IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661, p- ISSN: 2278-8727Volume 16, Issue 1, Ver. 5 (Jan. 2014), PP 94-98
www.iosrjournals.org

Efficient Medium Access Control Protocol and Dsr for Energy Management in Ad Hoc Networks

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Abstract: *Wireless ad hoc networks can be used to provide services anywhere and anytime. Ad hoc networks enable users to spontaneously form a dynamic communication system. In Ad hoc Network nodes have limited energy resources; the energy expended for transferring information across the network has to be minimized. Ad hoc wireless networks are constrained by limited battery power, which makes energy management an important issue. Energy needs to be optimally utilized so that the nodes can perform their functionality satisfactorily It is known that energy can be managed at various levels. In this paper, we propose energy management at three different levels: component, system, and network levels by suggesting an approach to conserve energy at each of these three levels. we are focusing on energy management schemes, energy efficient routing Protocol which tries to meet the challenge of using battery power efficiently.*
Keywords: *Ad hoc Networks, Energy Management, , DSR Protocol, EE MAC Protocol,, PMAC Protocol.*

I. Introduction

The current developments in mobile sensor devices indicate a future trend where we will have devices performing diverse functions in a fast changing environmental conditions. The energy management in ad hoc networks is a very important aspect of the overall management of ad hoc networks. The mobile wireless sensor nodes in the field need to conserve energy and use it optimally in order to play the assigned role in an ad hoc network for a longer period of time[10]. Energy can be managed at various levels: Component level [2,4,11], system level [5], and network level.

1.1 WHY ENERGY MANAGEMENT IS NEEDED IN AD HOC NETWORKS:

In wireless networks, the ratio of computation energy consumption to communication energy consumption varies in a wide range, depending on application type. In some applications like micro sensor networks, communication dominates energy consumption. In other application domains and applications like simulation, artificial intelligence, target detection, handwriting recognition, and voice recognition computation energy consumption generally dominates communication energy consumption.

1.1.1Reasons for energy management in ad hoc networks

1) Limited energy reserve:

The ad hoc networks have limited energy reserve. The improvement in battery technologies isvery slow as compared to the advances in the field of mobile computing and communication.

2) Difficulties in replacing the batteries:

In situations like battlefields, natural disasters such as earthquakes, and so forth, it is very difficult to replace and recharge the batteries. Thus, in such situations, the Conservation of energy is very important.

3) Lack of central coordination:

Because an ad hoc network is a distributed network and there is no central coordinator, some of the nodes in the multi hop routing should act as a relay node. If there is heavy relay traffic, this leads to more power consumption at the respective relay node.

4) Constraints on the battery source:

The weight of the nodes may increase with the weight of the battery at that node. If the weight of the battery is decreased, that in turn will lead to less power of the battery and thus decrease the life span of the battery. Thus, energy management techniques must deal with this issue; in addition to reducing the size of the battery, they must utilize the energy resources in the best possible way.

5) Selection of optimal transmission power:

The increase in the transmission power increases the consumption of the battery charge. Because the transmission power decides there ratability of the nodes, an optimal transmission power decreases the interference between nodes.

Channel utilization:

A reduction in the transmission power increases frequency reuse, which leads to better channel reuse. Power control becomes very important for CDMA-based systems in which the available bandwidth is shared among all the users. Hence, power control is essential to maintain the required signal to interference ratio (SIR) at the receiver and to increase the channel reusability.

II. Energy Management In Adhoc Networks

The energy management in ad hoc networks is a very important aspect of the overall management of ad hoc networks [2]. The mobile wireless sensor nodes in the field need to conserve energy and use it optimally in order to play the assigned role in an ad hoc network for a longer period of time. Energy can be managed at various levels: **Component level, system level and network level.**

1 A. Component Level Energy Management:

Component level energy management (CEM) gives an opportunity to control the energy utilization by various components of a system. There are several components that are part of a system that get used during initialization, and other components that get used at irregular intervals. By a suitable design, if the energy consumed by these components during idle time can be reduced close to zero, the main operation of the system can be better sustained.

