Power Management Strategies in MANET's: A review

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Abstract - Nodes in MANETs transit from one mode to another in order to communicate among themselves. Different types of modes are transmitting, receive, sleep and idle. Maintaining dynamic topology and states lead to consequences such as consumption of more battery power thereby diminishes the network lifetime. Therefore, it is essential to optimize the power consumption for improving the performance of the network. Many routing protocols have been proposed for efficient routing of the data. Different routing protocols can be collaborated with multiple energy models such as GENERIC, MICAZ, MICA-MOTES, and USER-DEFINED types in Qual Net order to analyse the power consumption mechanism. These protocols are implemented and evaluated to foregather the most reliable and efficient protocol. Analyses are done with the main emphasis to achieve energy efficiency. Performance evaluation is done based on metrics such as energy consumption, network lifetime, time to live, the amount of current utilized, cost of the battery, drain count, etc.

Keywords: Energy Models, Energy Efficiency, MANET's, Network lifespan, Qual Net etc.

I. INTRODUCTION

Nodes in Manet's are deployed dynamically, quickly and inexpensively using radio equipments and antennas at the physical layer. The flexibility of deploying a node is to ensure the easy and straight-forward way of expanding a network to larger scale. An ad hoc network consists of independent devices that interact with each other and send data either directly or via other nodes to the destination node. A MANET consists of mobile devices that move effortlessly in any direction while communicating with one another. Each node must act as a router and should forward the data packets besides its own use. Hence, it is a peer-topeer and self-forming decentralized network. Unlike centralized network which consists of a single base station, there is a chance of single point of failure due to which the whole network collapses. Whereas in the decentralized network the idea of the centralized system is dropped i.e. data routing takes place using multi-hop fashion that takes multiple paths. Therefore, even if one node stops functioning the other nodes continue to work resulting in a reliable network. This gives the lead to the decentralized network. Apart from advantages, there are also some issues that need to be addressed viz. Topology, mobility, battery, speed of the wireless link, dis-connectivity, caching, handovers, hidden and exposed nodes identification. Wireless scenarios are designed effortlessly using IEEE standards with basic knowledge of the technology

II. POWER MANAGEMENT TECHNIQUES

There are numerous ways to conserve power and increase the efficiency as well as the lifespan of the network

Energy model:

Using the energy models provided by the Quall Net simulator, analysis can be done on various routing protocols under radio/physical layer resulting in efficient power management mechanisms. With the help of energy model parameters i.e. electrical current load consumed/power supply voltage and depending on modes/states such as transmit, receive, idle and sleep, energy consumption can be calculated. Different types of energy models provided by Qualnet are,

1. GENERIC: Power usage of radio is computed by this radio generic energy model in different power modes and for variable transmission power.

2. MICAZ: Power usage of MicaZ motes is given by the radio specific energy model and this model is preconfigured.

3. MICA-MOTES: Power consumption of Mica motes is given by the radio specific energy model and this model is also preconfigured.

4. USER-DEFINED: User can specify the amount of energy that is available for consumption in the network. These energy models need to be configured using certain parameters prior to their implementation which helps to get to know the amount of power consumed and the need to control the power consumption.

MAC Layer:

Using the Mac layer, energy consumption at station node is reduced with the help of power saving mode which is mainly supported by three procedures.

- Wake-up Procedure
- Sleep Procedure
- Power-save Poll (PS-Poll) Procedure

On combining them power management can be achieved for various purposes. Wake-up Procedure:

An STA basically wakes up due to two chief reasons 1) to forward pending data or 2) to get buffered data from an access point (AP). When an STA transition its status from sleep mode to an active mode, it reports an AP by sending an uplink frame to it with the power-save (PS) bit set to active. Sleep Procedure: Alike to wake-up procedure, the transition to the sleep mode is done by setting PS bit active PS-Poll Procedure: An AP can perform two actions, either forwarding of buffered downlink frame with a result taking the form of an immediate data response or forwarding an acknowledgment message with a response consisting of the buffered data frame. With an emphasis on immediate data response case, sending a buffered downlink frame can be only a response to the PS-poll from the STA, while the STA can remain in the sleep state.

A Mac protocol frequently makes use of omni-directionalantenna model which aids in dispatching and accepting radio signals via any direction. When considering directional antennas, MAC protocols needs all other nodes in the surrounding area to continue being silent. This makes it likely to attain maximum gain values and confines the transmission to an exact direction. The below listed are few of the guidelines for minimizing the power utilization.

