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Cooperative Load Balancing and Dynamic Channel Allocation for Cluster-Based MANETs

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ABSTRACT:
Mobile ad hoc networks (MANETs) are becoming increasingly common, and typical network loads considered for MANETs are increasing as applications evolve. This, in turn, increases the importance of bandwidth efficiency while maintaining tight requirements on energy consumption, delay and jitter. Coordinated channel access protocols have been shown to be well suited for highly loaded MANETs under uniform load distributions. However, these protocols are in general not as well suited for non-uniform load distributions as uncoordinated channel access protocols due to the lack of on-demand dynamic channel allocation mechanisms that exist in infrastructure based coordinated protocols. In this paper, we present a lightweight dynamic channel allocation mechanism and a cooperative load balancing strategy that are applicable to cluster based MANETs to address this problem. We present protocols that utilize these mechanisms to improve performance in terms of throughput, energy consumption and inter-packet delay variation (IPDV). Through extensive simulations we show that both dynamic channel allocation and cooperative load balancing improve the bandwidth efficiency under non-uniform load distributions compared to protocols that do not use these mechanisms as well as compared to the IEEE 802.15.4 protocol with GTS mechanism and the IEEE 802.11 uncoordinated protocol.

KEYWORDS:
Mobile ad hoc networks, bandwidth efficiency, distributed dynamic channel allocation.

1. INTRODUCTION:
MOBILE ad hoc networks (MANETs) have been an important class of networks, providing communication support in mission critical scenarios including battlefield and tactical missions, search and rescue operations, and disaster relief operations. Group communications has been essential for many applications in MANETs. The typical number of users of MANETs has continuously increased, and the applications supported by these networks have become increasingly resource intensive. This, in turn, has increased the importance of bandwidth efficiency in MANETs. It is crucial for the medium access control (MAC) protocol of a MANET not only to adapt to the dynamic environment but also to efficiently manage bandwidth utilization. In general, MAC protocols for wireless networks can be classified as coordinated and uncoordinated MAC protocols based on the collaboration level. In uncoordinated protocols such as IEEE 802:11, nodes contend with each other to share the common channel. For low network loads, these protocols are bandwidth efficient due to the lack of overhead. However, as the network load increases, their bandwidth efficiency decreases. Also, due to idle listening, these protocols are in general not energy

efficient. On the other hand. Some of the key challenges in effective MAC protocol design are the maximization of spatial reuse and providing support for non-uniform load distributions as well as supporting multicasting at the link layer. Multicasting allows sending a single packet to multiple recipients. In many cases, supporting multicasting services at the link layer is essential for the efficient use of the network resources, since this approach eliminates the need for multiple transmissions of an identical payload while sending it to different destinations. Similar to cellular systems, coordinated MANET MAC protocols need specialized spatial reuse and channel borrowing mechanisms that address the unique characteristics of MANETs in order to provide as high bandwidth efficiency as their uncoordinated counterparts. Due to node mobility and the dynamic nature of the sources in a MANET, the network load oftentimes is not uniformly distributed. In this paper we propose two algorithms to cope with the non-uniform load distributions in MANETs:

- A light weight distributed dynamic channel allocation (DCA) algorithm based on spectrum sensing.
- A cooperative load balancing algorithm in which nodes select their channel access providers based on the availability of the resources.

We apply these two algorithms for managing non-uniform load distribution in MANETs into an energy efficient real-time coordinated MAC protocol, named MH-TRACE. In MH-TRACE, the channel access is regulated by dynamically selected cluster heads (CHs). MH-TRACE has been shown to have higher throughput and to be more energy efficient compared to CSMA type protocols. Although MH-TRACE incorporates spatial reuse, it does not provide any channel borrowing or load balancing mechanisms and thus does not provide optimal support to non-uniform loads. Hence, we apply the dynamic channel allocation and cooperative load balancing algorithms to MH-TRACE, creating the new protocols of DCA-TRACE, CMH-TRACE and the combined CDCA-TRACE.

