An Optimized Approach to Minimize Broadcast in Communication of Self Organized Wireless Networks

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Abstract. This paper proposes the strategy for effective connections in backbone of self organized wireless networks with role based approach. Various applications like disaster management, home monitoring and office automation, shows increasing demand for wireless networks. Nodes in a wireless and ad-hoc networks are free to move. Each node plays the efficient role for formation of backbone with local interaction. In this approach four roles are identified: Agent, Leader, Willingness to act as a Gateway and Gateway. Each node is playing one of the roles and backbone reconfiguration is performed with changes in environment. 'Willingness to act as gateway' node avoids the problem of duplicate gateways and unnecessary broadcast. Thus forming an efficient backbone provides good resource conservation property. Number of links of MST and proposed strategy are compared for performance analysis. As compared to the MST, proposed algorithm shows near solution for network connections. This approach utilizes resources in optimized way. In case of failure of original gateway on path, other appropriate device plays the role of original gateway.

Keywords: wireless sensor network, emergent behavior, clustering, self organization, wireless devices networks, wireless communication.

1 Introduction

A Wireless network is on-the-fly network formed by wireless devices like cell phones, PDAs, sensors etc. Because of the hardware and energy limitations, wireless networks needs extra mechanism to organize themselves in self organization than wired network.

In role based self organization every device need to perform certain task. In proposed strategy various roles are identified like agent, willingness to act as a gateway, gateway and leader. Network inconsistency due to duplicate gateway on single path increases number of communication links. Network inconsistency is removed by proposing new role: willingness to act as gateway. Every device will run IMPROVED self organization algorithm and clusters are formed [1]. Every cluster

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will have a cluster head called as Leader. Leaders can communicate with each other through gateways and all other members will act as an agent. When more than one gateway present on a single path, network inconsistency is identified. In proposed approach when original gateway is not available, duplicate gateway role can be modified to be a willing node to act as gateway.

A minimum connection in backbone of self organized network is proposed here. MST (Minimum Spanning Tree) is formed ideally for minimum connections. As compared to the MST, proposed algorithm shows near solution for network connections. This approach utilizes resources in optimized way as broadcast is minimized with effective connections. In case of failure of original gateway on path, other appropriate device plays the role of original gateway.

The remainder of the paper is organized as follows: In section 2 the related work is overviewed. In Section 3 describes the IMPROVED algorithm for various roles assignment and the environment. In Section 4 simulation results are shown. Conclusions that can be drawn are covered in section 5.

2 Related Work

Pure flooding allows each node to receive broadcast packets [2]. This requires maximum connections among the nodes and resources are not utilized in proper way. Energy-aware self-organization algorithms for small WSNs [4], allow deploying a WSN solution in monitoring contexts without a base station or central nodes. Sensors are self-organized in a chain and alternate between sleep and active mode where the sleep periods are longer than the activity periods. Effective creation of backbone is not considered. IDSQ ALGORITHM for Wireless sensor networks described in [5], consist of three components mainly: the sensor nodes, sensing object and the observer. The mutual cooperation between them, each sensor node has a small processors, some data need to be addressed was sent to the node summary, then through the multi-hop routing data about monitoring on the perceived object will be sent to the gateway, and finally by the gateway to data within the entire region is transferred to the remote center to manipulate. Hence this algorithm has constraints on roles and network reconfiguration.

Self organization proposes no need of any manual intervention and central control. Network topology changes with time and local interaction leads to global behavior. Various topology control approaches are designed and proposed like a Multi-Point Relay (MPR) based approach [7], a connected dominating set (CDS) based approach [10] and a cluster based approach [6]. But this strategy requires the knowledge of network in advance and constrained on equal transmission ranges [9]. Many cluster based approaches are proposed with self organization. Cluster based algorithm for self organization with various roles like member, leader and gateway is proposed [6] with variable transmission ranges. Each node performs some role like member, leader or gateway and they form backbone depending on local interaction. But backbone connection can have duplicate gateway for one path which leads increase in broadcast and extra energy consumption as multiple gateways can exist on single path [6]. This scenario is shown in figure 1.

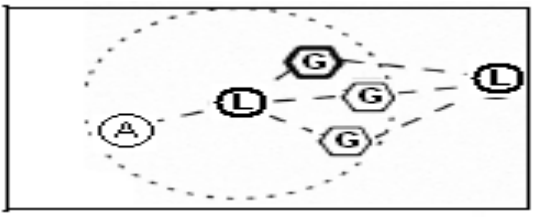

Fig. 1. Unnecessary Broadcasting

This paper proposes role based approach for effective connections in backbone in self organized wireless network. It tries to minimize the unnecessary broadcast with minimum connections, in turn optimal use of resources. Performance analysis is done by comparing number of links with MST.

