RPA: Scattered Throughput Maximization in Wireless Network

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Abstract— Random Power Allocation in wireless data networks assure significant for maximum throughput for power allocation, however, this problem is recognized to be difficult to tackle in carries out. We examine this trouble for maximum throughput for random power allocation in wireless network and with the goal of maximizing the overall network capacity. We propose a random power allocation and scheduling algorithm which provides significant capacity more gain for any finite number of users. This Random Power Allocation scheme, in effective, achieves a form of random spectral reuse, whereby the amount of reuse varies as a function of the essential wireless node. Then the performances are improving the wireless power allocation randomly

Key words: Random power allocation, wireless networks, stochastic control

I. Introduction

Classification level of performance of upcoming wireless networks like maximum throughput for power allocation. Fortunately, some form of coordination between the different cells occupy the same spectral resource can offer significant development. Random power allocation requires complete information about the network in order to decide which users in which cells should transmit concurrently with a given power allocation, while incur the least loss of capability due to inter cell interference.

Some interesting results exist exploit inter-node management with goals such as maximize system throughput [1]–[4], achieve a target carrier-to-interference ratio [5] or maintaining user queue stabilities [6]. All of these consequences however, rely on some form of central control to obtain gains at various layers of the communication stack. In a realistic network however, centralized multi nodes organization is hard to recognize in practice, especially in fast-fading environment.

In this article we address the trouble of random power distribution coordination to maximize the system capacity. This means that node know channel state information of their own users but have no information on node conditions of other users. The key idea here is to switch off transmission in node which does not throw in enough capacity to outweigh the nosiness dilapidation caused by them to the rest of the network. We propose a random power allocation scheme which allows a subset of the total number of cells to broadcast at once during a given setting up period.

A. Purpose and Scope:

The role of this expose is to give an overview of maximum throughput for random power allocation in wireless sensor network. The article discusses the power allocation, network scheduling, and safeguard for wireless network environments, and provides the coming required to make well throughput for power allocation in wireless sensor networks.

II. Related works

A. Optimal Backpressure Routing:

We consider a multi-node, multi-hop wireless network with “unreliable” channels. Each transmission link has an associated error probability that may vary with time due to external factors such as environment changes or user mobility. Many previous studies assume that accurate channel information is available so that error probabilities are relatively small and can be neglected. However, in this work we consider the opposite case where precise channel information is difficult or impossible to obtain, but where simple estimates of channel quality can be made based on limited channel feedback. A motivating example is an underwater sensor network that uses acoustic channels with large propagation delays.

This is a particularly challenging environment due to time varying wave ripple, complex signal reflections between surface and ground, and large delay spreads [1] [2]. While it may not be practical to assume that an accurate channel quality can be determined at the time of packet transmission, it is reasonable to estimate the error probability based on past signal strength values and/or ACK/NACK history from previous transmissions.

The problem of unreliable channels is also important in other contexts, such as mobile networks where knowledge of which receivers are within transmission range may be uncertain, or in dense ad-hoc networks where unpredictable transmissions of other nodes can act as random inter-channel interference. It is imperative to develop flexible mathematical models of such networks, and to develop robust networking strategies that exploit all system resources to operate efficiently in these extreme environments.

In this paper, we design robust algorithms by exploiting the broadcast advantage of wireless networks. Specifically, our network model includes the fact that a single packet transmission might be overheard by a subset of receiver nodes within range of the transmitter. This creates a multi-receiver diversity gain, where the probability of successful reception by at least one node within a subset of receivers can be much larger than the corresponding success probability of just one receiver alone. Hence, it is desirable to design flexible routing algorithms that do not require a single “next hop” receiver to be specified in advance. Such algorithms can dynamically adjust routing and scheduling decisions in response to the random outcome of each transmission.

The wireless broadcast advantage has been used in various contexts, for example, in [3] for the design of wireless multicast algorithms, and in [4] for the designs of minimum energy disjoint paths. Our model and problem formulation is closest to the work by Zorzi and Rao in [5], and more recently by Biswas and Morris in [6], where efficient methods of using multi-receiver diversity for packet forwarding are explored. We note that such formulations inevitably involve situations where the same packet is redundantly distributed over different network nodes. A fundamental decision is whether to allow the different versions of the packet to simultaneously propagate throughout the network, or to designate only a sing le copy that is allowed to proceed. While this scheme has many desirable properties, especially for large adhoc networks, it is clear that for a given network of fixed size, the "closest-to-destination" heuristic neither maximizes throughput nor minimizes average power expenditure. Further, this scheme can lead to an undesirable deadlock mode if data is consistently forwarded to a particular node for which there are no other next-hop receivers that are closer to the destination. Thus, it is often better to route packets along paths that temporarily take them further from the destination, especially if these paths eventually lead to links that are more reliable and/or that are not as heavily utilized by other traffic streams. The work in [6] considers a routing heuristic based on an estimated delivery cost, computed by an estimate of the expected number of hops required to reach the destination along a traditional shortest path. However, this method is not necessarily optimal in terms of energy or throughput.

