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Back-Pressure-Based Packet-by-Packet Adaptive Routing in Communication Networks

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Abstract: Back-pressure-based adaptive routing algorithms where each packet is routed along a possibly different path have been extensively studied in the literature. However, such algorithms typically result in poor delay performance and involve high complexity implementation. In this paper, we develop a new adaptive routing algorithm built upon the widely studied back-pressure algorithm. We decouple the routing and scheduling components of the algorithm by designing a probabilistic routing table that is used to route packets to per-destination queues. The scheduling decisions in the case of wireless networks are made using counters called shadow queues. The results are also extended to the case of networks that employ simple forms of network coding. In that case, our algorithm provides a low-complexity solution to optimally exploit the routing–coding tradeoff.

Keywords: Back-Pressure-Based Adaptive Routing Algorithms, Shadow Queue Algorithm Adaptive Routing Algorithms, Wireline Networks.

I. INTRODUCTION

In the traditional back-pressure algorithm, each node n has to maintain a queue and for each destination d denote the number of nodes and the number of destinations in the network, respectively. Each node maintains queues. Generally, each pair of nodes can communicate along a path connecting them. Thus, the number of queues maintained at each node can be as high as one less than the number of nodes in the network, In proposed system, the main purpose of this paper is to study the case of scheduling and routing the shadow queue extends, which brings new invention that the number of hops is minimized. In the antagonism the objectives of the invention is same, the solution involves per hop queue as compared to backpressure algorithm. In this paper, we have used different types of solution. Small number of real queues used as per neighbor, but the number of shadow queues is same as back pressure algorithm. The shadow queue size always upper bounds the real queue size, it follows that the real queue is also assured to be stable. The advantage of this approach is that buildup of the shadow queues can take place to provide a routing "gradient" for the backpressure algorithm without corresponding build up (and so packet delay) of the real queues, but at the cost of compact network capacity.

So we brought a new idea which allows the reduction in the number of real queues by routing via probabilistic splitting. One more important observation in this paper to reduce delays in routing case because of partial decoupling of shadow back-pressure and real packet transmit allows us to activate more links as compare to regular back-pressure algorithm. By the modification of our routing algorithm automatically it balances with good performance. This is very good advantage for our proposed system instead of keeping a queue for every destination, each node n maintains a queue n_j for every neighbor j; which is called a real queue. Notice that real queues are per-neighbor queues. Let J_n denote the number of neighbors of node n; and let J_{max} = max n J_n: The number of queues at each node is no greater than J_{max}: Generally, J_{max} is much smaller than |ϕ |: Thus, the number of queues at each node is much smaller compared with the case using the traditional back-pressure algorithm. In additional to real queues, each node n also maintains a counter, which is called shadow queue, and for each destination d: Unlike the real queues, counters are much easier to maintain even if the number of counters at each node grows linearly with the size of the network. A backpressure algorithm run on the shadow queues is used to decide which links to activate. The statistics of the link activation are further used to route packets to the per-next-hop neighbor queues mentioned earlier.

II. EXISTING SYSTEM

The back-pressure algorithm introduced has been widely studied in the literature. While the ideas behind scheduling using the weights suggested in that paper have been successful in practice in base stations and routers, the adaptive routing algorithm is rarely used. The main reason for this is that the routing algorithm can lead to poor delay performance due to routing loops. Additionally, the implementation of the back-pressure algorithm requires each node to maintain per-destination queues that can be burdensome for a wire line or wireless router.

Disadvantages of Existing System: In existing algorithms typically result in poor delay performance and involve high implementation complexity.

III. PROPOSED SYSTEM

The main purpose of this paper is to study if the shadow queue approach extends to the case of scheduling and routing. The first contribution is to come up with a formulation where the number of hops is minimized. It is interesting to contrast this contribution. The formulation has the same objective as ours, but their solution involves per-hop queues, which dramatically increases the number of queues, even compared to the back-pressure algorithm. Our solution is significantly different: We use the same number of shadow queues as the back-pressure algorithm, but the number of real queues is very small (per neighbor). The new idea here is to perform routing via probabilistic splitting, which allows the dramatic reduction in the number of real queues. Finally, an important observation in this paper, not found is that the partial ”decoupling” of shadow back-pressure and real packet transmission allows us to activate more links than a regular back-pressure algorithm would. This idea appears to be essential to reduce delays in the routing case, as shown in the simulations.