3 Role Based Self Organization with IMPROVED Algorithm

In proposed strategy four different roles are identified with the help of IMPROVED Self Organization Algorithm. Firstly Leader Election algorithm is run to form clusters with cluster head. Then for cluster communication gateway role is identified. Cluster members are called as agents. Duplicate gateway is assigned with role Willingness to act as Gateway. Following algorithm describes the IMPROVED Role Based self-organization algorithm [1].

Algorithm 1 IMPROVED Role Based Self –Organization Algorithm

```
1: if NodeExist≠ 0
2:    if NodeLeaderNum= 0 then
3:         ROLE<=LEADER;
4:    else if ROLE =Leader then
5:         leaderElection();
6:    else if Node LeaderNum=1 then
7:         ROLE<= AGENT
8:     else
9:         ROLE<=GATEWAY
10:           if NodeGatewayNum >1 then
11:               ROLE<=WillingGateway
12:           end if
13: else
14:       ROLE<=ANY
15: end if
```

Algorithm 1 describes the assignment of various roles. As duplicate gateway problem is solved by identifying new role, minimum connections required to form backbone.

Figure 2 shows effective formation of backbone with proper role assignment [1]. When more than one gateway present on single path, only one gateway remains active and others will show willingness to become as gateway but perform function like an agent.

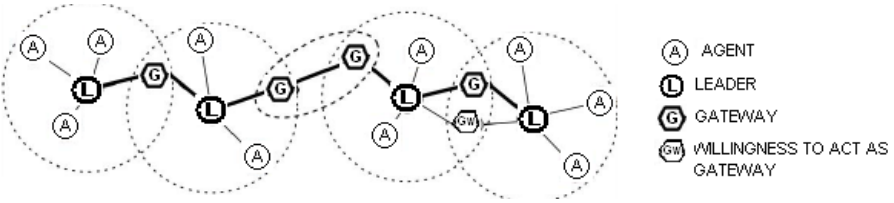

Fig. 2. Effective Formation of Backbone with proper role assignment

FDA is shown in figure 3.

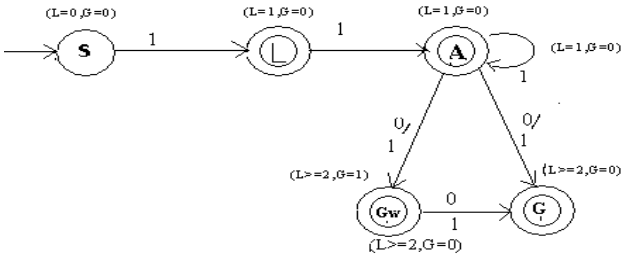

Fig. 3. DFA for Role Change

4 Simulation Results

The behavior and performance of proposed IMPROVED algorithm has been analyzed and simulated using NS-2 version 2.33**.** NS-2 is an event oriented network research simulator**.** In this section sample of simulation tests are shown**.**

I Scenario

A scenario of wireless sensor network has to be organized. It consists of 100 mobile nodes distributed within an environment of 100 x 100 meters.
Initial configuration of all nodes is same. Following are the configurations required:
- The network interface is 802.15.4
- The initial energy of every node is 2 joule.
- The maximum transmission range is 15 meters.
- The IMPROVED algorithm is run on every node.

II Running NS-2

The stabilizing time is considered as 10 second. At instant 25, the weight is estimated and at instant 30, clustering is done. Here various nodes are identified like agent, leader, gateway and willingness to act as gateway. Proper role assignment is shown in figure 4.

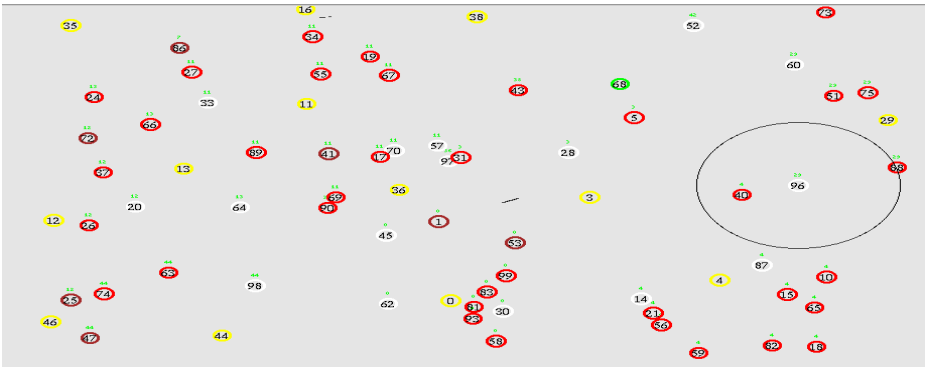

Fig. 4. Roles are assigned with each node

III Analyzing and Comparing Number of Connections with MST

The Minimum communication links generated by MST for 50 nodes is shown in figure 5 [2].

