DOWNLOAD PDF MATHEMATIC MODELS FOR QUALITY OF SERVICE PURPOSES IN AD HOC NETWORKS

Chapter 1 : A Trust Framework for Peer-to-Peer Interaction in Ad Hoc Networks

Mathematic Models for Quality of Serice Purposes in Ad Hoc Networks 5 Let P stand for routing path from a source s of data (massage) to a destination d.

For more information, see the articles on the Poisson process. Other point processes[edit] Despite its simplifying nature, the independence property of the Poisson process has been criticized for not realistically representing the configuration of deployed networks. In addition to this, MAC protocols often induce correlations or non-Poisson configurations into the geometry of the simultaneously active transmitter pattern. Strong correlations also arise in the case of cognitive radio networks where secondary transmitters are only allowed to transmit if they far from primary receivers. The dependent thinning is done in way such that for any point in the resulting hard-core process, there are no other points within a certain set radius of it, thus creating a "hard-core" around each point in the process. More specifically, the probability of a point existing near another point in a soft-core point process decreases in some way as it approaches the other point, thus creating a "soft-core" around each point where other points can exist, but are less likely. Although models based on these and other point processes come closer to resembling reality in some situations, for example in the configuration of cellular base stations, [34] [40] they often suffer from a loss of tractability while the Poisson process greatly simplifies the mathematics and techniques, explaining its continued use for developing stochastic geometry models of wireless networks. Models based on specific network architectures[edit] Around the beginning of the 21st century a number of new network technologies have arisen including mobile ad hoc networks and sensor networks. Stochastic geometry and percolation techniques have been used to develop models for these networks. In MANET models, the transmitters form a random point process and each transmitter has its receiver located at some random distance and orientation. The channels form a collection of transmitter-receiver pairs or "bipoles"; the signal of a channel is that transmitted over the associated bipole, whereas the interference is that created by all other transmitters than that of the bipole. The approach of considering the transmitters-receive bipoles led to the development and analysis of one of the Poisson bipolar network model. The choice of the medium access probability, which maximizes the mean number of successful transmissions per unit space, was in particular derived in. Each node is designed to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. In unstructured sensor networks, [45] the deployment of nodes may be done in a random manner. A chief performance criterion of all sensor networks is the ability of the network to gather data, which motivates the need to quantify the coverage or sensing area of the network. It is also important to gauge the connectivity of the network or its capability of relaying the collected data back to the main location. The random nature of unstructured sensors networks has motivated the use of stochastic geometry methods. For example, the tools of continuous percolation theory and coverage processes have been used to study the coverage and connectivity. One of the main limitations of sensor networks is energy consumption where usually each node has a battery and, perhaps, an embedded form of energy harvesting. To reduce energy consumption in sensor networks, various sleep schemes have been suggested that entail having a sub-collection of nodes go into a low energy-consuming sleep mode. These sleep schemes obviously affect the coverage and connectivity of sensor networks. Rudimentary power-saving models have been proposed such as the simple uncoordinated or decentralized "blinking" model where at each time interval each node independently powers down or up with some fixed probability. Using the tools of percolation theory, a new type model referred to as a blinking Boolean-Poisson model, was proposed to analyze the latency and connectivity performance of sensor networks with such sleep schemes. In cellular networks, each cell uses a different set of frequencies from neighboring cells, to mitigate interference and provide higher bandwidth within each cell. The operators of cellular networks need to known certain performance or quality of service QoS metrics in order to dimension the networks, which means adjusting the density of the deployed base stations to meet the demand of user traffic for a required QoS level. In cellular networks, the channel from the users or phones to the base station s is known as the uplink channel. Conversely, the downlink channel is from he base station s to the users. The downlink channel is the most studied with stochastic geometry models while models for the uplink case, which is a more difficult problem, are starting to be developed. In the simplest case, there is one point-to-point channel per receiver i. Another option consists in