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The Design of Channel Estimation and Blocking Probability for Multi-Hop Wireless Communication Network

Divya Jyothi. K[1], Shavali. V[2]
[1]Department of ECE, Sri Venkateswara Institute of Science and Technology, Kadapa, India
[2]Assistant Professor Department of ECE, Sri Venkateswara Institute of Science and Technology, Kadapa, India

Abstract: The paper presents the design of channel estimation and blocking probability for multi-hop wireless communication network (MH-WCN). This work proposed a bidirectional network coding 4−hop transmission strategy and followed by 2N−hop WCNs. The proposed method follows two steps. Firstly, assign composite channel coefficients at desired nodes and then derived the MSE performance expression for the proposed LMMSE estimation scheme, and an optimal training scheme has been designed to minimize MSE. Secondly, Fault-tolerant wavelength assignment algorithm. This method checks for the establishment of fault-free path, when path established, assign a particular wavelength to the established path. The experimental results shows the LMMSE, blocking probability and ML estimators have demonstrated effectiveness to improve the estimation accuracy in 4−hop WCNs.

Index term:- Fault-tolerant wavelength assignment algorithm, Multi-hop wireless communication networks, mobile social networks, network coding, channel estimation.

I. INTRODUCTION

In recent years, there has been significant advances in wireless networking. Such advances are improved by the demand of new practical and military applications as well as advances in wireless communication technology at the communication layer. These new advances at upper and lower layers in communication have brought many new research problems for networking researchers. Among these problems, a fundamental problem is to determine performance limits and to design a system to achieve these limits. Due to new requirements (performance metrics) by these new applications and unique characteristics (constraints) associated with these wireless networks, traditional analytical approaches are no longer adequate[1] . With the dramatic evolution of mobile communication systems and the rapid rise in the use of advanced mobile devices, the original web-based social networks have comprehensively penetrated into the mobile platform in recent years, motivating the newly emerged research field of mobile social networks (MSNs) [2]. Currently, a large proportion of global communication traffic is contributed by user-generated activities associated with MSNs, e.g., instant messages, document sharing, and interactions within friend circles. MSNs have been characterized as pervasive and omnipotent mobile communication platforms involving social relationships via which users can search, share and deliver data anytime and anywhere [3].

In power on-off scheduling topology management schemes, few nodes, rich in power, are selected as cluster heads and gateways. These cluster head nodes are selected distributive in such a way that each node in the ad hoc wireless network is either cluster head or connected (i.e., in transmission range) to the cluster head and the gateway nodes are selected such that they forward packets between cluster heads. Cluster heads and gateways form the virtual backbone for routing in ad hoc networks. Some proposed power on-off scheduling topology management schemes are Span [4]and TMPO (Topology Management by Priority Ordering) [5] . In span, some special coordinator nodes are selected distributive in such a way that two of the coordinators neighbors can not reach each other either directly or via one or two coordinators. This selection rule ensures the connectivity in ad hoc network. Span runs over 802.11 ad hoc power saving mode, which has high broadcast overhead. While TMPO assigns willingness value to each node, based on the energy level and speed of the node. A node with high willingness value is selected as cluster head with high probability.

II. NETWORK TOPOLGY

In our topology management scheme, NFPQR (Node Failure prediction for query routing) nodes are selected in such a way that link nodes have the maximum power level among their on hop neighbors and all non-link nodes are within the transmission range

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of link nodes. These link nodes have the routing intelligence i.e. they make all decisions related to routing. The gateway nodes having sufficient power level are selected so that they can forward packets between link nodes. A gateway node does not have routing intelligence. These link and gateway nodes stay continuously awake to route the packets of other member nodes. The member nodes wake up a number of times in a beacon period T, and if they do not have to transmit or receive data, they goes to sleep mode again. The wake up time for each node is calculated from a pseudo-random number, such that link node and neighbor nodes know the wake up of that node time. Thus the member node can remain in power saving sleep mode most of the time, if it is not actively sending or receiving packets. The packets are routed over the virtual backbone consisting of link nodes and gateways. The routes are found with the help of mobile agents.

The topology management scheme runs above the MAC layer and interacts with the routing protocol. If a node has been asleep for a while, packets destined for it are not lost but are buffered at a neighboring link node. When the node awakens, it can retrieve these packets from the buffering link node. This topology management schemes makes the routing simple, as only those entries in a node's routing table that correspond to currently active link nodes can be used as valid next-hops (unless the next hop is the destination itself).

