Comparison and Analysis of Opportunistic Delay Tolerant Network Protocols for Off-Shore Communication

Radhika M.
Amrita Center for Wireless Networks and Applications
Amrita School of Engineering, Amritapuri Campus
Amrita Vishwa Vidyapeetham University

Dhanesh Raj
Amrita Center for Wireless Networks and Applications
Amrita School of Engineering, Amritapuri Campus
Amrita Vishwa Vidyapeetham University

Maneesha Vinodini Ramesh
Amrita Center for Wireless Networks and Applications
Amrita School of Engineering, Amritapuri Campus
Amrita Vishwa Vidyapeetham University

***Abstract*— In a maritime environment, affordable long range communication network for fishing vessels are highly necessary for safety at sea and to communicate to shore and back to the fishing vessels. The existing communication architecture faces major challenges in achieving seamless connectivity due to the mobility of fishing vessels, lack of backbone infrastructure, propagation effects, and fault tolerance. In this work, we explored the capability of Delay Tolerant Networks (DTN) for providing better connectivity under the above mentioned parameters. Existing DTN protocols such as Epidemic, Spray and Wait and MaxProp protocols were studied and analyzed for maritime scenario. These protocols were simulated in Opportunistic Networking Environment (ONE) simulator and analyzed with respect to node density, node mobility, and intermittent connectivity. The results show that Epidemic protocol has moderate average latency, whereas Spray and Wait protocol and MaxProp has better data delivery rate with lesser average latency.**

Keywords- Delay Tolerant Networks (DTNs), sparse networks, intermittent connectivity, ONE simulator

I. INTRODUCTION

Ensuring seamless connectivity in mobile networks are one of the major challenges yet to be solved. Each of the mobile networks has its own specific characteristics and mobility patterns which will impart new constraints on implementing the existing protocols. Hence the existing protocols will become incapable to provide the required performance for the specific network characteristics. To avoid the performance degradation while we use existing protocols, we need to devise enhanced protocols that will capture the unique characteristics of the mobile networks.

Our research focuses on the maritime environment, where large number of fishing vessels travel kilometers away from the shore to catch fishes for multiple number of days. In India, the fishing vessels lack seamless communication network while they are at sea. The current cellular communication network provides connectivity only up to a maximum of 15 km from the shore. This work analyzes the necessity of delay tolerant networking for a new communication network proposed by a team of researchers as part of the project MICRONet to improve the reliability of communication facility to the shore and between the fishing vessels.

The communication architecture of MICRONet uses a multi-level P2MP hierarchical network integrated with Long Range Wi-Fi and Wi-Fi communication technology. This is a hybrid architecture which shows the characteristics of infrastructure mode networking, ad-hoc communication networking, and mesh networking. This opportunistic networking provides unique challenges and the mobility of fishing vessels incorporates more challenges in ensuring reliable connectivity to the shore. Hence our effort is to develop requirements for designing an enhanced delay tolerant networking protocol very specific to the above mentioned communication architecture.

In a maritime communication network, using traditional MANET concepts messages can be routed toward the destination in a short time if there exists a dense mobile network. However, the extensive fishing area and the sparse number of fishing vessels leads to opportunistic contacts. Communication between the fishing vessels occur only when the fishing vessels are in the connectivity range of each other. The communication link may experience frequent connections and disconnections in a MANET based mobile networks. Moreover, routing the message at ocean requires the data to pass through multiple hops, leading larger latency and packet drop. To avoid data loss, the data need to be queued prior to translation between the networks. Therefore, we need a message delivery system at ocean, with minimum transmission delay and latency, which communicates regardless of the harsh environmental conditions and lack of infrastructure.

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ISSN 1947-5500