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REVIEW OF REAL TIME CONTROL OF LAUNCH VEHICLES USING WIRELESS NETWORK

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Abstract - *Network design for real time control of launch vehicles need to consider latency and noise in wireless environments. The proposed system will gather the acceleration information received from multiple sensors to reliably and robustly relay the orientation of the rocket back to the actuator system. To do so, a network simulation software will give us an estimate of the efficiency of these sensors in terms of their latency and throughput. Several factors can be considered to analyze the performance of these sensors such as the location of these nodes, device type, and the network parameters associated with the sensor nodes. In this work, we have analyzed these factors using OPNET simulator to have a better understanding of the performance of these sensors*

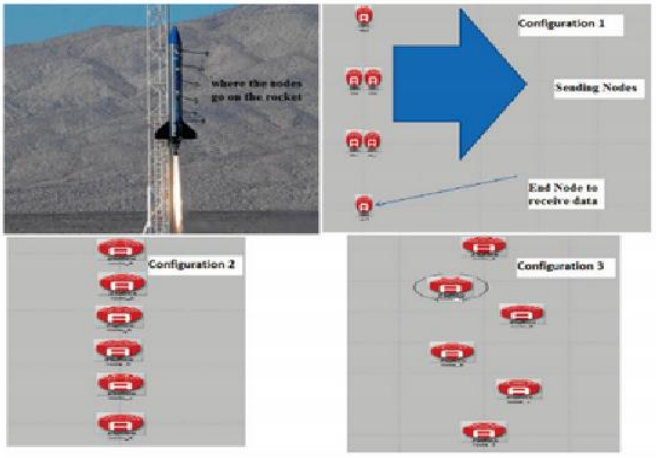
1. INTRODUCTION

As we move towards space missions cost effective development of space technology and launch systems is becoming more important. Wireless Sensor Network[WSN] can be used to decrease the cost and weight of the lengthy wires and to increase the fuel efficiency of the launch vehicles. In a recent publication using the data from multiple sensors the rocket projectiles landing point has been successfully estimated. Using seismic sensors the tremor caused by the landing of the rocket may be measured. The topology if WSN's can vary from a simple star network to an advanced multi-hop wireless mesh network. WSN's can be used in space for various purposes such as space weather missions in low earth orbit(LEO),structural health monitoring of spacecraft, single probe missions etc. The work sensors that gather the acceleration information from the solid rocket body are studied to provide a insight of network performance and its effect on future rocket design. So in order to measure the acceleration data, one node considered the main node, will be capable of receiving information from all other sensor transceivers. The goal is to have a better performance with regard to the delay and throughput of the network. [The paper is organized as follows. section 2 presents the network topology, Section 3 provide simulation results, section 4 concludes the paper]

2.Network Topology:

OPNET network simulator has been used in order to analyze the performance of the network. OPNET is a simulation software that provides user friendly graphical inference. It has a rich library that include. ZigBee standard as well which is low cost, low power and wireless mesh network standard. The low cost allows the topology to be widely deployed in wireless control and generic mesh networks. In this work, we have used the tree network.

Figure 1 describes the network configuration.config-1 is composed of sensors in tandem which is appropriate for narrow rocket bodies with space in mid-section. Config-2 is similar to first one where space is limited in the mid section, and the last configuration places sensors in zigzag fashion is larger diameter rocket.



3.Simulation Results:

The three different scenarios based on the location of the devices on the rocket are composed in this section.

The throughput and the delay of the network have been compared for these 3 scenarios. It allows us to receive more data with less loss.

Table 1 describes the attributes of each node and nodes are being placed on the rocket based on 3 configurations. Total of 6 nodes are located on a 12 feet tall rocket.

The first 2 scenarios show almost similar performance while the last scenario i.e. configuration 3 performs superior to the other two. This is because nodes are located differently inside the network combined with the usage of the CSMA/CA. Protocol which allows the user to use the channel with less number of collisions.

4.Conclusion:

In this work, the network performance for the data acquisition from several sensors on board of rocket is studied. One way of positioning the nodes inside the network is determined. The wired networks such as bus and star topology will also be compared with the wireless scenarios. So wireless sensor networks are highly recommended for future spacecraft control systems based on their lower weight and cost

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