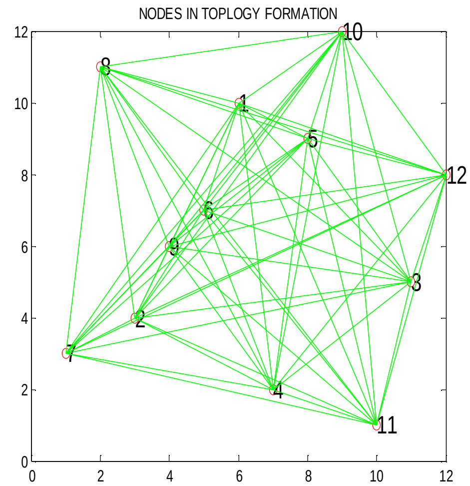

Fig.1. network topology

Definition 1 link nodes are the nodes such that all non-link nodes are connected to (i.e., in transmission range of) link nodes and route packet for all other nodes with the help of mobile agents.

Definition 2 Sleep Cycle period is the time period during which member nodes remain in the power efficient sleep mode and wake up once for fixed time duration T.

We assume that each node periodically broadcasts a HAI message that contains:

Node's id,

Its status (i.e., whether the node is a Link node, gateway, and member, undecided),

Its current power level,

Its current link node,

A wakeup counter wi,

Information about each neighbor i.e. Neighbors id, Its status & Its link node.

Based on the HAI messages received from neighbors, each node constructs a list of the its neighbors, their link nodes, power level, wakeup counter and information about their neighbors. A node switches state from time to time between being a link node and being a member. A node becomes a gateway, if its link node chooses it as a gateway to route the packets between link nodes. It switches its state to undecided, if it looses contact with its link node due to mobility. A node includes its current state in its HAI messages. The following sections describe that it should withdraw from being a link node, and how a link node selects its gateways.

III. CHANNEL ESTIMATION SCHEME

The proposed method used LMMSE estimation. The method of least -mmse is estimating the mmse by minimizing the squared discrepancies between input node signal and their expected destinate node signal values. We will study the method in the context of a regression problem, where the variation in one variable, called the response variable Y, Multiple Linear Regression co variables X. The prediction of Y is given by

$$Y = x + \text{noise}$$

Where
x=source node signal
The least squares estimator, denoted by β, is that value of b that minimizes

$$\sum_{i=1}^{n} (y_i - f_b(x_i))^2,$$

To obtain a closed-form expression of the corresponding MSE, we use Cramer Rao Lower Bound (CRLB), which provides a lower bound on the variance of unbiased estimates is given by

$$\text{CRLB}_{\theta_1} = \frac{D_3(D_1 D_3 - |D_2|^2)}{|D_2|^4 - 2D_1 D_3 |D_2|^2 + D_1^2 D_3^2 - |D_4|^2 D_3^2}$$

Where

$$D_1 = \frac{\alpha_1^4 \tilde{\alpha}_3^2 Q_1}{\sigma_n^2 \xi(1+a)} + \frac{a_0^2 (r-2)^2}{4(1+a)^2},$$

$$D_2 = \frac{\alpha_1^4 \tilde{\alpha}_3^2 \rho \sqrt{Q_1 Q_2}}{\sigma_n^2 \xi(1+a)},$$

$$D_3 = \frac{\alpha_1^4 \tilde{\alpha}_3^2 Q_2}{\sigma_n^2 \xi(1+a)}$$

$$D_4 = \frac{a_0^2 (r-2)^2 \theta_1^2}{4(1+a)^2 |\theta_1|^2}.$$

Improving the signal quality, removing noisy signal domain and minimum MMSE denoise signal are the advantages of LMMSE technique.

IV. WAVELENGTH ASSIGNMENT ALGORITHM

This algorithm is used to calculate the blocking probability of each node i.e it estimate the noise signal in particular path. As the load per link increases blocking probability increases in the earlier models and algorithms; whereas, blocking probability decreases with the proposed fault-tolerant routing and wavelength assignment algorithm. The algorithm of wavelength assignment algorithm as shown below

Begin
Do not assign any wavelength in any path
Check for the establishment of fault free path
When path is establish then assign the wavelength for particular path
End

This method checks for the establishment of fault-free path, when path established, assign a particular wavelength to the established path. This will lead to the proper utilization of wavelength hence minimum number of wavelengths will be required for the given network.

