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# Performance Analysis of Network Resources in Standard Access Protocols

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**Abstract-Wireless Protocols resources and devices are constantly battery-powered, and hence expand the association lifetime and it is the primary concerns in the ubiquitous deployment of wireless networks. One approach is to efficiently utilize the limited energy supplies of the antenna is to have the access periodically putting resources to sleep and waking them up to utilize the resources which is energy intensive. For protocol designers, it is significant to understand which type of protocol should be chosen, as well as what values should be allocate to the protocol constraint under a given network scenario in order to achieve an attractive presentation for resources like throughput, wait, packet transmission, power utilization. Providing flexibility to tradeoff different performance metrics by optimizing the protocol resources.**

***Index Terms—Wireless networks, resources, throughput, wait, packet transmission, power.***

## 1 Introduction

WIRELESS protocols and networks have attracted much interest in both academia and industry due to their low cost, ease of deployment, and, most importantly, hold for a variety of applications ranging from military supervision and urgent situation set free to medical monitoring. However, power constraints imposed by the battery-powered nodes are a limiting factor, preventing the ubiquitous use of wireless networks. As a result, much research in wireless networks has focused on how to save power and prolong the network lifetime In particular, the protocol can put the resources to sleep periodically to reduce idle pay attention which is energy intensive in wireless networks. Some of them synchronize all the nodes in the network, so that the nodes sleep and wake up at the same time. Since the receiver is ready to receive when a sender wakes up and has a packet to send, harmonization improves the message efficiency. However, harmonization requires slide at each node to exchange sleep-wake-up schedules with the nodes' neighbors. This overhead can be significant when the data traffic is light in the network the harmonization overhead is removed, but a sender with packets to send may have to wait the transmission until the receiver wakes up and the protocol includes not only power consumption but also throughput and wait. Hence, it is highly desirable for analyze the framework that can used in the network oriented protocols. To handle different protocols, our approach decouples the performance analysis problem into two parts. Specifically, we propose a queuing model for nodes with a finite queue capacity. Based on the model, a node to have an empty queue can be obtained as a function of the probability p for each node to transmit a data packet in a cycle. On the other hand, to handle the protocol-specific media access rules, we model the probability p for each node to transmit a data packet in a cycle as a function of the probability Therefore, solving these functions, the protocol operating on it can be obtained, and the throughput, wait, and power consumption of the network can be determined.

## 2 Related Work

Much work has been done to evaluate the performance of various protocols for wireless networks. Most of the performance evaluations are obtained from simulations. However, simulations are usually time consuming and require a large number of runs to obtain statistically significant results. Some other work implemented protocols on field and obtained their performance using measurements However, constrained by time, space, and available resources, field measurements are oftentimes a case study, from which it is difficult to draw general or quantitative conclusions on the performance of a protocol. Therefore, analytical models are needed to provide insight into the performance of protocols. Analytical models have been proposed to evaluate the performance of a specific protocol. Although these models can estimate the performance of a specific protocol, they are fundamentally different and cannot be generalized as different protocols have different media access rules. Hence, the application of these models is limited. Some other work focused on analyzing a specific performance metric, such as delay, or energy consumption, for a specific protocol or a series of similar protocols. Hence, models cannot be used to determine the tradeoffs in different performance metrics. In fact, the stationary probability of the empty-queue state in return determined the number of contending neighbors of each node in the network. Additionally, their models assume the knowledge of packet transmission rate at each node in a cycle. However, the packet transmission rate at each node is also related to the contention in the network. Hence, the assumption of knowing the number of contending neighbors of each node and the assumption of knowing the packet transmission rate at each node in a cycle are impractical. Unlike these previous approaches, our model can be used to obtain throughput, wait, and power consumption for protocols.

## 3 Protocol-Specific Production Study

Our queuing model holds for any nodes with a fixed cycle length. It provides a relationship, we provide examples of how to obtain the stationary probability of the empty-queue state and the probability p for each node to win the contention can be obtained. Plugging p into stationary distribution of the model can be found. These values enable us to analyze the throughput, wait, and power consumption of the network.