The contributions of this paper are: i) we propose a light weight dynamic channel allocation scheme for cluster- based mobile ad hoc networks; ii) we propose a cooperative load balancing algorithm; iii) we incorporate these two algorithms into our earlier TRACE framework leading to DCA-TRACE and CMH-TRACE; and iv) we combine both algorithms to provide support for non-uniform load distributions and propose CDCA-TRACE. We compare the performance of these algorithms for varying network loads. In multi-hop wireless networks, CSMA techniques enable the same radio resources to be used in distinct locations, leading to increased bandwidth efficiencies at the cost of possible collisions due to the hidden terminal problem. Different channel reservation techniques are used to tackle the hidden terminal problem. Karn use an RTS/ CTS packet exchange mechanism before the transmission of the data packet. 802.11 distributed coordination function (DCF) uses a similar mechanism. Although this handshake reduces the hidden node problem, it is inefficient under heavy network loads due to the exposed terminal problem. Several modifications to the RTS/CTS mechanisms have been proposed to increase the bandwidth efficiency including use of multiple channels.

1.1 EXISTING SYSTEM:

- A distributed dynamic channel allocation algorithm with no optimality guarantees for a network with a fixed a-priori control channel assignment.
- Alternatively, there are various game-theoretic approaches to the channel allocation problem in ad hoc wireless networks.
- Multichannel model the channel allocation problem in multi-hop ad hoc wireless networks as a static cooperative game, in which some players collaborate to achieve a high data rate.
- In multi-hop wireless networks, CSMA techniques enable the same radio resources to be used in distinct locations, leading to increased bandwidth efficiencies at the cost of possible collisions due to the hidden terminal problem.

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- Different channel reservation techniques are used to tackle the hidden terminal problem. Karn use an RTS/ CTS packet exchange mechanism before the transmission of the data packet.
- 802.11 distributed coordination function (DCF) uses a similar mechanism.

1.2 DISADVANTAGES OF EXISTING SYSTEM:

- Existing approaches are not scalable
- They not cover group communication

1.3 PROPOSED SYSTEM:

- In this project we propose two algorithms to cope with the non-uniform load distributions in MANETs: a light weight distributed dynamic channel allocation (DCA) algorithm based on spectrum sensing, and a cooperative load balancing algorithm in which nodes select their channel access providers based on the availability of the resources.
- We apply these two algorithms for managing non-uniform load distribution in MANETs into an energy efficient real-time coordinated MAC protocol, named MH-TRACE. In MH-TRACE, the channel access is regulated by dynamically selected cluster heads (CHs).
- MH-TRACE has been shown to have higher throughput and to be more energy efficient compared to CSMA type protocols.
- Although MH-TRACE incorporates spatial reuse, it does not provide any channel borrowing or load balancing mechanisms and thus does not provide optimal support to non-uniform loads.

1.4 ADVANTAGES OF PROPOSED SYSTEM:

- Increase the throughput
- Here we use scalable approach
- Reduce energy consumption

2. IMPLEMENTATION MODULES:

- ❖ Service provider
- ❖ Router
- ❖ Cluster
- ❖ Receiver (End User)
- ❖ Attacker

MODULES DESCSRIPTION:

- **Service provider:**

In this module, the service provider will browse the data file and then send to the particular receivers. Service provider will send their data file to router and router will connect to clusters, in a cluster highest energy mobile node will be activated and send to particular receiver and if any attacker will change the energy of the particular mobile node, then service provider will reassign the energy for mobile node.

- **Router**

The Router manages a multiple clusters (cluster1, cluster2, cluster3, and cluster4) to provide data storage service. In cluster n-number of nodes (n1, n2, n3, n4…) are present, and in a cluster the mobile node which have more energy considered as a cluster head and it will communicate first. In a router service provider can view the node details, view routing path, view time delay and view attackers. Router will accept the file from the service provider, the cluster head will select first and it size will reduced according to the file size, then next time when we send the file, the other node will be cluster head. Similarly, the cluster head will select different node based on highest energy. The time delay will be calculated based on the routing delay.

- **Cluster**

In cluster n-number nodes are present and the clusters are communicates with every clusters.In a cluster themobile node which have more energy considered as a cluster head. The service provider will assign the energy for each & every node. The service provider will upload the data file to the router; in a router clusters are activated and the cluster-based networks, to select the highest energy mobile nodes, and send to particular receivers.

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- **Receiver (End User)**

In this module, the receiver can receive the data file from the service provider via router. The receivers receive the file by without changing the File Contents. Users may receive particular data files within the network only.

