the adaptive virtual rate vector. The different scheduling and congestion control components are used to quantify both the throughput and delay in wireless networks.

4.3 SCHEDULING ALGORITHM

The distributed scheduling algorithm with low complexity is used for scheduling the packets. Each time slot having an initial scheduling property which is further divided into n mini slots. Each link has to be scheduled and selected according to the scheduling slot. Each time slot consists of an initial scheduling slots is further divided into particular mini-slots. In the scheduling slot the links are rest of time slot selected to be scheduled and transmit their packets in the network.

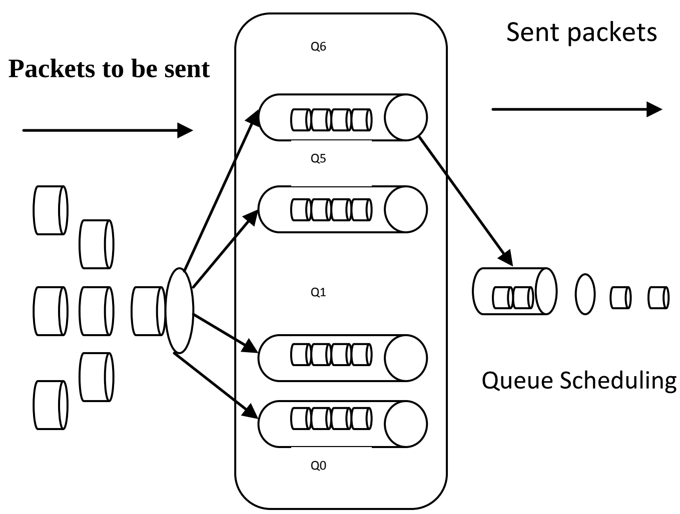

Figure-4 General process of scheduling

4.3.1 Adaptive Virtual Rate Based Scheduling Algorithm

For each time slot t the distribution process is calculated with each link l. The each link randomly picks a back-off mini slot with distribution function. In the scheduling slot, when the back-off timer for a link expires, it begins the transmission. When a link begins transmission, it will randomly choose a passing flow to serve with probability distribution. This scheduling algorithm only uses virtual rates to compute the distribution function that is different from basic queue-length based algorithm. The performance analysis will be based on this scheduling algorithm. This algorithm will be improved by letting each link attempt only if it starts transmission and if it has packets to transmit. The link transmission attempts randomly to serve a flow with positive backlog with probability.

5. PERFORMANCE ANALYSIS

Generally, evaluating the performance is entirely based on the Scheduling algorithm. The improvement of the algorithm is allowing each link if it has to involve packet transmission. The average delay of the algorithm deals with increases linearly with the hop count. The output of the simulation variables has been considered in the simulator is Packet delivery ratio, packet dropped rate and end- to- end delay.

Algorithm	**Through-put**	**Delay**	**Average Arrival Rate**	**Source rate**
Back-pressure algorithm	Efficient	Less Efficient	Maximum	Less efficient
Virtual rate based and Max-weight scheduling algorithm	**More efficient**	**Efficient**	**Minimum**	**Good**

Table- 1 Comparison of algorithm design approaches

The integrated components sharply works together to provide better performance in terms of trade off between optimal throughput and delay. The bandwidth utilization of multicast transmissions in wireless networks is achieved in scheduling process. The performance evaluation shows that the adaptive approach is highly stable and feasible for multicast data transmission.

6. CONCLUSION AND FUTURE WORK

In this paper, a dynamic joint scheduling and congestion control is proposed for wireless network. The proposed system produces the congestion free outputs, throughput and end-to-end delay. The main ideas of the proposed algorithm are to control the congestion with window based flow control and to use both virtual adaptive rates based information and window size to perform scheduling. The scheduling algorithm requires a constant time to compute a schedule. The congestion control and scheduling algorithm be able to increase the capacity region and that increases linearly with the number of hops. In the future work, the study will be about how to extend this novel technique to reduce the power consumption during dynamic routing.

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