B. System Level Energy Management:

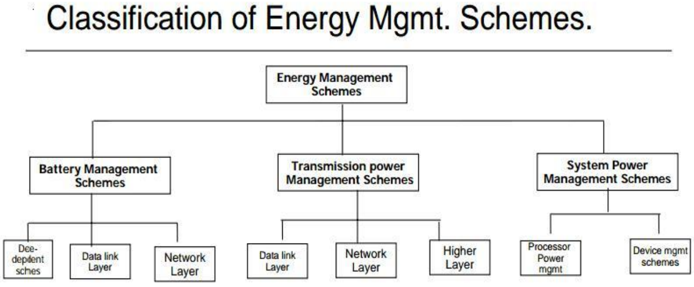
At system level, we need to evaluate the energy loading due to the design decisions such as
(a) real- time OS; (b) system drivers; (c) protocol stacks; and (d) user applications. User interfaces with differing graphical content can be designed so that the interface can be switched on the fly from graphical to text based one whenever there is a need to conserve energy. Energy-efficient design in ad hoc networks is more important and challenging than with other wireless networks. First, due to the absence of an infrastructure, nodes in an ad hoc network must act as router sand join in the process of forwarding packets. Therefore, traffic loads in ad

III. Energy Efficient Protocol

hoc network are heavier than in other wireless networks with fixed access points or base stations ,and thus ad hoc network have more energy consumption. Second, energy-efficient design needs to consider the tradeoffs between different network performance criteria. Third, no centralized control implies that energy-efficient management must be done in a distributed and cooperative manner, which is difficult to achieve [5] [7]. In the wireless interface, energy consumption in idle mode is only slightly less than in transmit mode and almost equal to that of receive mode.

C. Network Level Energy Management:

At the third level, we consider the issues related to energy management at network level. The objective is to conserve energy at network level by a cooperative loading of neighboring nodes. No centralized control implies that energy-efficient management must be done in a distributed and cooperative manner, which is difficult to achieve [5] [7]. In the wireless interface, energy consumption in idle mode is only slightly less than in transmit mode and almost equal to that of receive mode.



In this paper, we addressed how to manage energy efficiently in wireless ad hoc networks. Because the nodes are mobile and can be used for emergency purposes like military or natural disasters, each node should utilize its battery efficiently. Some of the problems which are faced while managing energy and are limited energy reserve, difficulties in replacing batteries, lack of central coordination, and constraints on the battery source. We also presented energy management in Ad hoc Networks at various levels like Component, System and Network, as well as the energy management schemes, power management in Ad hoc Networks. The challenge is not to provide each node with either battery power but to utilize the available battery power in a very efficient manner.

Energy efficiency is a major challenge in wireless networks. To facilitate communication,most wireless network devices are portable and battery-powered, and thus operate on an extremely constrained energy budget. First, due to the absence of an infrastructure, nodes in an ad hoc network must act as routers and join in the process of forwarding packets. Second, energy-efficient design needs to consider the tradeoffs between different network performance criteria. Third, no centralized control implies that energy-efficient management must be done in a distributed and cooperative manner, which is difficult to achieve [5] [7]. In the wireless interface, energy consumption in idle mode is only slightly less than in transmit mode and almost equal to that of receive mode. Therefore, anetwork protocol is needed to maximize the time a device is in sleep mode and also maximizes the number of wireless devices that can be in sleep mode. Many protocols have been proposed to deal with this challenge.

III . A. Energy-Efficient Medium Access Control (EE-MAC)Protocol

The Energy-Efficient Medium Access Control (EE-MAC)Protocol is based on the fact that most applications of ad hoc networks are data driven, which means that the sole purpose of forming an ad hoc network is to collect and disperse data. The protocol conserves energy by turning on and off the radios of specific nodes in the network. The goal is to reduce energy consumption without significantly reducing network performance. The key idea of EE-MAC is to select master nodes from all nodes in the network. Master nodes stay awake all the time and act as a virtual backbone to route packets in the ad hoc network.

III. B. Features of EE-MAC Protocol:

The features of EE-MAC are

1. Entering Sleep Mode Earlier
2. Priority processing of packets to slaves

III .C. PMAC FOR WIRELESS SENSOR NETWORKS

PMAC is a medium access protocol designed for wireless sensor networks. The protocol is based on exploiting the periodicity inherent in carrier sensing schemes like CSMA/CA combined with a relaxed time-access arbitration regime among the competing nodes. Transmission and reception of data frames are made to be strictly receiver-triggered events which makes it possible to bring down idle-listening drastically. The protocol also provides a way to make the channel access collision-free among the two-degree neighbors. PMAC requires no additional control signaling and no network-wide synchronization. The protocol design is not based on making any tradeoffs for the gains in energy efficiency with latency or throughput. The performance of PMAC protocol is demonstrated using simulations and compared with SMAC protocol. In the results presented, PMAC provides an energy-efficiency by a factor of 3-8 when compared with SMAC. Also, latency improvement goes up by a factor of 5 and through put increases by a factor of 3 on average.

