IJSEAT International Journal of Science Engineering and Advance Technology

# A Routing Algorithm To Reduce The Queueing Complexity In Communication Networks

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**Abstract:**
A new adaptive routing algorithm built ahead 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. The routing algorithm is considered to decrease the average number of hops used by packets in the network. This idea along with the scheduling/routing decoupling leads to setback decrease compared with the traditional back-pressure algorithm. The algorithm can be applied to wire line and wireless networks. Wide simulations show spectacular improvement in delay performance compared to the back-pressure algorithm. When network coding is employed per-previous-hop queues may also be essential but this is a requirement compulsory by network coding not by our algorithm.

**Keywords:** Back-pressure algorithm, network coding, routing, scheduling.

## Introduction:

The back-pressure algorithm was first described in the circumstance of wireless networks and independently discovered later as a low-complexity solution to definite multi commodity flow problems. This algorithm unites the scheduling and routing functions together. While many variations of this basic algorithm have been studied they mainly focus on capitalize on throughput and do not consider QoS performance. Our algorithm uses some of these ideas as building blocks and therefore we first explain the basic algorithm, its drawbacks and some prior solutions. The algorithm maintains a queue for each purpose at each node. Since the number of destinations can be as large as the number of nodes this per-destination queuing necessity can be relatively large for practical implementation in a network. At each link the algorithm assigns a weight to each possible destination that is called back-pressure. Back-pressure-based adaptive routing algorithms where each packet is routed along a probably different path have been widely studied in the literature. However such algorithms normally result in poor delay performance and engage high functioning difficulty.

## Related Work:

Prior work has acknowledged the importance of doing shortest-path routing to get better delay performance and modified the back-pressure algorithm to prejudice it toward taking shortest-hop routes. A part of our algorithm has alike motivating ideas. In addition to provably throughput-optimal routing that reduces the number of hops taken by packets in the network we decouple routing and scheduling in the network through the use of probabilistic routing tables and the so-called shadow queues. The min-hop routing and shadow queues were introduced but the key step of partly decoupling the routing and scheduling which guides to both major delay reduction and the use of per-next-hop queuing is unique here. The min-hop routing idea is also studied but their solution requires even more row than the original back-pressure algorithm. Compared to the main purpose of this paper is to study if the shadow queue approach extends to the case of scheduling and routing. The first involvement is to come up with a formulation where the number of hops is diminished.

## Existing Method:

The back-pressure algorithm introduced has been widely studied in the literature. The adaptive routing algorithm is rarely used. The most important cause for the routing algorithm which can lead to poor delay performance due to routing loops. Additionally the performance of the back-pressure algorithm necessitates each node to maintain per-destination queues that can be burdensome for a wire line or wireless router.

**Disadvantages:**

In an existing algorithms typically result in poor delay performance and involve high implementation complexity.

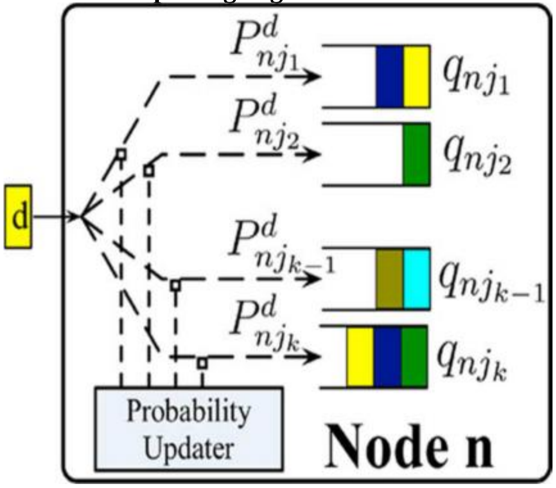
**Proposed Method:**

The main purpose 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. The new idea here is to perform routing via probabilistic splitting which permits the dramatic reduction in the number of real queues. Finally an important observation 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.

**Advantages:**

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.

**Probabilistic Splitting Algorithm At Node:**



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Based on the purpose of a packet, a packet is routed to its next hop based on routing table entries. Instead here these are used to probabilistically decide the next hop for a packet. Packets waiting at link are conveyed over the link when that link is scheduled The first question that one must ask about the above algorithm is whether it is steady if the packet arrival rates from flows are within the competence region of the multi hop network. Since the shadow queues are positive recurrent “good” estimates can be maintained by simple averaging and therefore the probabilities will stay close to their “ideal” values.

