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# MA-LTRT Method to Improve Network Connectivity and Power Consumption in Mobile Ad-hoc Based Cyber-Physical Systems

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**Abstract:**

The main objective of this project is improve the power consumption in cyber-physical systems. First, each node sends the Hello message including its moving speed and the position to the neighboring nodes in the area of its maximum transmission range.Secondly, after receiving the returned message including the information of the node such as the position and the moving speed from the neighbors, the topology based on LTRT is constructed according to the neighbors' information with the given initial value of k.Finally the optimal topology reconstruction interval and the redundant transmission range are calculated.

## 1. Introduction:

A cyber-physical system (CPS) is a system of collaborating computational elements controlling physical entities. Today, a precursor generation of cyber-physical systems can be found in areas as diverse as aerospace, automotive, chemical processes, civil infrastructure, energy, healthcare, manufacturing, transportation, entertainment, and consumer appliances. This generation is often referred to as embedded systems. In embedded systems the emphasis tends to be more on the computational elements, and less on an intense link between the computational and physical elements. A challenge in the development of embedded and cyber-physical systems is the gap between the various involved disciplines, like software and mechanical engineering. In a marketplace, where rapid innovation is essential, engineers from all disciplines need to be able to explore system designs collaboratively, allocating responsibilities to software and physical elements, and analyzing trade-offs between them. Recent advances show that coupling disciplines by using co-simulation, will allow disciplines to cooperate without enforcing new tools or design methods. Mobile cyber physical systems, in which the physical system in question has inherent mobility, are a prominent subcategory of cyber-physical systems. Examples of mobile physical systems include mobile robotics and electronics transported by humans or animals. Network connectivity is not a single function, with a single impact on power and energy use. Rather, we need to deal with a variety of potential conditions that can occur that have inherent implications for energy use, dictate potentials for functionality, and are measureable. These all can depend on the nature of the physical layer interface in use, the status of the connection, and the quantity and nature of any data flowing across the link. Mere data links are almost always much simpler; for example, the infrared sensor (receiver) on a television for a conventional remote control has a power requirement that is essentially constant and low.

## 2. Related Work:

L. Xu [1] This paper presents an effective service scheduling for human drivers in vehicular cyber physical systems by using linear programming and greedy heuristic algorithm. The linear programming is used to progressively set the nodes based on the results from the constraints. The greedy heuristics uses three techniques utility loss dominant strategy, utility income dominant strategy and utility profit dominant strategy to schedule the works. N. Thuan [2] This paper presents the performance evaluation of reliable topology control algorithms in mobile ad hoc networks by using local tree based reliable topology. The local tree based reliable topology uses the k edge connected component to improve the connectivity of the networks. By the node movement control the energy used by the nodes are being controlled. J. Wu [3] This paper presents the mobility sensitive topology control in mobile ad hoc networks by using consistency. It uses weak and strong consistency which synchronizes the mobility in the networks. The delay and the mobility management techniques are used to control the energy used by the nodes in the networks. Fang-Jing [6] In the past two decades, a lot of research activities have been dedicated to the fields of mobile ad hoc network (MANET) and wireless sensor networks (WSN). More recently, the cyber physical system (CPS) has emerged as a promising direction to enrich the interactions between physical and virtual worlds. In this article, we first review some research activities in WSN, including networking issues and coverage and deployment issues. Then, we review some CPS platforms and systems that have been developed recently, including health care, navigation, rescue, intelligent transportation, social networking, and gaming applications. Through these reviews, we hope to demonstrate how CPS applications exploit the physical information collected by WSNs to bridge real and cyber spaces and identify important research challenges related to CPS designs.

In CBTC, each node sets its transmission range to connect its neighboring nodes, which are on the fan shaped area, having an angle. In LMST, each nodeConstructs the topology, which is based on the MST (Minimum Spanning Tree) with the information from only the neighboring nodes that are one hop away. Each node calculates the MST by using the information including their position information, and uses the MST to construct topology. LMST and Tree-based Reliable Topology (TRT) guarantees k-edge connectivity, i.e., the network connectivity cannot be lost if the number of broken links is smaller than k. It has low transmission range and excessive power. To avoid the above drawbacks this project proposed MR-LTRT. In this method each node sets the reconstruction interval of its topology dynamically to increase the connectivity and to reduce the power consumption. Additionally, by controlling the redundancy of the topology, it also achieves to prevent ineffectual increase of the power consumption while keeping high network connectivity. The following chapter shows the methods and results.