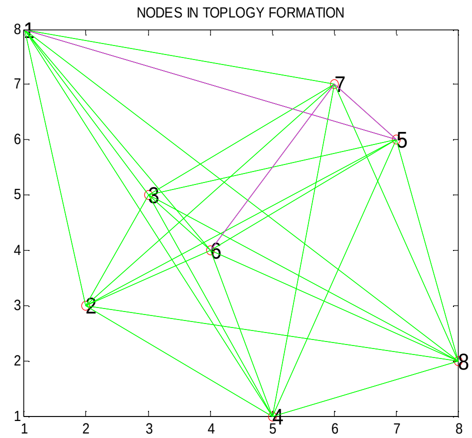

Fig.2. minimum number of wavelengths

V. EXPERIMENTAL RESULTS

THE proposed method is simulated using MATLAB with 23 random sensor nodes. Simulations are performed for random distribution of sensor nodes. The base station is located at one corner of the network.

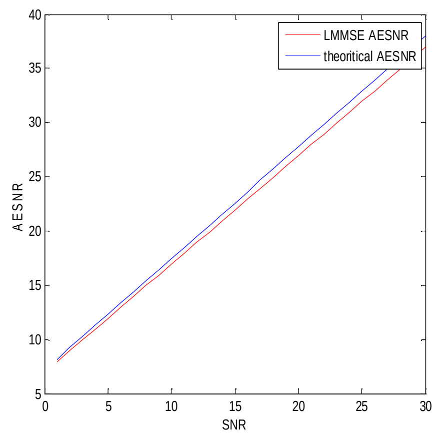

Fig.3. Theoretical and LMMSE AESNR comparison with regards of SNR.

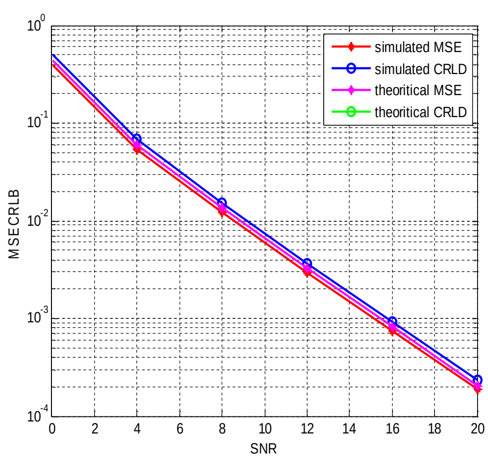

Fig.4. MSE/CRLB comparisons between analysis and simulation.

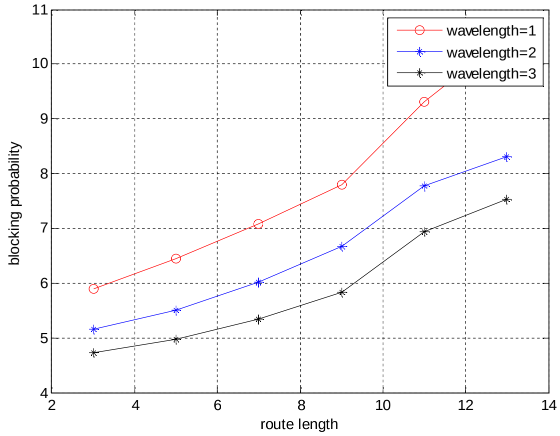

Fig.5. Blocking probability of the proposed fault-tolerant routing and wavelength assignment algorithm, as a function of route length,

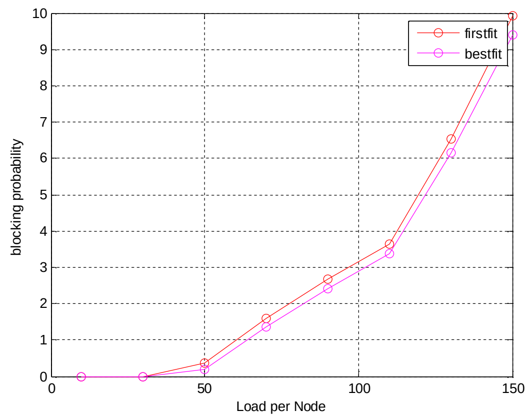

Fig.6. Blocking probability of best-fit and first-fit routing algorithm as a function of load

VI. CONCLUSION

In this paper has presented the channel estimation and blocking probability in wireless network. Using this routing and wavelength assignment algorithm we can reduce the blocking probability to a large extent. The simulation results show that the amount of transmitted data is reduced the noise, significant improvement in bandwidth utilization and energy consumption.

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