### *3.1 System Model*

We look at the throughput, wait, and power consumption per subsequent nodes according to the following system. A certain number of nodes create a fully connected network. The nodes are harmonized in initial energy, power, and communication capabilities. Every node has a limited queue to buffer the inward DATA packets. DATA packet arrivals at different nodes are independent, and they arrive at the nodes with the same distribution. A node randomly selects one of its neighbors as the destination to transmit DATA packets for a certain time.

### *3.2 Throughput Analysis*

Throughput is defined as the amount of data successfully delivered within a unit time. Since the protocols work in a cycled fashion, the throughput can be calculated within a cycle time. Since the number of nodes in the network N, the MAC layer DATA packet size S, and the length of a cycle T are known, once probability $p_s$ for each node to successfully transmit a DATA packet.

### *3.3 Delay Analysis*

The delay of a DATA packet can be divided into two parts. The first part is the queuing delay DQ, which is defined as the time interval from when a DATA packet joins the queue at the tail to the DATA packet becoming the head of the queue. The second part is the contending delay DC, which is defined as the time interval from when the DATA packet is at the head of the queue to when the DATA packet is transmitted and hence removed from the queue.

There are numerous delivery methods to transmit messages to mobile emissaries: Direct, Group, Blackboard, Mailbox, and Forwarding. In the Direct approach, a mobile emissary interacts with one more mobile emissary unswervingly and synchronously. In the Group approach, a mobile emissary sends messages to a set of mobile emissaries simultaneously. In Blackboard approach a universal information room is used to exchange messages. When a mobile emissary desires to throw a message, it puts the message in the common information room regardless of where the recipient emissary is or when it reads the message. If the receiver emissary moves to the node where the message is stored, it can read the message. In the Mailbox approach, a mobile emissary sends and receives messages through a mailbox or a message correspondent. In the Forwarding approach, when a mobile emissary drifts to a unusual node, it leaves following a trail that conveys information in relation to the next location. A message is delivered by subsequent the trail passageway.

A mobile emissary computing environment consists of subsequent devices: mobile emissary, nodes, Region and a Region Lookup Server (RLS).

- Mobile emissary: A mobile emissary is a mobile entity consisting of procedure, information, status, and mobility metadata. When a mobile emissary drifts, it chooses the subsequent object, based on its itinerary or vigorously according to execution flow. The lane from a antecedent to the target is known as migration path.
- Node: A node provides the execution environment for mobile emissary. A mobile emissary system, a stage that can generate, construe, implement, transmit, and terminate mobile emissary, is installed at a node. A node offers an unambiguous service. The node that originally creates a mobile emissary is called its Home Node (HN).
- Region: A Region is a collection of nodes with the aim of similar ability.
- Region Lookup Server: An RLS is conscientious for the ability of its region. Lookup Server maintains the location information (that is, HNs and RLS) for mobile emissaries produced in all regions. Thus, it can be used to offer a preliminary point for locating an emissary at some point in communication. It additionally maintains a record of, the services delivered at each node.

We are planning to conduct the simulations, using the basic set-up is a fully connected network with N nodes, a contention window size W of 128, a data arrival rate _ at each node of 1.5 packets per second, and a queue capacity Q at each node of 10. For each set of simulations, we vary one of these parameters and investigate the throughput, delay, and average energy consumption per second of protocols.,

In the simulation,

1. The network is fully connected,
2. Every 100 s one of a node's neighbors is randomly selected as the destination of the packets that arrive in the following 100 s,
3. The simulation time is 2,000 s, and
4. All the results (throughput, delay, and energy consumption) are averaged over 50 runs.
5. Each node randomly selects one of its neighbors as the destination for every packet,
6. The cycle length T is 200 ms.