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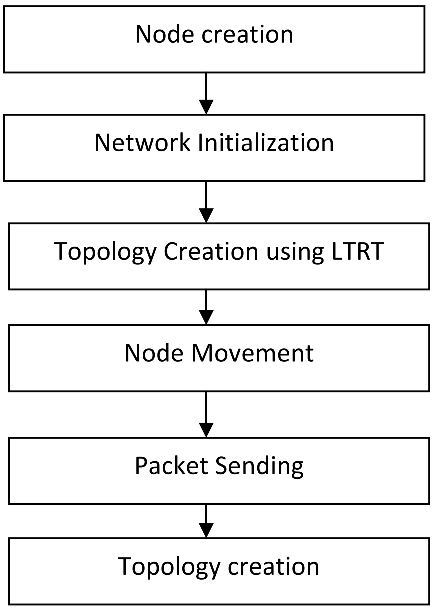
## 3. Methodology:

### 3.1 System Architecture




### 3.2 Modules

#### 3.2.1 Topology creation using LTRT:

The topology created using the LTRT. The proposed MA-LTRT utilizing the redundant transmission range dynamically for topology control. The edge node of the transmission range of the center node which controls the topology results in the decrease of the connectivity in the mobile ad-hoc network based CPS. MA-LTRT method, redundant transmission range is utilized to keep a certain level of redundancy of the topology.

#### 3.2.2 Node Movement:

Moving of the center node which controls the topology and the edge node of the transmission range, and define the moving speed of these two nodes as vc and ve, respectively. To keep connectivity with the edge node at any time until the next reconstruction of the topology, the redundant transmission range is determined by considering the worst situation where the center and edge nodes move in the opposing directions. By considering the worst situation in determining the level of redundancy, the center node will be able to keep connection with the edge node regardless of the moving direction.

#### 3.2.3 Packet Sending:

An adequate redundant transmission range, we focus on the relationship between the power consumption and topology reconstruction interval. If the interval is set to a small value, each node needs to broadcast the Hello Messagequite frequently. Since the message is sent to the entire area covered by the maximum transmission range, the increase of number of times to send the message causes the increase of power consumption.

$$P_{\text{hello}} = n \cdot p_{\text{d}} \cdot d_{\text{hello}}.$$

The number of topology reconstruction during the time of T is expressed with the topology reconstruction interval and the time of T as follows.

$$n = \frac{T}{\Delta t}.$$

The power consumption, when the proposed method is utilized, is calculated as follows.

$$P_{\text{opt}} = \frac{p_{\text{d}} \cdot d_{\text{hello}} \cdot T}{\Delta t_{\text{opt}}} + p_{\text{d}} \cdot d_{\text{data}} \cdot T \cdot \left\{ \frac{R_{\text{tra}} + (v_c + v_e)\Delta t_{\text{opt}}}{R_{\max}} \right\}^4.$$