Advantages of Proposed System: Our adaptive routing algorithm can be modified to automatically realize this tradeoff with good delay performance. The routing algorithm is designed to minimize the average number of hops used by packets in the network. This idea, along with the scheduling/routing decoupling, leads to delay reduction compared with the traditional back-pressure algorithm.

IV. ALAGORITHMS

A. Shadow Queue Algorithm

Traditional Back Pressure Algorithm is same as the Shadow algorithm but, the shadow algorithm works on the bases of shadow queuing. Here every node upholds a fictitious queue called shadow queue. These shadow queues are work as counter for every flow. By the movement of fictitious entities called shadow packets the shadow queues are updated. These packets are used for the purpose of scheduling and routing as an exchange of control messages. The shadow queue as counter it is incremented by 1 when packets are arrival, and decremented by 1 when these packets are departure. The packet arrival rate is slightly larger than the real external arrival rate of packets. . Just like real packets, shadow packets arrive from outside the network and eventually exit the network. The evolution of the shadow queue.

B. Adaptive Routing Algorithms

Now we discuss about packets how it routes once when it arrives at a node. Number of shadow packets, which are transferred from node say n to node j for destination d during time slot t by the show queue algorithm. When shadow queuing process is in a stationary command.

V. TECHNICAL OVERVIEW

We have studied in the literature about back pressure algorithm which is introduced in. While the ideas behind scheduling using the weights suggested in that paper have been successful in practice in base stations and routers, the adaptive routing algorithm is rarely used. The previous work carried out in has accepted the significance of under taking shortest path routing to improve performance of delay and the algorithm of back pressure has modified to bias it towards taking shortest hop routs. A part of our algorithm has related inspiring idea. In the network the throughput optimal routing minimizes the number of hops, which are taken by packets. We use probabilistic routing tables also called as shadow queue used for scheduling in the network. In conference paper the idea of min hop routing was studied first. In and the shadow queues were introduced, but in this paper the main step of incomplete decoupling the routing and scheduling, where indicate to both substantial delay reduction and the use of per-next-hop queuing is original here.

To solve a fixed routing problem the, the authors introduced shadow queues. We studied the min hop routing idea, so we require more queues than the original back pressure algorithm. In this paper we compare with we study the shadow queues methodology covers the case of scheduling and routing. We consider some network where the packets are XORs and broadcast them to decrease the transmission between two nodes by using simple form of network coding in here the comparison made between long routs and short routes. Long routes are used for network coding prospects (see the notion of reverse carpooling in) and to reduce uses of resources we use short routes. To realize our adaptive routing algorithm can be modified to automatically with good delay performance. In addition, network coding requires each node to maintain more queues, and our routing solution at least reduces the number of queues to be maintained for routing Since the adaptive routing having very bad delay performance by using back-pressure algorithm so because of this, in this paper we have presented on the concept of shadow queue introduced in here we are using the probabilistic splitting algorithm for packets to routes on shortest hops and decouples and scheduling whenever possible. Probabilistic routing table, that varies

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gradually by means of upholding. So the real packets do not have to travel long paths to improve through put. To reduce delays our algorithm also permits extra link activation and also helps in reduce the queuing complexity at each node and can be extended to optimally tradeoff between routing and network coding.

VI. IMPLEMENTATION

A. Exponential Averaging

In this module, using the concept of Vqueues, we partially decouple f shadow routing and scheduling. A shadow network is used to up-date a probabilistic routing table that packets use upon arrival at a node. The same shadow network, with back-pres-sure algorithm, is used to activate transmissions between nodes. However, first, actual transmissions send packets from first-in–first-out (FIFO) per-link queues, and second, potentially more links are activated, in addition to those activated by the shadow algorithm.

B. Extra Link Activation

Links with backpressure can be activated greater than or equal to parameter only under the shadow back pressure algorithm. This can adequate to condense the real queues. But the delay recital can still be deplorable. Use of unnecessarily long path can be disappointed. So to avoid this we introduce the parameter. The shadow back pressure at a link may be habitually less than this parameter, when light and moderate traffic loads. Because of this the packets are processed after waiting a long time at this links. To cure these circumstances we can establish additional links. With the extra activation, a certain degree of decoupling between routing and scheduling is achieved.