selecting the transmitter with the best signal power to the receiver. In any case, there may be several channels with the same transmitter. A first approach for analyzing cellular networks is to consider the typical user, who can be assumed to be located anywhere on the plane. Under the assumption of point process ergodicity satisfied when using homogeneous Poisson processes , the results for the typical user correspond to user averages. The coverage probability of the typical user is then interpreted as the proportion of network users who can connect to the cellular network. Building off previous work done on an Aloha model , [44] the coverage probability for the typical user was derived for a Poisson network. In the presence of sufficiently strong and independent log-normal shadow fading or shadowing and a singular power-law attenuation function, it was observed by simulation [50] for hexagonal networks and then later mathematically proved [51] [52] that for general stationary including hexagonal networks that quantities like the SINR and SIR of the typical user behave stochastically as though the underlying network were Poisson. The results were originally derived for log-shadowing, but then extended to a large family of fading and shadowing models [52] For log- normal shadowing, it has also been mathematically shown that the wireless networks can still appear Poisson if there some correlation among the shadowing. This is in particular used to cope with the difficulty of covering with macro-base stations only open outdoor environment, office buildings, homes, and underground areas. Recent Poisson-based models have been developed to derive the coverage probability of such networks in the downlink case. If each tier is a Poisson network, then the combined network is also a Poisson network owing to the superposition characteristic of Poisson processes. This is, however, just a first approach which allows one to characterize only the spectral efficiency or information rate of the network. In other words, this approach captures the best possible service that can be given to a single user who does not need to share wireless network resources with other users. Models beyond the typical user approach have been proposed with the aim of analyzing QoS metrics of a population of users, and not just a single user. Broad speaking, these models can be classified into four types: Static models have a given number of active users with fixed positions. Semi-static models consider the networks at certain times by representing instances or "snapshots" of active users as realizations of spatial usually Poisson processes. Furthermore, it is assumed that each user is motionless during its call. Queueing models have been successfully used to dimension or to suitably adjust the parameters of circuit-switched and other communication networks. Adapting these models to the task of the dimensioning of the radio part of wireless cellular networks requires appropriate space-time averaging over the network geometry and the temporal evolution of the user phone call arrival process. These relations form part of the network dimensioning tools, which allow the network operators to appropriately vary the density of the base stations to meet the traffic demands for a required performance level. The aim is to reduce or prevent collisions by limiting the power of interference experienced by an active receiver. The MAC protocol determines the pattern of simultaneously active channels, given the underlying pattern of available channels. Different MAC protocols hence perform different thinning operations on the available channels, which results in different stochastic geometry models being needed. Aloha MAC models[edit] A slotted Aloha wireless network employs the Aloha MAC protocol where the channels access the medium, independently at each time interval, with some probability p. ALOHA is not only one of the simplest and most classic MAC protocol but also was shown to achieve Nash equilibria when interpreted as a power control schemes. This mitigates the interference from other transmitters, and can be represented in a mathematical model by multiplying the interference by an orthogonality factor. Stochastic geometry models based on this type of representation were developed to analyze the coverage areas of transmitters positioned according to a Poisson process. In recent years, models have been developed to study more elaborate channels arising from the discipline of network information theory. These codes, consisting of randomly and independently generated codewords , give transmitters-receivers permission when to exchange information, thus acting as a MAC protocol. Furthermore, in this model a collection or "party" of channels was defined for each such pair. This party is a multiple access channel, [77] namely the many-to-one situation for channels. The receiver of the party is the same as that of the pair, and the transmitter of the pair belongs to the set of transmitters of the party, together with other transmitters. Using stochastic geometry, the probability of coverage was derived as well as the geometric properties of the coverage cells. Other network models[edit].