IV. Current Work

Computational needs in mobile sensor networks are growing rapidly. In spite of impressive developments in the battery technologies and diminishing power requirements for displays and other similar power intensive tasks, the energy management in ad hoc sensor networks remains a challenge. We have suggested an approach in which the energy management is addressed at different levels of an ad hoc sensor network so as to achieve the best possible fulfillment of performance expectations.

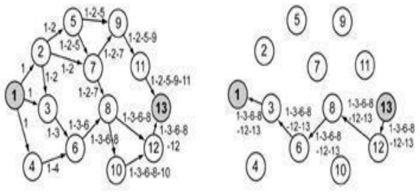
V. Dynamic source Routing Protocol:

In this paper also discuss about how the energy managed using DSR can explained . Dynamic Source Routing protocol (DSR) is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration.

The protocol is composed of the two mechanisms of Route Discovery and Route Maintenance, which work together to allow nodes to discover and maintain source routes to arbitrary destinations in the ad hoc network. The use of source routing allows packet routing to be trivially loop-free, avoids the need for up-to-date routing information in the intermediate nodes through which packets are forwarded, and allows nodes forwarding or overhearing packets to cache the routing information in them for their own future use. All aspects of the protocol operate entirely on-demand, allowing the routing packet overhead of DSR to scale automatically to only that needed to react to changes in the routes currently in use. We have evaluated the operation of DSR through detailed simulation on a variety of movement and communication patterns, and through implementation and significant experimentation in a physical outdoor ad hoc networking test bed we have constructed in Pittsburgh, and have demonstrated the excellent performance of the protocol.

V.I. Route Discovery:

Route Discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D. Route Discovery is used only when S attempts to send a packet to D and does not already know a route to D.



Route Discovery process in DSR

V .II.Route Maintenance:

Route Maintenance is the mechanism by which node S is able to detect, while using a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. When Route Maintenance indicates a source route is broken, S can attempt to use any other route it happens to know to D, or it can invoke Route Discovery again to find a new route for subsequent packets to D. Route Maintenance for this route is used only when

S is actually sending packets to D.

```
^   "A"        ^"A,B"  ^ "A,B,C"  ^ "A,B,C,D"
|            id=2     | id=2   | id=2   | id=2
+-----+              +-----+    +-----+   +-----+     +-----
+
| A  |---->|          B  |---->| C |---->| D  |---->|     E  |
+-----+              +-----+    +-----+   +-----+     +-----
+
|                    |         |         |
v                    v         v      v
```

To initiate the Route Discovery, node A transmits a

"Route Request "as a single local broadcast packet, which is received by approximately) all nodes currently within wireless transmission range of A, including node B in this example. Each Route

Request identifies the initiator and target of the
v v v v
Route Discovery, and also contains a unique request identification (2, in this example), determined by the initiator of the Request. Each Route Request also contains a record listing the address of each intermediate node through which this particular copy of the Route Request has been forwarded. This route record is initialized to an empty list by the initiator of the Route Discovery. In this example, the route record initially lists only node A.

When another node receives this Route Request (such as node B in this example), if it is the target of the Route Discovery, it returns a "Route Reply" to the initiator of the Route Discovery, giving a copy of the accumulated route record from the Route Request; when the initiator receives this Route Reply, it caches this route in its Route Cache for use is sending subsequent packets to this destination

VI. Conclusion:

Energy efficiency is one of the main problems in a MANET, especially in designing a routing protocol. In this paper, we surveyed and classified a number of energy aware routing techniques. Each technique has its own assumptions and different objectives and different methodologies in the implementation. The key advantage of a source routing design is that intermediate nodes do not need to maintain up-to-date routing information in order to route the packets that they forward, since the packets source has already made all of the routing decisions. We have evaluated the operation of DSR through detailed simulation on a variety of movement and communication patterns, and through implementation and significant experimentation in a physical outdoor ad hoc networking tested we have constructed in Pittsburgh, and have demonstrated the excellent performance of the protocol. There are different channels for sending data and control packets to reduce the energy consumption in power management approach but it increase the network traffic. The sleep/power-down mode approach is different from the other approaches as it focuses on inactivity energy.

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