C. Extension to the Network Coding Case

In this fragment, we spread out tactic to reflect networks, where network coding is used to progress throughput. We use network coding which reduces the transmission between two nodes. Suppose if a node i wants to send some packets to node j, for this as per traditional back pressure it has transmit I to n and n to j again j to n and n to i. so it requires more transmission . To avoid such kind of transmission we use intermediate relay say n. Here the two of the packets are gets XORed and simultaneously it broadcast two of them to I and j. From this we can reduces the number of transmission. We need to design to build an algorithm to find right adjustment by via possible long routes to arrange for network coding prospects and delay incurred by using long routes as shown in Fig.1.

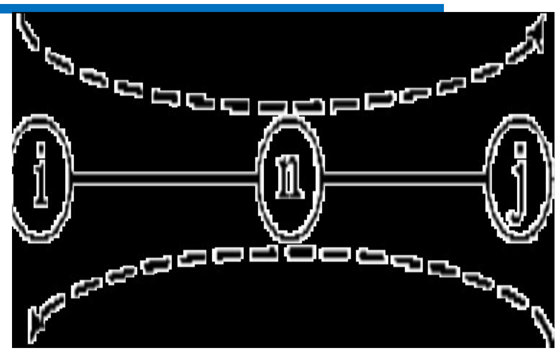

Fig.1. Network coding opportunity.

VII. SIMULATION

Wire line and wireless are the two networks. We consider these two networks in our simulation. Her we see the topology of these two and also simulation parameter which is used in our simulation.

A. Wireline Setting

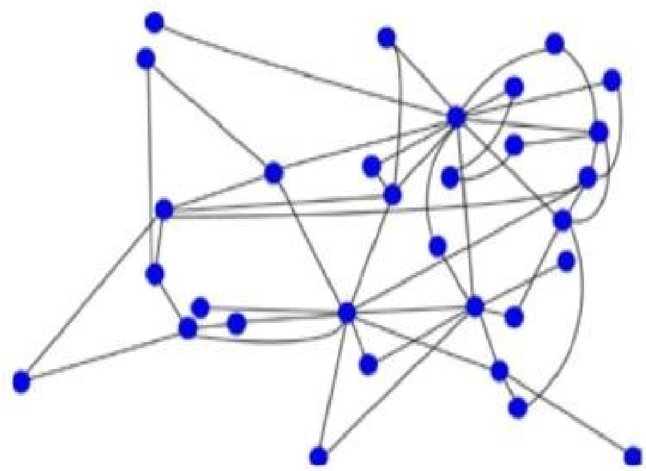

Fig.2. GMPLS Network Topology with 31 Nodes.

The fig.2 shows 31 nodes with GMPLS topology. Here every link assume to be transmit 1 packet to each slot we assume that the arrival process is a Poisson process with parameter; and we consider the arrivals come within a slot are considered for service at the beginning of the next slot. Once a packet arrives from an external flow at a node n, the destination is decided by probability mass.

B. Wireless Setting

We used the following procedure to generate the random network: 30 nodes are placed uniformly at random in a unit square; then starting with a zero transmission range, the transmission range was increased till the network was connected. We assume that each link can transmit one packet per time-slot. We assume a 2-hop interference model in our simulations. By a -hop interference. Model, we mean a

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wireless network where link activation silences all other links that are hops from the activated link. The packet arrival processes are generated using the same method as in the wireline case. We simulate two cases given the network topology: the no coding case and the network coding case. In both wireline and wireless simulations, we chose to be, and we use probabilistic splitting algorithm for simulations.

VIII. EXPERIMENTAL RESULTS

Wireline Networks: First, we compare the performance of three algorithms: the traditional back-pressure algorithm, the basic shadow queue routing/scheduling algorithm without the extra link activation enhancement and PARN. Without extra link activation, to ensure that the real arrival rate at each link is less than the link capacity provided by the shadow algorithm. We also compare the delay performance of PARN with that of the shortest path routing in Fig.4 For each pair of source and destination, we find a shortest path between them by using Dijkstra's Algorithm. However, a wireline network does not capture the scheduling aspects inherent to wireless networks, which is studied next. , we need we study wireless networks without network coding. Here the delay performance is relatively insensitive to the choice of as long as it is sufficiently greater than zero. However, does play an important role because it suppresses the search of long paths when the traffic load is not high.

