Performance Evaluation for Network Set up and Nodes Discovery Protocol in Underwater Grid Topology Networks

A.K Othman, W.A.Wan Zainal Abidin, H. Zen, K. Hong Ping, N. Zamhari
Department of Electronic Engineering,
Faculty of Engineering
Universiti Malaysia Sarawak
Kota Samarahan, Sarawak
okhalid@feng.unimas.my

Abstract — **There has been a large volume of research invested over the last decade into overcoming the difficulties inherent with propagation of information bearing signals through the underwater acoustic communications. This has been driven by an increasing demand for reliable and high capacity Underwater Acoustic Networks (UANs). Applications of interest in this area include oceanographic information gathering, environmental monitoring and coastal defence. One of the major challenges in the UANs area of research is the development of a networking protocol that can cope with the adverse underwater environment. We proposed a scheme to perform node discovery based on time of arrival by only one seed node (Primary Seed) placed in known position. The primary seed is capable of determining neighbouring nodes and eventually all nodes in the network without GPS. The protocol of discovery and algorithms of selecting the next seed node that is capable of node discovery and gain their connectivity are suggested. In this paper the structured grid topology networks is used to compare and evaluate the performances of the algorithms. By the end of node discovery, each node will have the knowledge of nodes identification; number of nodes in the network and direction all other nodes.**

Keywords: Node Discovery; Underwater Networks; Protocol;

I. INTRODUCTION

Underwater acoustic network may be a static network whose nodes are dropped by a plane into a sea or dynamic such as autonomous underwater vehicle (AUV). The primary seed node (S_1) and nodes are equipped with an acoustic modem where they can interface with each other across the underwater acoustic network. S_1 could be equipped with the high speed interface such as high frequency (HF) transceiver, very high frequency (VHF) or ultra high frequency (UHF) so it can pass the data or information to the onshore station. S_1 is the node that responsible to start the discovery in the network with known coordinate. In underwater acoustic network, one considers the problem of organizing nodes whose connectivity is unpredictable.

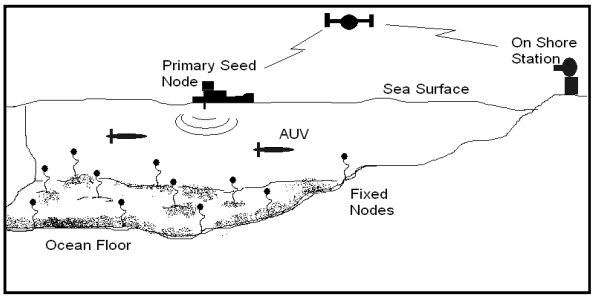

Figure 1. Typical Underwater Acoustic Network

This connectivity is depending on a few factors. At low frequency acoustic signal range is not constant but varies in time and frequency due to variety of factors such as:

- relative node orientation (location of the remote nodes)
- noise level
- propagation losses (sea state affects [1])
- fading (bottom and upper sea wave interference)

As a result of these variations, the connectivity in the network is subject to change. Furthermore, this connectivity is affected by relative movement of the node in such environment, node and link failures and the addition of the new nodes. Consequently a very important characteristic of a mobile and widely dispersed underwater communication network is a changing of topology and long propagation delay (approximately 1550 m/s).

Another characteristic should be considered in such environment is the half duplex communication where the modem cannot transmit and receive at the same time. The near far problem may occur in such underwater environment. To prevent the near far effect, scheduled transmission is required. Therefore, any organization of the network's architecture must take account of these characteristics. The technique to gain distance is by using the time of arrival. Recently a few approached in RF have been proposed to gain location that require few anchors (node with known coordinate) [3, 4, and 5]. We propose of using one anchor (primary seed node) while tackle the limitations of underwater environment. As GPS is not used