ISSN 2229-5518

# Survey on Distributed Algorithm for Energy Efficient Multicasting in Wireless Adhoc Networks

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**Abstract**— On wireless computer networks, ad-hoc mode is a method for wireless devices to directly communicate with each other. Operating in ad-hoc mode allows all wireless devices within range of each other to discover and communicate in peer-to-peer fashion without involving central access points (including those built in to broadband wireless routers). An ad-hoc network tends to feature a small group of devices all in very close proximity to each other. Performance suffers as the number of devices grows, and a large ad-hoc network quickly becomes difficult to manage. Nevertheless, as electronic devices are getting smaller, cheaper, and more powerful, the mobile market is rapidly growing and, as a consequence, the need of seamlessly internetworking people and devices becomes mandatory. The problem area is availability of limited energy at nodes of a wireless ad hoc network (WANET) has an impact on the design of multicast protocols. For example, the set of network links and their capacities in WANETs are not pre-determined but depends on factors such as distance between nodes, transmission power, hardware implementation and environmental noise. This survey paper presents an overview of issues related to energy efficiency in distributed network and any further possibilities of improvement.

**Index Terms**— WANET, Total Energy Consumption (TEC), System Lifetime (SL), P- ReMit, G- ReMit, S-ReMit Algorithm.

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## 1. INTRODUCTION

The limited battery power characteristic of ad hoc networks has an impact on the design of multicast protocols [1]. Some approaches have been proposed to reduce the Total Energy Consumption (TEC) of broadcast/multicast trees [2], or to extend System Lifetime (SL) [3], where SL is the minimum lifetime of nodes in a multicast tree. In this paper, we assume that there exists topology control protocols in the system to deal with interference with other nodes. We assume that nodes use omni-directional antenna. We also assume a wireless communication model. We also assume that each node can dynamically select its transmission power level $p^{RF}$, where $0 \le p^{RF} \le$ pmax. In the rest of the paper, we restrict our discussion to the construction and refinement of a single multicast tree. There are three algorithms which we have taken into account and tried to find out the possibilities of each algorithm.

i. P-REMiT Algorithm.
ii. G-REMiT Algorithm.
**iii.** S-REMiT Algorithm.

### LITERATURE SURVEY

The P-REMiT algorithm have three different stages:

1. Building an initial multicast tree.
2. Refining the multicast tree.
3. Eliminating all non-member redundant transmissions by pruning the multicast tree.

### 1.1. S-REMIT ALGORITHM

The distributed algorithm called S-REMiT is a part of a suite of algorithms called REMiT (Refining Energy efficiency of Multicast Trees). We are designing to achieve various energy-efficiency goals related to multicasting in WANETs. REMiT algorithms are distributed algorithms which refine the energy-efficiency of a pre-existing multicast tree using local knowledge at each node. The following assumptions have been supposed in S-REMiT algorithm:

1. Nodes are stationary in the WANET.
2. Each node in the WANET uses omni-directional antennas.

Each node knows the distance between itself and its neighboring nodes using distance estimation scheme such as [4] and [5].
S-REMiT consists of two phases:
1) Multicast tree construction.
2) Multicast tree refinement.
In the first phase, If nodes use long range radios, all nodes run a distributed algorithm proposed by Gallager et al. [6] to build a MST tree; if nodes use short range radios, all nodes run a distributed algorithm proposed by Chandy et al. [7] to build a SSSPT tree. We require that at the end of the first phase, node $i$($i \in T$, where $T$ is the multicast tree) has all local information. $lk$, $\forall k \in Vi$. Nodes obtain $lk$ by hearing $k$'s one-hop locally. In the **second phase**, the difficulty in this distributed environment is when and how to terminate the refinement. We organize the second phase in rounds. Each round of the second phase is led by the multicast source $s$. It terminates S-REMiT algorithm when there is no energy *gains* by switching any node in the multicast tree. In each round, S-REMiT token is passed to the nodes one by one in DFS order. The S-REMiT token gives the permission to a node to do refinement. The node holding the S-REMiT token can do refinement, other nodes only can respond to the node with S-REMiT token. When $i$ obtains the S-REMiT token, it does the following steps to refine the tree. We use $Ej(T\_, s)$ and $Ex(T\_, s)$ to denote the energy cost at $j$ and $x$ after *Changex,ji* , respectively.
*JOIN REQ*, *JOIN REP* and *LEAV E* messages are used by nodes *i, x,* and *j* to make *Changex,j*
*i* . Following are the steps of the second phase in S-REMiT algorithm (see Figure 3 for illustrations of these steps):