Chapter 2 : An analytical model for evaluating usable throughput in ad-hoc wireless networks

Khalil Amine (January 30th). Mathematic Models for Quality of Service Purposes in Ad Hoc Networks, Mobile Ad-Hoc Networks Xin Wang, IntechOpen, DOI: / Available from: Khalil Amine (January 30th). Mathematic Models for Quality of Service Purposes in Ad Hoc Networks, Mobile Ad.

With our empirical model we are able to determine the science: Although the physics of radio available capacity of the ad hoc network and the maximum bandwidth propagation is complete for a long time ago, its application to real- of new flows to guarantee a specified QoS. We show that a combination world scenarios makes the problem extremely complex due to of our network model, PREFAIRS and a empirical model is able to pseudo randomness properties. Such properties stem from, e. A notable example of such I. In particular, the problem of characterizing its being written more than 20 years ago, it is still widely used today. Hata and other researchers defined a methodology that consists in three main procedures: Although there is already valuable work on each of the research in a number of different areas, namely, those that deal with mentioned areas, practical results are still missing. The main pseudo-random phenomena economics, social sciences, biology, problem in providing QoS in an ad hoc network is to determine the etc. In network science, they have been the basis, for example, of available bandwidth in each link, due to the shared medium and research in traffic models that can describe with good accuracy end- instability of the network. For example, in SWAN [1] all nodes user behaviour [2][4]. Another example is interdomain traffic need to ear the shared medium to determine the number of packets analysis where such pseudo-randomness is evident [5]. We argue in a specified time frame, and then, determine the available that the same approach can be used in ad hoc networks, since they bandwidth. This process is extremely complex for an ad hoc node. An empirical model has results obtained. The problem we try to solve is the following: Since deploying given a general purpose scenario, can we use empirical results to such a scenario, especially with mobile nodes, is very hard today, determine the capacity of an ad hoc network, and then, design we use simulations. But since a simulation is, arguably, the only current scenarios? And, if yes, what empirical results we need to design a possible way to obtain large-scale data, we chose, nevertheless, to general-purpose ad hoc network? The first step is a formal definition of the desired service section III. Apart from this, the European limitations, not all findings can be presented. We then present how Commission has no responsibility for the content of this paper. The information we have designed the proposed protocol section V , that is able to in this document is provided as is and no guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the assure rate regulation taking into account the empirical bandwidth information at its sole risk and liability. Moreover, nodes are able to perform traffic shaping; we have used a token bucket for this. We will also assume that nodes exchange traffic randomly no preferred peers. As for the service, we assume that users expect a similar best-effort service as they have in a non-congested wired network: Service Characterization Our interest is to provide a service with soft guarantees such as the ones that the wired internet exhibits. We characterize the BBE Fig. Proposed methodology to obtain suitable empirical models service using three requirements: In cases where the user does not have a dedicated II. The very first some reason for it to happen. Although a common user tolerates short-term network will be operated. This includes the following parts: This first step should expect to have a minimum of connectivity always. Further, a user also expects its experience to be smooth compromising its flexibility. This is After understanding the operational scenario, the service, defined to say that the user knows more or less what to expect from the from a user point-of-view, should be characterized. For example, while it may tolerate some disruptions in a service, in this context, as the expected network behaviour to the VoIP call, it will not tolerate taking several minutes to open a user. After freezing the operational scenario and the service, a set of simple webpage just after it started to appear on the screen. An illustrative case inputs. A mathematical model should be obtained that, with good concerns applications that use TCP [7]. Due to several factors, accuracy, describes the system response. This is the system model. The first component will typically be used to design a protocol to obtain real-time C. Identification of Pseudo-Randomness Sources information; the second part relates to the pre-conditions a node Besides the regular unknowns of all networks, mobile ad hoc must satisfy in order to be able to obtain the service as it is defined. First, and perhaps more important, it seems Then, a network and a node model should be produced. If any of that capacity of ad hoc networks decreases with its size that we the components is proved to be too restrictive e. Finally, the service that incur overhead. Another source of uncertainty comes from the model should be documented especially to make clear its route pattern. While a typical wired network is organized in a limitations and applicability. We will now follow the previous section to obtain the system Overall, we will