- **Attacker**

Attacker is one who is injecting the fake energy to the corresponding mobile nodes. The attacker decries the energy to the particular mobile node. After attacking the nodes, energy will be changed in a router.

3. SCREEN SHORTS:

Fig: Basestation

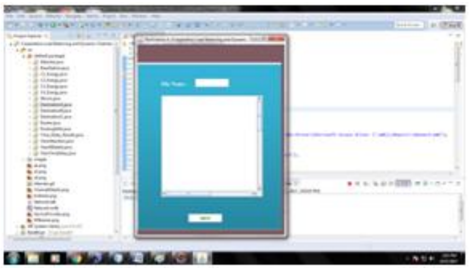

Fig: Destination A

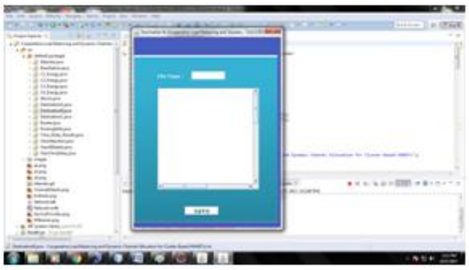

Fig: Destination B

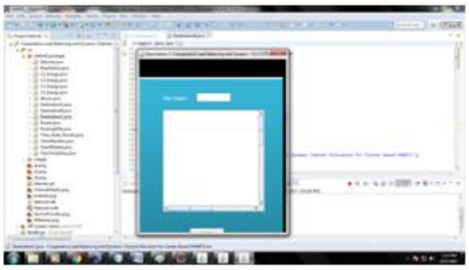

Fig: Destination C

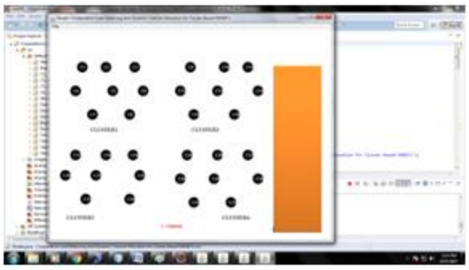

Fig: Router

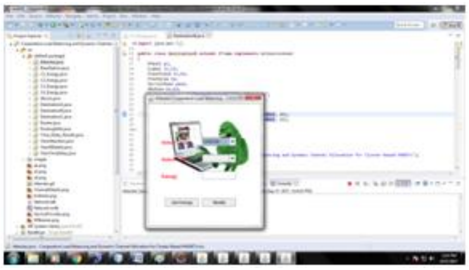

Fig: Attacker

4. CONCLUSION:

We studied the problem of non-uniform load distribution in mobile ad hoc networks. We proposed a light weight dynamic channel allocation algorithm and a cooperative load balancing algorithm. The dynamic channel allocation works through carrier sensing and does not increase the overhead. It has been shown to be very effective in increasing the service levels as well as the throughput in the system with minimal effect on energy consumption and packet delay variation. The cooperative load balancing algorithm has less impact on the performance compared to the dynamic channel allocation algorithm. We showed that these two algorithms can be used simultaneously, maximizing the improvements in the system.

The combined system has been shown to perform at least as well as the systems with each algorithm alone and performs better for many scenarios. Both of the algorithms as well as the combined system also have a fast response time, which is on the order of super frame duration of 25 ms, allowing the system to adjust under changing system load. We focused on bandwidth utilization and leave full adaptation of the system for delay sensitive communications as future work. For instance,"channel handover" is not implemented. Systems incorporating channel handover provide uninterrupted channel access for source nodes that travel away from one channel coordinator towards another one by transferring their load. The cooperative load balancing algorithm can be extended to provide such channel handover capability. In this provisioned system, moving active nodes are required to change their channel coordinator not only based on the load on the channel coordinators but also based on the RSSI measurements of Beacon packets from each channel coordinator. Similar to cooperative load balancing, the nodes would not drop the reserved channel resources before they secure new channels in order to have uninterrupted channel access during the transition. In addition to this, CHs may reserve a certain percentage of resources for transfers and not use them for new calls, should it be desirable to prioritize preventing dropped calls at the expense of an increased number of blocked calls.

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