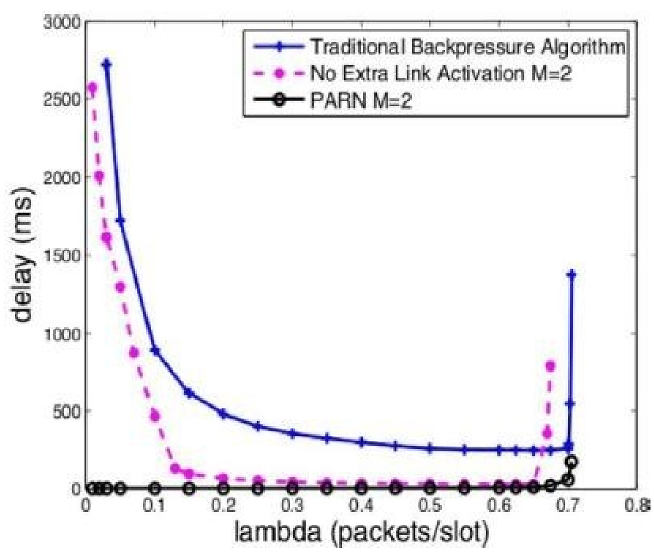

Fig.3.

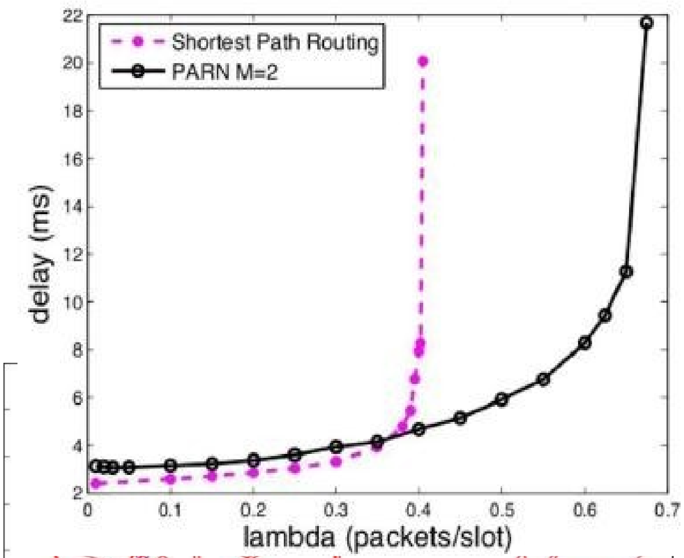

Fig.4

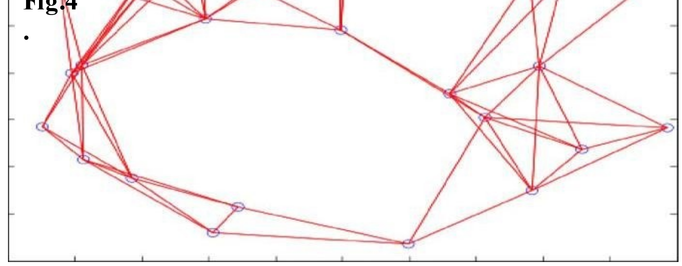

Fig.5. Wireless network topology with 30 nodes.

X. SREEN SHOTS

Fig 6

IX. SIMULATIONS

We consider two types of networks in our simulations: wireline and wireless. Next, we describe the topologies and simulation parameters used in our simulations, and then present our simulation results.

A. Simulation Settings

Wireline Setting: The network shown in Fig. 5 has 31 nodes and represents the GMPLS network topology of North America]. Each link is assume to be able to transmit one packet in each slot. We assume that the arrival process is a Poisson process with parameter, and we consider the arrivals that come within a slot are considered for service at the beginning of the next slot. Once a packet arrives from an external flow at a node, the destination is decided by.

The back-pressure algorithm, while being throughput-optimal, is not useful in practice for adaptive routing since the delay performance can be really bad. In this paper, we have presented an algorithm that routes packets on shortest hops when possible and decouples routing and scheduling using a probabilistic splitting algorithm built on the concept of shadow queues introduced. By maintaining a probabilistic routing table that changes slowly over time, real packets do not have to explore long paths to improve throughput; this functionality is performed by the shadow "packets." Our algorithm also allows extra link activation to reduce delays. The algorithm has also been shown to reduce the queuing complexity at each node and can be extended to optimally tradeoff between routing and network coding.

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