However, the throughput stops increasing and remains constant as the data arrival rate further increases. Before the turning point of the throughput curves, network resources can deliver all the DATA packets as soon as they arrive in the network. Hence, the throughput increases linearly as the number of nodes increases, or the data arrival rates increases, and the throughput of resources remains constant as the contention window size increases. However, after the turning point of the throughput curves, reaches its delivering limit and can no longer deliver all the incoming DATA packets, and thus DATA packets are backlogged in the queue until the queue overflows. As the node density keeps increasing, the contention in the network further increases. Hence, the probability of successfully transmitting a packet decreases, and more packets are finally dropped due to collisions and queue overflow. Consequently, the throughput decreases as the node density increases. Different from increasing the node density in the network, increasing the data arrival rate saturates does not increase the contention in the network since every node always has packets to send in each cycle. Therefore, more arriving packets are dropped due to queue overflow instead of collisions, and hence the throughput does not decrease. However, as the node density increases, 1) the contention in the network increases, hence a packet has a longer contending delay, and 2) packets have a longer queuing delay as the average queue length increases. When there is little traffic in the network that has an extremely low node density or data arrival rate or contention window size, few nodes are contending for the media and all nodes are idle listening to the channel during Tdata in every normal cycle. As the node density or the data arrival rates increase, more nodes have packets to send in a cycle, and hence more nodes hear an unintended RTS and go to sleep before Tdata expires. Meanwhile, as more nodes are contending for the media, the average backoff window of a contention winner decreases, which means nodes tend to hear an RTS earlier and go to sleep for a longer time in each cycle.However, Access protocols with a higher duty cycle always has higher energy consumption per second than protocols with a lower duty cycle

A discrete-time random process involves a system which is in a certain state at each step, with the state changing randomly between steps. The steps are often thought of as moments in time, but they can equally well refer to physical distance or any other discrete measurement; formally, the steps are the integers or natural numbers, and the random process is a mapping of these states. The property states that the conditional probability distribution for the system at the next step (and in fact at all future steps) depends only on the current state of the system, and not additionally on the state of the system at previous steps.

Since the system changes randomly, it is generally impossible to predict with certainty the state of a chain at a given point in the future. However, the statistical properties of the system's future can be predicted. In many applications, it is these statistical properties that are important.

The changes of state of the system are called transitions, and the probabilities associated with various state-changes are called transition probabilities. The set of all states and transition probabilities completely characterizes a chain. By convention, we assume all possible states and transitions have been included in the definition of the processes, so there is always a next state and the process goes on forever.

***Reducibility***

A state j is said to be accessible from a state i (written i → j) if a system started in state i has a non-zero probability of transitioning into state j at some point. Formally, state j is accessible from state i if there exists an integer n ≥ 0 such that

$$\Pr(X_n = j | X_0 = i) = p_{ij}^{(n)} > 0.$$

Allowing n to be zero means that every state is defined to be accessible from itself.

A state i is said to communicate with state j (written i ↔ j) if both i → j and j → i. A set of states C is a communicating class if every pair of states in C communicates with each other, and no state in C communicates with any state not in C. It can be shown that communication in this sense is an equivalence relation and thus that communicating classes are the equivalence classes of this relation. A communicating class is closed if the probability of leaving the class is zero, namely that if i is in C but j is not, then j is not accessible from i.

A state i is said to be essential if for all j such that i → j it is also true that j → i. A state i is inessential if it is not essential. Finally, a Markov chain is said to be irreducible if its state space is a single communicating class; in other words, if it is possible to get to any state from any state.

***Periodicity***

A state i has period k if any return to state i must occur in multiples of k time steps. Formally, the period of a state is defined as

$$k = \gcd\{n : \Pr(X_n = i | X_0 = i) > 0\}$$

(where "gcd" is the greatest common divisor). Note that even though a state has period k, it may not be possible to reach the state in k steps. For example, suppose it is possible to return to the state in {6, 8, 10, 12, ...} time steps; k would be 2, even though 2 does not appear in this list.

## CONCLUSION

Approaches that are efficiently utilize the limited energy supplies of the antenna is to have the access periodically putting resources to sleep and waking them up to utilize the resources which is energy intensive and it is significant to understand which type of protocol should be chosen, in order to achieve an attractive presentation for resources like throughput, wait, packet transmission, power utilization

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