test the hypothesis that the BBE service, as model for the specific service we aim. Some assumptions are define before, will depend on the following: We expect the bitrate available for each intend to be universal or exhaustive. Although fairness only concerns with a fair A. Operational Scenario division of resources for all nodes, stability and predictability The set of assumptions we make are the following. All nodes use strictly depends on the available bandwidth for each node. Dynamic Source Routing DSR is the Additionally, the model should be able to predict when a joining selected routing protocol. This is also valid for the requirement of 0 20 40 60 80 predictability, as no user should need to be aware of the distance, Fig. Strategy and Results We present now our empirical model and key findings. Due to standalone - throughput kbps space limitations, we will show only the most relevant results. We performed a large-scale m x m simulation study. We first investigated the loss behaviour with increasing m x m load for several scenario areas, with random pairs source- destination and with little mobility. The investigated areas were squares of side length ranging from m to m. Bandwidth plots for three illustrative areas. Curves were fit to the samples using the least-squares method. Discussion The main information that nodes will need to know in real-time are the number of active nodes in a certain area and the length of It is clear that the obtained results are general enough at least, the routes. This protocol works as systematic. Hence, one can model the network capacity using two follows. First, whenever a node needs to setup a route e. Between the two effects, longer longest route in use traversing the nodes of the probed path may routes seem to dominate in accordance with other authors [11][12]. When the source node finds the required information, it determines through the empirical model the bandwidth of the V. This time is needed so that all nodes in the path our scheme, being able to determine if a new flow can be started and nearby have time to adjust their shapers to the new conditions This full text paper was peer reviewed at the direction of IEEE Communications Society subject matter experts for publication in the WCNC proceedings. Hence, two rules must be 1 Source node enforced by every node: A source node needs to implement two important functionalities: The traffic probed; shaper must be configured with the information carried by 2. Each node is free to use any technology new sessions, all other nodes must reduce its bitrate according to for the shaper as long as it enforces the empirical model. Knowing the found empirical laws in order to accommodate the new user. In this case, the node should wait some area, if a range of m is used for the link layer ; this information time before re-probing the network. Assuming that there are only maximum bitrate possible for a specified QoS requirement for the three nodes generating packets S1, S2 and S3 , S1 can completely flow. Overall, the tuple dest, N, H is the state maintained by every disregard the other two routes, since they do not interfere. On the contrary, assuming S3 starts after S2, S3 should obtain packet with a unique ID to the destination and wait for the reply. If a maximum route length of 5 hops route B and 1 active node. This time is required to or region of the network state. Our solution uses inband signalling allow that other active nodes are updated before the flow is started; and an extension header IPv6 with the current values of active in this sense, all active nodes may regulate its shapers to reflect the nodes and maximum route length seen by the nodes that the packets new conditions. Each node also stores the tuple active-nodes; the delay per hop. Upon receiving a packet, if either conservative the factor 2 is to have a RTT. To ensure that neighbour routes are also updated, Another important function of source nodes is to, whenever every node should listen the broadcast medium. In case a neighbour possible, report that it is leaving the network or to cancel any is not on the path but has a relevant notification, it must send a resources it has been using. Node Model In Fig. If we assume a fully distributed ad hoc network, this is also the network model. It must be stressed that shaping is only performed at each source; hence, as soon as a packet is released to the network, all nodes will only use normal routing. This has the extra advantage of keeping nodes simple. There are 2 different types of messages: S3 is about to start a flow. It should be noted that, for the case of increasing sources, The most important task of a relay node is to update the without PREFAIRS, packet delivery actually starts to drop due to information of a packet with the maximum route length and the congestion and medium saturation. There are two operations: When how much resources they have available in real-time. In case a node listens variances. The source b node will use the information to configure its shaper.

Chapter 3 : QoS for Ad Hoc Networks Using an Empirical Model | Rui Aguiar - calendrierdelascience.com

Mathematic Models for Quality of Service Purposes in Ad Hoc Networks 3 S N D M L K Waiting Contention Exposed node Node in competition Intruder node Intrusion Fig. 1. Ad hoc networks challenges.

Chapter 4 : Stochastic geometry models of wireless networks - Wikipedia

0 Mathematic Models for Quality of Service Purposes in Ad Hoc Networks Khalil Amine Department of Mathematics Faculty of Sciences and Techniques, University of Sidi Mohammed Ben Abdellah.