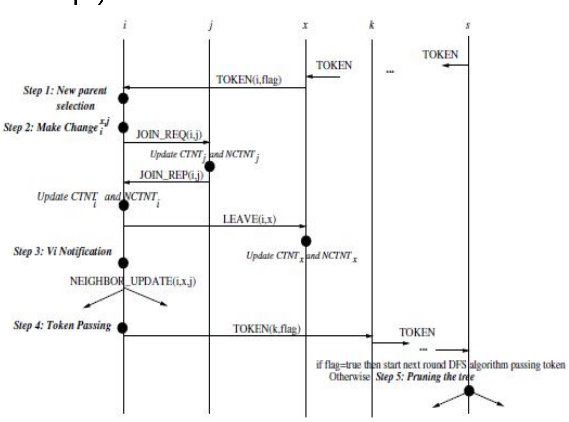


**Fig 1. SECOND PHASE OF S-REMIT**

We compare the performance of P-REMiT with that of S_REMiT and G-REMiT under different network environments [2]. We use the following metrics:

(1) *NT* (Normalized TEC): *NT* is the ratio of $TEC_{alg}$ to $TEC_{best}$, where *alg* ◎◎A={S-REMiT, L-REMiT, PREMiT,MIP} and $TEC_{best}$=min{$TEC_{alg}$ | *alg*◎◎A}.

(2) *NS* (Normalized SL):*NS* is the ratio of $SL_{alg}$ to $SL_{best}$, where $SL_{best}$= max{$SL_{alg}$ | *alg* ◎A}.

## 2. PROBLEM FORMULATION

### 2.1. P-REMIT ALGORITHM

We make assumptions on the network model: nodes with omni-directional antennas are stationary, and each node knows the distance between itself and its neighboring nodes in the ad hoc networks. The energy cost Ei(T,s) of node i in a source-based multicast tree T is defined in [1] .

## DEFINITION 1:

The power cost function, briefly PCF, of where Er(i) is the residual energy of node i at current time, Ei is the energy cost estimation of node i at current time by utilizing the well-known exponential weighted moving average method to

$$C_i = \log_2(E_r(i)/E_i$$

$E_i$(T,s). Er(i)/$E_i$ is the number of packets that can be transmitted. The PCF difference of node i and its neighboring nodes is

$$\varepsilon_i = C_i - \frac{1}{\sigma}\sum_{j=1}^{\sigma} C_j$$

where each j is a neighboring node of node i and ◎ is the total number of neighboring nodes. Let ◎ be the maximum ◎$_i$ over all nodes i, the probability of selecting nodes is assigned as follows:

Let x be the parent node of node i. The probability that x agrees node i to change parent is:

$$P_i\_x = \begin{cases} 1-\frac{\varepsilon_x}{\omega}, & \varepsilon_x > 0 \\ 1 & \varepsilon_x \le 0 \end{cases}$$

## 3. CONCLUSIONS

The P-REMiT takes into account of both reducing TEC and extending SL for multicasting in a source based tree. Simulation results show that the algorithm can reduce the TEC of a source-based multicast tree, which is close to that of S-REMiT, but with SL similar to that of MIP. For future work, we plan to change the second phase of S- REMit algorithm so as to minimize the multicast tree. Using BFS and DFS both in combination proposing a chunk based scheme.

### ACKNOWLEDGMENT

We thank the teachers of ITM and specially our Project Guide Mr. Amit Kumar Kar for his insightful comments which helped to improve the quality of the paper. We also wish to thanks our HOD Mr. Rajeev Ranjan Kumar Tripathi. This work was supported in part by a grant from him.

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