## 4. Results:

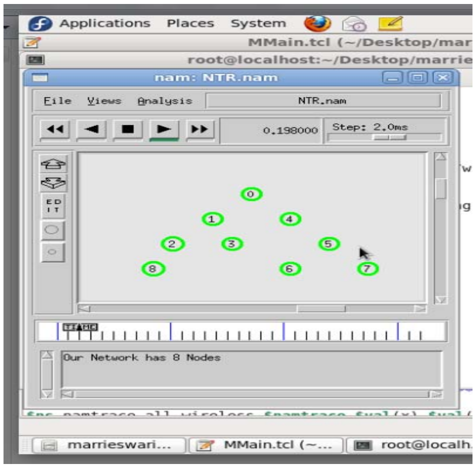



Fig: 4.1 Node Creation

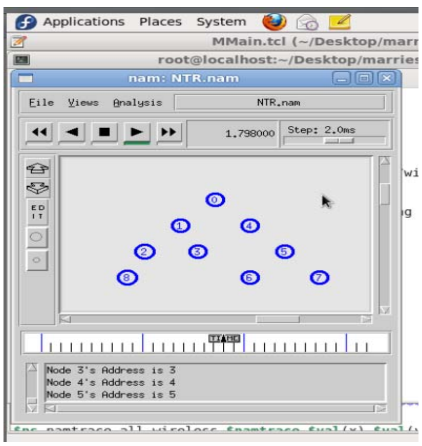



Fig: 4.2 Node Address

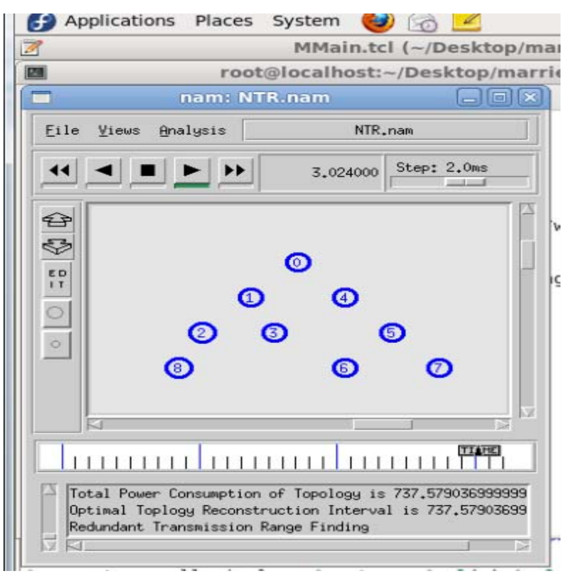



Fig: 4.3 Topology Reconstruction

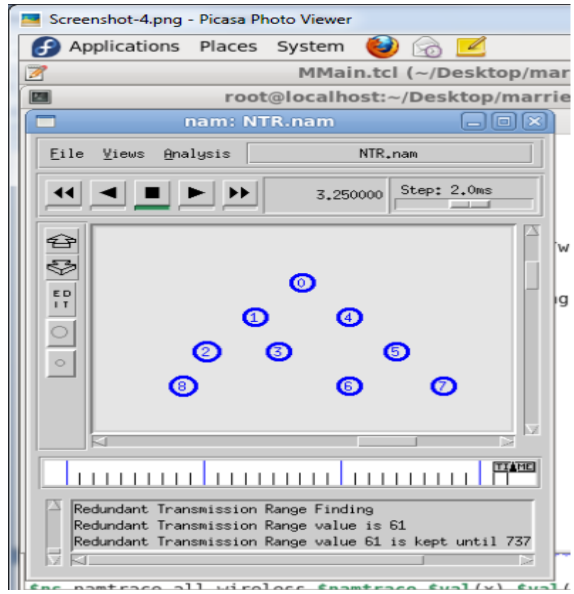



Fig: 4.4 Redundant Transmission Range

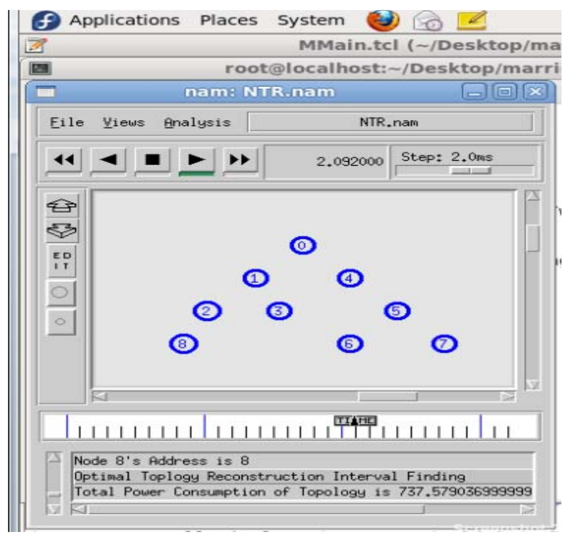



Fig: 4.5 Optimal Topology Reconstruction

### Performance Evaluation:

### Performance Metrics:

### Energy:

To define this amount of power consumption when the maximum

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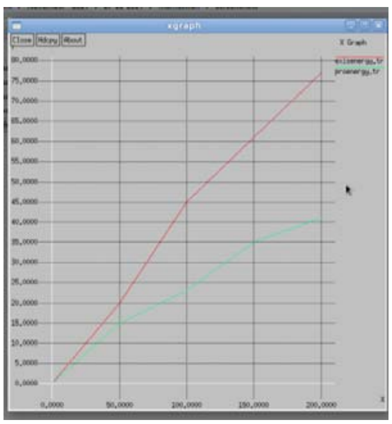
transmission range is utilized as *P*max. Thus, the energy expanded ratio, denoted by *EER*, is expressed as follows.

$$EER = \frac{P_{\mathrm{opt}}}{P_{\max}}.$$

To compare the existing and proposed system with the energy. The following graph shows the results.



## 5.Conclusion:

This project proposed the MA-LTRT for power consumption. After network initialization, the topology to be constructed using the LTRT. The movement of each node occurred. Then the Hallo packet to be sent.Finally calculated the power transmission. This method is very efficient and power consumption. The proposed MA-LTRT method in terms of significant improvement in thenetwork connectivity and power consumption. In future this can be extended as to improve the security of packet sending.

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