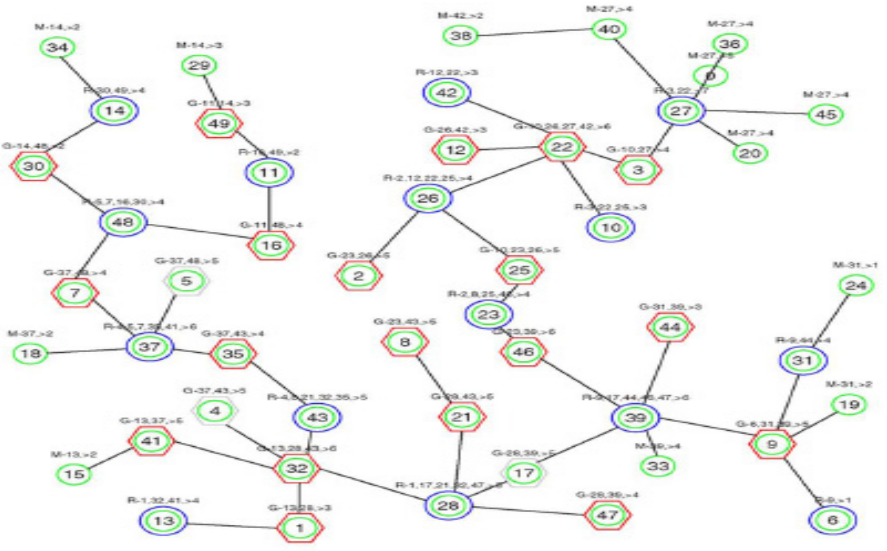

Fig. 5. Number of communication links generated by MST

Figure 6 shows connections formed by IMPROVED role based self organization algorithm for 50 nodes.

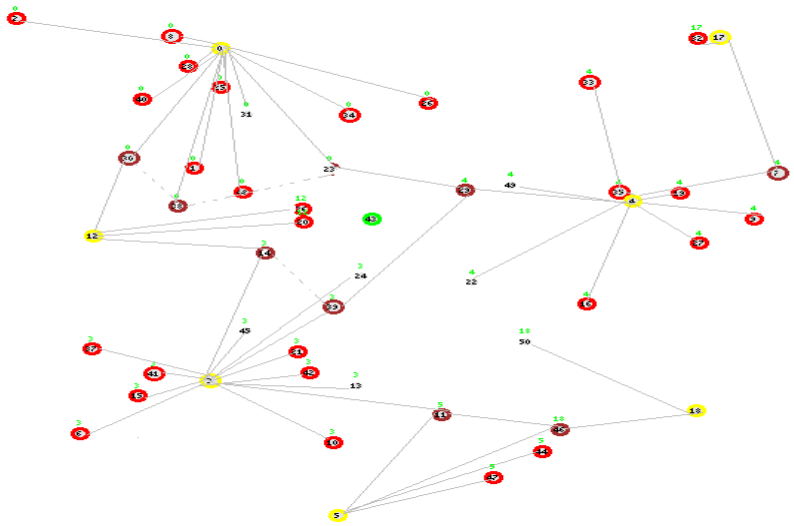

Fig. 6. Number of communication links generated by IMPROVED algorithm

Following table gives comparative analysis of number of links with MST [2].

Table 1. Comparitive analysis of MST and IMPROVED Algorithm

NS2 Environment			No of links		Performance	
Range	Agents	Dimensions	MST	IMPROVED Algorithm	Inactive Links	Proximity %
15 Mts	50	100x100	49	54	3	96%
15 Mts	60	100x100	59	69	3	89%
15 Mts	70	100x100	69	78	3	92%
15 Mts	80	100x100	79	90	8	96%
15 Mts	100	100x100	100	121	12	92%

Table 1 indicates that simulation results are near to MST and IMPROVED algorithm gives better performance.

5 Conclusion

Efficient use of resource is very important in case of wireless sensor network. Unnecessary broadcast due to duplicate gateway increases number of network

connections and energy consumption. Proposed approach identifies roles efficiently and minimum connection backbone is formed. Simulation results have shown that simulation is near to MST. Thus role based IMPROVED algorithm forms efficient backbone and helps in minimizing network connections and in turn avoids unnecessary broadcast.

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