Chapter 11
A Self-Organized Software Deployment Architecture for a Swarm Intelligent MANET

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ABSTRACT

A class of self-organizing readily deployable network (MANET: Mobile Ad-hoc Network) has been developed to address applications such as distributed collaborative computing, disaster recovery, and digital battlefield. Some of these applications need collaboration software running in the network to help in their mission. Because of the inherent nature of MANET, collaborative software application deployment has not been easy. Researchers have focused on those challenges like minimizing power, computing and memory utilization, and routing. With advancement of high-end devices, power, computing, and memory is not much of a constraint now. Mobility is still a challenge and is a major inhibitor for researchers to think about software application deployment architecture on MANET. This chapter proposes a self-organized software deployment architecture by which any 3-tier application can be deployed in a MANET. After the application is deployed, this chapter also enhances the previously proposed adaptive movement influenced by swarm intelligent principles.

INTRODUCTION

Wireless network allows users to access information and services electronically, regardless of their geographic position. Demands for user mobility and portable computing, lead to the development of a class of self-organizing, readily deployable network architecture known as MANET. It operates without any fixed pre-installed communication infrastructure. Ad-hoc networks have found great interest in applications such as distributed collaborative computing, disaster recovery and digital battlefield.

A group of nodes form MANET to achieve a common goal and that is nothing but swarming as it can easily be compared with an aggregation of similar animals cruising in same direction. Collaboration software can help in these goals. Initial challenges in MANET like mobility, memory, computation power did not allow researchers to think about application software deployment over MANET.

With technology advancement a MANET can now be formed of high end heterogeneous type of devices where power, computing and memory is not much of a constraint.

Communication between two arbitrary nodes in an ad-hoc network requires routing over wireless multi hop paths. The nodes taking part in a route being mobile cause frequent link failure. Thus mobility of nodes presents the most challenging issue for communication within the network. In our prior work we proposed adaptive movement algorithms (Basu & Chaudhuri, 2003; Basu & Chaudhuri, 2004) to stabilize network connectivity.

Swarm Intelligence (SI) is the collective behavior of decentralized, self-organized systems, natural or artificial (Zhang, Agarwal, Bhatnagar, Balochian, & Yan 2013). SI systems are typically made up of elements interacting locally with each other and by that influencing the environment. These are inspired by nature especially biological systems. Natural examples of SI are ant colonies, bird flocking, animal herding, bacterial growth, fish schooling etc.

Research in SI started in the late 1980s (Zhang, Agarwal, Bhatnagar, Balochian, & Yan 2013). Apart from the applications to conventional optimization problems, SI can also be applied in to a variety of fields in fundamental research, engineering, industries, and social sciences such as library materials acquisition, communications, medical dataset classification, dynamic control, heating system planning, moving objects tracking, and prediction.

Swarm intelligence has several powerful properties desirable in many network systems. . A key element of future design paradigms is emergent intelligence – simple local interactions of autonomous swarm members, with simple primitives, giving rise to complex and intelligent global behaviour. Swarm intelligence has found its interest in MANET also.

In this chapter I propose self-organized software deployment architecture using which a three tier collaborative software application can be deployed. I also enhance our previously proposed adaptive movement scheme using Swarm Intelligence principles. To the best of my knowledge no proposal has been made on how to deploy a multitier application over an ad-hoc network.

In the current scheme the network selects a node as application server and another node as database server dynamically based on some predefined preconfigured network performance characteristics e.g. number of one hop neighbors, strength of neighbors, node willingness etc. If the application software is not much memory hungry both application server and database can be hosted in a single node.

After an application server and database server is identified, a three tier application can easily be deployed in a self organized manner. Usually a three tier application needs a web application server to host the application and a database server to have the database. Clients connect to the application server through HTTP/HTTPs (w3C).

The application server can host any collaborative application as per the network's need. The scheme will also outline the backup and recovery mechanism for application server and/or database server so that the network can self-restore itself in case there is a failure in the application server and database server and continue using the collaborative software.

All nodes can access the software through HTTP protocol either using a browser or programmatically. To secure the on air communication HTTPS can also be implemented. The scheme also proposes an authentication mechanism for the nodes by which individual nodes can have their own login in the deployed application, and application can implement user based access mechanism for various application functionalities.

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