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Nuglets: A Virtual Currency

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Abstract - *In mobile ad-hoc network, there is always an assumption being made that all the nodes are belong to a single mastery. Therefore, to cooperate in order to support basic functions of the network is expected from the nodes such as routing. Here in this paper, we take an account that every belongs to an individual master and tries to maximize the benefits it gets from its network. For this, concept of virtual currency is being introduced.*

Keywords: *Virtual currency.*

1. INTRODUCTION

A mobile ad-hoc network is usually a wireless network created by some nodes in a self-organized structure which is independent of any established infrastructure. Working of mobile ad-hoc networks is deliberately depend upon the cooperative behavior of their nodes that's why all the services that are assumed to be necessary to a network are provided by the network itself. Communication between two nodes A and B depend on the intermediate nodes that forward packets for the beneficiary of A and B.

So, applications of mobile ad-hoc networks can be visualized mainly for the situations that are much critical such as in military or in rescue operations. In this type of application areas, all the nodes present in the network are belong to a single master (such as single rescue team manager) and they share a common goal. Because of this, nodes are naturally cooperated with each other.

Since, because of this progress in technology, deployment of mobile ad-hoc networks on a huge platform for civilian scenario will be possible very soon. Such applications will include network of cars, provision of communication facilities in remote areas. In these types of networks, nodes simply do not belong to a single authority or master. Each node belongs to a different authority: to its user and they so not share the same goal. And these networks could be much bigger and have larger lifetime and they could be completely self-organized means they can be run by operation of its end users.

In these types of networks, there is no need to assume that nodes are cooperating and provide services to each other. Service provision is not in the interest of the nodes, because it consumes energy and it does not have any direct advantages. Nodes in the mobile ad-hoc network are battery powered in general, so, energy consumption is must since energy is the precious resource that they may not want to waste for the benefit of other nodes.

Lack of cooperation may have very worse effect on the operation the network. In this paper, we are concerned for the problem of non-cooperating nodes in large, self-organized, mobile ad-hoc network for civilian purpose. Assumption is that nodes are belong to the different mastery, which has all control on nodes. In practical, the user can interfere with the hardware and software of the node and can modify its behavior and nature to adapt the better goal on his own.

On the other hand, users are not interested in altering the low-level protocols of their nodes. These protocols have to be participated in the network, but they do not provide very much benefits to the node or to the network. Modification in these can be disturbance to the network. This results in a network where nodes are selfish. They use the services which are provided by the other nodes but do not provide their own services free to the community. In such network, it is more necessary to simulate for cooperation. In this paper, we have an economic approach for this type of network. We introduce a virtual currency called nuglets. It is a mechanism for charging/rewarding service usage.

Nodes that use services must pay for it (in nuglets) to the nodes from which they are gaining their services. This makes nuglets crucial for using the network and because of this each node is interested to increase the nuglets in its stock. This mechanism is a way to deal with selfish nodes and to provide all the service that are necessary a node.

There are some charging models for the packet forwarding service.

2. BASIC CHARGING MODELS FOR PACKET FORWARDING

Packet forwarding is a service which is provided by the intermediate nodes to the source and destination of the packet. Therefore, either the source or the destination will pay for the services provided.

2.1 PACKET PURSE MODEL (PPM)

In this model, for packet forwarding services, source will pay. The service charge is distributed among the forwarding nodes in a following way: when packet is sent by source, the source load it with the number of nuglets that are sufficient to reach the destination. Each intermediate node took some nuglets from the packet that covers its forwarding cost. The number of nuglets charged by the intermediate (forwarding nodes) can be depend upon many factors such as, amount of energy used for the forwarding operation, the current battery status of the node and its current number of nuglets. If a packet does not have sufficient number of nuglets to forward the packet, it will be discarded.

The main advantage of this model is, besides simulating the cooperation it may also discourage nodes for sending the useless data and it will reduce overhead of the network since for all the network source has to pay. Prevention of overloading is an important issue since available bandwidth per node declines when the number of nodes increases.

The main disadvantage of this model is, that it is very difficult to determine the exact number of nuglets required for the forwarding to reach its destination. If source does not load the sufficient nuglets the packet will not be forwarded, it will be discarded at some point. Thus, source should over estimate the number. The surplus will remain with the packet and it will be acquired by the destination.

2.2 PACKET TRADE MODEL (PTM)

In this approach, destination will pay for the services. Packet will not carry the nuglets, but it is traded for the nuglets by the intermediate nodes. Each intermediate node buys the packet form the previous one for some nuglets and sells it to the next one. In this way, total cost of the forwarding services is covered by the destination node. If the next intermediary node does not want to buy the packet, then forwarding may try to sell it for a lower price or may drop the packet.

Main advantage of this approach is, source does not have to estimate the exact number of nuglets in advance to forward the packet. Letting the destination pay for the packet forwarding makes this approach applicable in case of multicast packet as well.

The main disadvantage of this model is, it does not discourage sender to send useless data which will cause overloading of the bandwidth and increase overhead of the channel.

2.3 HYBRID MODEL

This approach is the combination of the previous two models. The previous models can be combined in the following way: the packet is handled according to the Packet Purse Model until it runs out of the nuglets and then it is handled according to the Packet Trade Model until the destination buys it.

This approach combines the advantages of both the models: since source still has to pay, it will never send useless packet, so overhaeding will be less. Then, source does not have to estimate the exact number of nuglets since destination will buy the packet if nuglets given by the source runs out.

2.4 PROTECTION OF MODELS

Clearly, models described above must be protected and secured against the various attacks. A general problem to solve is the anticipation of nuglets forgery.

Another problem in the Packet Purse Model is protection of packet purse from illegal modifications during the transmission, anticipating the detachment of a packet purse from its original packet and ensuring each intermediate packet will receive its forwarding charges.

Similar problem in the Packet Trade Model is to ensure that the forwarding node receives the payment form the next hop, if and only if, next hop is receiving the packet.

3. RELATED WORK

The paper indicated that these two mechanisms are able to maintain the total throughput of the network, even in the presence of high amount of the misbehaving nodes.

This proposal has an advantage of being easier to implement and it is independent of any cryptographic functions. It does not only foster cooperation but it prevents overloading. The concept of currency can be used to reward more sophisticated services.

4. CONCLUSIONS

In this paper, we describe how the cooperation of nodes the self-organized mobile ad-hoc network can be simulated by the introduction of a virtual currency in the system.

Nuglets are a way to encourage the user to make modest usage of the network and to keep her device turned on so that it can used as a relay.

We argued possible charging models for the packet forwarding and described the economic model that we used in our simulations. We also discussed how to protect the nuglets forgery from various attacks.

We believe that introduction to virtual currency can serve several other purposes in mobile ad-hoc networks.

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