**Min-Resource Routing:**

The back-pressure algorithm looks at all paths in the network and as a result may decide paths that are gratuitously long which may even contain loops thus foremost to poor performance. We address this trouble by introducing a cost function that measures the total amount of resources used by all flows in the network. Particularly we add up traffic loads on all links in the network and use this as our cost function. The objective then is to reduce this cost subject to network capacity constraints.

**Packet-By-Packet Adaptive Routing:**

In further to real queues each node also preserves a counter which is called shadow queue for each destination. Unlike the real queues counters are much easier to preserve even if the number of counters at each node grows linearly with the size of the network. A back-pressure algorithm run on the shadow queues is used to choose which links to make active. The statistics of the link activation are further used to route packets to the per-next-hop neighbour queues mentioned earlier.

**Shadow Queue Algorithm:**

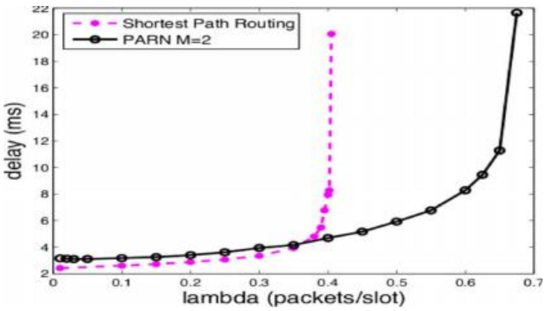
The shadow queues are efficient based on the movement of pretended entities called shadow packets in the network. The movement of the fictitious packets can be thought of as a swap over of control messages for the reason of routing and schedule. Just like real packets shadow packets turn up from outside the network and finally exit the network. The exterior shadow packet arrivals are general when an exogenous packet arrives at node to the destination the shadow queue is incremented by and is advance incremented by 1 with probability in addition. Thus if the arrival rate of a flow then the flow generates “shadow traffic.

**Token Bucket Algorithm:**

Calculating the standard shadow rate and producing random numbers for routing packets may compel a computational overhead of routers which should be evaded if possible. Thus as a substitute we recommend the simple algorithm. At each node, for each next-hop neighbour and each destination, maintain a token bucket. Consider the shadow traffic as a guidance of the real traffic with tokens removed as shadow packets negotiate the link. In detail the token bucket is decremented by in each time-slot but cannot go below the lower bound 0.

**Experimental Results:**

For every pair of source and destination we locate a shortest path by using Dijkstra’s algorithm. This entails that PARN can get hold of similar delay presentation as the shortest-path routing at light traffic. Though the shortest-path routing can only accomplish about 60% of the capacity region of the network. The wire line reproduction shows the usefulness of the PARN algorithm for adaptive routing. However a wire line network does not capture the scheduling aspects inherent to wireless networks.



## Enhancement:

Under the shadow back-pressure algorithm, only links with back-pressure greater than or equal to can be activated. The stability theory ensures that this is sufficient to render the real queues. On the other hand, the delay performance can still be unacceptable. Recall that the parameter was introduced to discourage the use of unnecessarily long paths. However, under light and moderate traffic loads, the shadow back-pressure at a link may be frequently less than, and thus, packets at such links may have to wait a long time before they are processed. One way to remedy the situation is to activate additional links beyond those activated by the shadow back-pressure algorithm. We add additional links to the schedule based on the queue lengths at each link. For extra link activation purposes, we only consider point-to-point links and not broadcast. Thus, we schedule additional point-to-point links by giving priority to those links with larger queue backlogs.

## Conclusion:

We presented an algorithm that direct packets on shortest hops when probable and decouples routing and preparation using a probabilistic splitting algorithm built on the thought of shadow queues introduced. By preserving a probabilistic routing table that changes gradually over time, real packets do not have to survey long paths to get better throughput. This functionality is executed by the shadow “packets.” Our algorithm also allows extra link commencement to decrease delays. The scheduling decisions in the case of wireless networks are made using counters called shadow queues. The results are also comprehensive to the case of networks that utilize simple forms of network coding. In that case our algorithm provides a low-complexity clarification to optimally exploit the routing coding trade off.

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