- The foremost reason of frequent retransmissions that needs to be averted is Collision.
- Since there is more power utilization by transceivers in active mode, the transition to the stand-by mode becomes a necessity whenever possible.
- The transmitter also has the facility to shift to power saving mode that provides enough battery capacity for the destination to accept the packets

Battery model:

Battery is mainly a depository of electrical charge which gets loaded on recharging and discharges itself when in use. Therefore, performance of the peripherals such as CPU, DCDC converter, sensors, memory blocks, etc attached to battery is often limited. DC-DC converter acts as a voltage regulator for various components With the help of battery models provided by Qualnet, the network efficiency can be achieved, perhaps increasing the lifetime and predicting the behavior of the nodes under various circumstances. Battery models capture the characteristics of real-life batteries and can be used to predict their behavior under different design such as system architecture, power management policy, Life time of the battery, transmission power control and components based on time. Three Battery models supported by Qualnet 7.4 include Service life time, Linear and Residue which are useful tools for a battery driven systems. The total energy utilized by the system per cycle is equivalent to the sum of energies absorbed by the peripherals i.e. nodes/transceivers (E Transceivers), processors (E Processors), the DC-DC converter (EDC-DC) and the discharged amount of current in the battery (E Battery).

Models for 802.11 MAC layer coordination functions:

Basically, the issue evolved in WLAN's is sharing of the communication medium and the protocols that help in allotment of the medium i.e. concluding when a station can forward the data are recognized as co-ordination functions. Two main coordination functions are that play a prominent role

- DCF (Distributed Coordination Function)
- PCF (Point Coordination Function)

The communication model of BSS is shown in fig 1, which consists of groups of station that Interact with one another internally and communicates with those outside the group with the help of an AP and performs functions in infrastructure mode.

IBSS assembles the stations into groups that interact with each other directly without considering an AP and works in an ad-hoc mode.

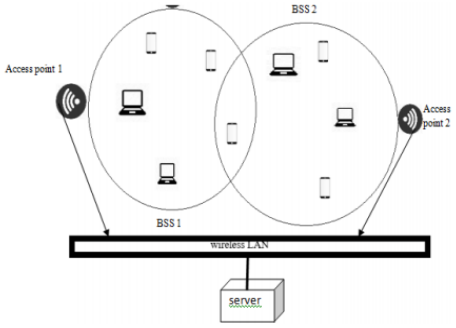

Fig: 1

Other strategies:

Other strategies available at the lower level protocols are listed below Power-Aware Medium Access Control with Signalling (PAMAS): A node halts its power usage when left with no transmission, while it is aware of transmissions in its vicinity. Dynamic Power-Saving Mechanism (DPSM): DPSM uses the scheme which involves 2 states i.e., sleep

and wake to lessen the power usage. Being an alternative of the IEEE 802.11, it employs variable sized ATIM windows to attain prolonged snooze time for nodes. Power Control Medium Access Control (PCM): In PCM, data and ACK packets are forwarded with the least amount of power, while the RTS and CTS packets are dispatched with utmost power, in order to facilitate the ongoing communication between two end points.

III. MISCELLANEOUS ROUTING PROTOCOLS

Some of them are,

a) Signal Stability Routing Protocol: Its main emphasis is on selecting the routes based on signal strength between nodes also considering the node's location stability.

b) Power-Aware Routing Protocol: These protocols concentrate on making smart, power-aware routing decisions that direct the actual transmission of data.

c) Associatively Based Routing Protocol: In this protocol, the path is selected depending on the degree of associative stability.

d) Opportunistic routing: In Opportunistic routing when a node enters the transmission phase, the neighbours around it are capable of hearing it. When a neighbour receives a packet from the sender node, it further forwards the packet to its neighbour nodes in the direction of the destination node, so that, some specified conditions are satisfied.

e) QOS based routing protocol: Route is discovered by considering circumstances such as constrained bandwidth, limited minimal search, distance and traffic conditions.

f) NC-aware routing: The nodes that consider the NC aware routing is known as coding points in the network, that aid in path selection for transmission of the packets in the network.

IV. CONCLUSION

The prime focus is on energy efficiency in MANET's. Since nodes in MANET's transitions from one mode to another mode such as transmitting, receiving, and idle and sleep mode, this in turn leads to more consumption of battery power leading to reduced network lifetime. Therefore, more priority is given to reduce the power consumption in the system, thereby increasing the lifetime of the battery. This performance analysis of efficiency can be experimented using different energy models such as GENERIC, MICAZ, MICA-MOTES, and USER-DEFINED using Quall Net simulator.

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