There are several difficulties associated with developing a throughput optimal algorithm in this context. First, individual nodes might only know the error probabilities on their own outgoing links, and may not know the error rates or traffic loads on other portions of the network. Second, even if centralized network knowledge were fully available, an optimal algorithm would need to specify a contingency plan for each possible random transmission outcome. For example, suppose a given node transmits a packet for which there are k potential receivers. There are 2 k possible outcomes of this single transmission (one for each possible subset of successful receivers). An optimal algorithm would require a decision for each possible outcome, perhaps also allowing for redundant packet forwarding. Hence, the design of an optimal algorithm must overcome these geometric complexity issues. This is further complicated if there are multiple simultaneous packet transmissions and multiple traffic streams sharing the same network, and if the network topology and link error probabilities are changing with time. In this paper, we overcome these challenges with a simple solution that uses the concept of backpressure routing and Lyapunov drift. We first show that it is possible to restrict attention to algorithms that do not allow redundant forwarding, without loss of optimality. We then show that the optimal packet commodity to transmit at each network node can be determined by a backpressure index that compares the current queue backlog of each commodity to the backlog in the potential receivers. Once a packet from this optimal

Commodity is transmitted; the responsibility of forwarding the packet to its destination is shifted to the receiver node that maximizes the differential backlog. Responsibility is retained by the original transmitter if no suitable receivers are found on a given transmission attempt.

Backpressure techniques of this type were first applied to multi-hop wireless networks by Tassiulas and Ephremides in [7], where throughput optimal algorithms were developed using Lyapunov drift theory. Lyapunov theory has since been a powerful mathematical tool for the development of stable scheduling strategies for wireless networks and switching systems [7]-[18], including our own work in [15]-[18] that applies backpressure concepts to solve problems of optimal power allocation, routing, and fair flow control in wireless networks with mobility. Related work on energy efficient wireless scheduling is developed in [19]-[22]. The work in [7]-[22] does not consider the broadcast advantage of wireless networks, and assumes that all transmissions are fully reliable.

Scheduling for wireless MIMO downlinks with multiple transmit and receive antennas is considered in [23], and related MIMO results are developed for channels with errorsin [24] [25]. Recent work in [26] considers backpressure techniques in combination with network coding, and work in [27] considers backpressure strategies for cooperative transmission where multiple nodes can transmit redundant information simultaneously for a power enhancement at the receiver. Complexity issues of cooperative communication under the wireless broadcast advantage are discussed in [28]. We do not consider network coding or cooperative transmission in this paper, and restrict attention to the multi-user diversity problem for networks with errors, as described above. It is likely that our formulation can be extended to consider more sophisticated control actions by augmenting the set of decision options available to the network controller, in which case redundant packet forwarding may be required for optimality.

B. Throughput Optimal Distributed Power Control of Stochastic Wireless Networks:

The optimal control of multihop wireless networks is a major research and design challenge due, in part, to the interference between nodes, the time-varying nature of the communication channels, the energy limitation of mobile nodes, and the lack of centralized coordination. This problem is further complicated by the fact that data traffic in wireless networks often arrive at random instants into network buffers.

Although a complete solution to the optimal control problem is still elusive, a major advance is made in the seminal work of Tassiulas and Ephremides [1]. In this work, the authors consider a stochastic multihop wireless network with random traffic arrivals and queueing, where the activation of links satisfies specified constraints reflecting, for instance, channel interference. For this network, the authors characterize the stability region, i.e., the set of all end-to-end demands that the network can support.

Moreover, they obtain a throughput optimal routing and link activation policy which stabilizes the network whenever the arrival rates are in the interior of the stability region, without a *priori* knowledge of arrival statistics. The throughput optimal policy operates on the Maximum differential backlog (MDB) principle, which essentially seeks to achieve load-balancing in the network. The MDB policy (sometimes called the "backpressure algorithm") has been extended to multihop networks with general capacity constraints in [2] and has been combined with congestion control mechanisms in [3], [4].

