A Power-aware Routing Approach for Ubiquitous Sensor Networks

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Abstract. An autonomic computing system has four basic characteristics, namely self-configuration, self-optimization, self-healing and self-protection. Autonomic computing can be viewed as a new computing paradigm and it is becoming a hot research topic in distributed and ubiquitous computing area. In this paper, we proposed an autonomic agent based power-aware routing approach for ubiquitous sensor networks which is a distributed and localized routing approach. We also provided an application scenario to the network where the power consumption is one of the most critical issues. The amount of agent is carefully selected and network performance is compared.

Keywords: Autonomic Computing, Routing, Ubiquitous Sensor Networks

1 Introduction

Autonomic computing [1] has in the past few years attracted much attention as a novel computing paradigm. Basically, it is a concept of self-managed computing systems with minimum human consciousness or involvement, deriving from the human autonomic nervous system. In [2], the essence of autonomic computing and scientific challenges are thoroughly analyzed. Opportunities and possible research directions of autonomic computing in engineering field are explained in [3].

Swarm Intelligence (SI) is an Artificial Intelligence technique involving the study of collective behaviour in decentralized systems. Although there is typically no centralized control dictating the behaviour of these agents, local interactions among them often cause a global intelligent pattern to emerge. Swarm-like algorithms, such as Particle Swarm Optimization (PSO) [4] and Ant Colony Optimization (ACO) [5], have already been applied successfully to solve real-world optimization problems.

It is a good alternative to combine autonomic computing with swarm intelligence and to apply them to some distributed applications such as ubiquitous sensor networks and complex networks etc. Through localized collaboration among autonomic agents, better performance like power consumption, packet delivery rate and communication overhead can be achieved in a dynamic and distributed environment.
2 Our Autonomic Agent based Routing Approach

Inspired by [6], we present an autonomic agent (AA) based routing approach in Fig. 1 by combining some autonomic functions with routing mechanism.

![Figure 1. An autonomic agent based routing approach](image)

Usually, each AA is piggybacked into a hello packet and periodically broadcasted to collect information like available services, remaining energy, distance, hop number etc. SI mechanism is adopted with pheromone evaporation, reinforcement and aging.

Once source node has routing request, it will first check the availability of service and send its data to the next candidate neighbor if service is available. If not, it will check availability of AA and perform routing discovery process and use subclass functions like pheromone generation, update and aging etc.

Thus, each node will find its next hop candidate and forward the traffic packet based on the routing table and pheromone table during route setup phase. During route maintenance phase, routes are maintained either through periodical hello packets or AA exchange. In the meantime, pheromone value is reinforced or evaporated to represent real network situation.

3 Performance Evaluation

We set our simulation environment as follows. There are [40,150] nodes randomly placed within a 200*200 m² area with transmission range [30,80]m.

In Fig. 2, we make a comparison between different numbers of agent approaches in the aspect of successful routing set-up rate. From this figure, we can see that there is no reliability guarantee if the agent number is too small. As node number increases, the successful packet delivery rate will also increase.
4 Conclusion

By combing the mechanism of autonomic computing and swarm intelligence, an autonomic agent based novel routing approach is proposed in this paper. The detailed autonomic routing approach is discussed and simulation results also validate the effectiveness of our proposed approach.

References