III. RANDOM POWER ALLOCATION SCHEME

The randomization move toward within reach of was initial developed for scheduling in input queued switches, and extended for distributed operations in multi-hop wireless networks. Recall that under these setting; a possible schedule is to be found in each time slot. The key feature of the randomization approach is that it does not seek to find an optimal schedule in every slot, and hence, it can significantly reduce the computation overhead.

Although the MDB policy represent a outstanding attainment, there remains a significant difficulty in applying the policy to wireless networks. The mutual interference between wireless links implies that the evaluation of the policy involves a centralized network optimization.

When There are finitely many feasible schedules, the centralized optimization can be approximated by a randomized algorithm with linear complexity while preserving throughput optimality.

In wireless networks with limited transmission range and scarce Battery resources, however, any centralized algorithm is undesirable. The call for more distributed scheduling algorithms with guaranteed throughput has given rise to two main lines of research.

A. Advantage:

– Minimize power allocation time.
– More effective for randomized power allocation.
– Reduce the communication costs.
– The data transmission does not need to wait
– Until the update of power allocation is finished.

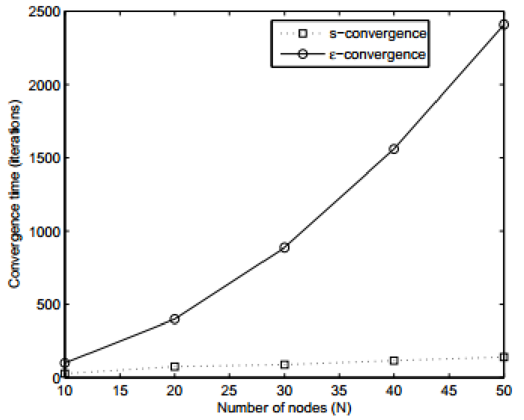
B. Algorithm for random power allocation:

1) Each node a decides to be a transmitter w.p. 1/2and a receiver w.p. 1/2, and initializes Iab =0, ∀b ∈ V (a).
2) Each transmitting node a sends a pair-request message (PQM) to one of its neighbors in V (a) uniformly at random.
3) If node b receives a PQM, one of the following happens: If node b is a receiver, then it accepts the request and sends a pair-request-accepted message (PAM) to node a. Otherwise, ignore the PQM and nothing happens for node a.
4) If node a receives a PAM from node b, set Iab = 1, Meaning that node b is a receiver of node a.

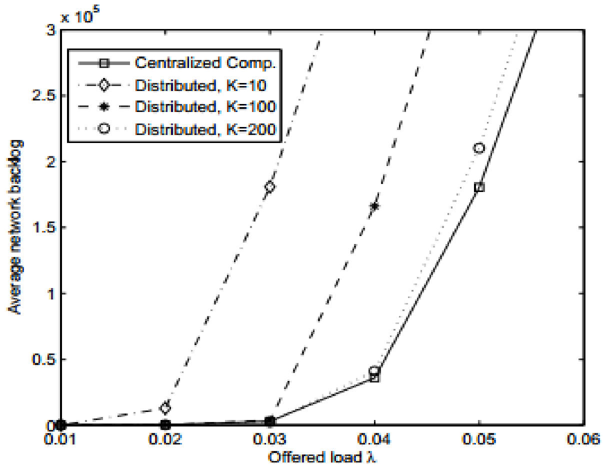
IV. Evaluation

We generate a network topology by randomly placing N nodes in a plane. For each link (a, b), packets arrive according to a Poisson arrival process of rate 0.5, with the mean packet size of 2λ. The offered load is thus λ, and this parameter will be changed to examine the algorithm performance. Let dab be the distance between nodes a and b.

The channel gain gab is fixed to 1/ (1 + d4 ab) if a ≠ b, and as assumed in Section 2, gab = ∞ if a = b. The noise power and the maximum transmit power are fixed as na = 0.01 and P max a = 1 for every node a compare the previous and proposed system analysis the graph.



(a) Convergence time: ϵ =0.002



(b) Network backlog vs. offered load (N = 17)

Fig. 1: Convergence time and stability performance

V. Conclusions

We accessible in this work a Random Power Allocation scheme for power allocation and scheduling for capacity maximization in full reuse multi node wireless networks. The key idea is to combine multi-user diversity gain with random spectral reuse more gain through inter-cell coordination to maximize the overall system capacity. Relying on local cell information, cells which do not offer sufficient capacity to outweigh interfering caused to the network are deactivated. The approach can be applied to random power allocation in wireless networks as well, where an added frequency variety gain can be exploited by scheduling users. comparison with usual fixed use again schemes in a realistic network demonstrated significant capacity gains for maximum through put.

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