Abstract- The demand for seamless positioning has been significantly high in vehicular applications, such as navigation, intelligent transportation systems, collision avoidance, etc. Most seamless positioning techniques are based on integrated methods. In order to provide seamless positioning, this paper proposes GPS, RFID Hybrid approach in three different scenarios. Hybrid approach, also allows vehicles without GPS to compute their position by contacting GPS equipped neighbors. The performance of the proposed localization system is evaluated using MatLab.

Index Terms- Vehicular, localization, DGPS, Map-matching

1. INTRODUCTION

The demand for seamless positioning has significantly increased since the introduction of ‘ubiquitous computing’ in the late 1980s. Positional information has become more and more important seeing as it is needed everywhere all the time. Consequently, the method of providing seamless positioning has attracted a great interest towards various integrated techniques such as GPS/INS, GPS/MEMS, GPS/DR etc.

This paper introduces three different RFID-GPS scenarios for achieving localization accuracy as RFID tags at road side, RFID tags at center of lane & RFID tags at divider. Rest of the paper is organized as follows. Next section shows implementation of three different RFID-GPS Scenarios. Results are discussed in detail in section III. Section IV provides our conclusion.

2. DEFAULT SCENARIO FOR PROPOSED SYSTEM

Table 1 shows default values of scenario parameters and simulation is carried out using MatLab.

<table>
<thead>
<tr>
<th>Scenario Parameter</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of vehicles</td>
<td>100</td>
</tr>
<tr>
<td>% of Non-GPS vehicles</td>
<td>50%</td>
</tr>
<tr>
<td>Speed range of vehicles</td>
<td>20-30m/s</td>
</tr>
<tr>
<td>Interval of stationary RFID tag</td>
<td>5 km</td>
</tr>
</tbody>
</table>

By using above mentioned default parameters, the implementation of proposed scenario is carried out and the effect of the scenario parameters on accuracy is observed.

The default VANET scenario developed for simulation is as shown in Fig. 1. Road length of 50 Km is considered for simulation. Blue line indicates road out line. Width of the lane is in between 0m to 9m. Two green dotted lines indicate lane separation at 3m & 6m. GPS vehicles are represented by red dot & Non-GPS vehicles are represented by black dot and the vehicles get Pink colour circles have got its accurate position.

RFID tags on the road side are shown by green square box with black outline at 5Km distance from each other. Green colour circle around each RFID tag indicate 4m range. Identification of vehicles in 4m RFID range is done in next step. After that, movement is provided to the vehicles. Then calculations for GPS & Non-GPS vehicles position are calculated. By varying scenario parameters, graphs are plotted.

Default VANET Scenario :

Three Different Cases of Scenario

Following are the three different cases of RF-GPS scenario.

- **RFID at road side**
  
  Here, RFID tags are installed on road side at 5Km distance from each other. Hence, RFID Y-coordinates will be 0m, which is shown in Fig.2.
RFID tags at center of lane
Here, RFID tags are installed in the center of first lane at 5Km distance from each other. Hence RFID Y-coordinates will be 1.5m, which is shown in Fig.3.

RFID tags between 1st and 2nd lane (at divider)
Here, RFID tags are installed in between first lane and second lane (at divider) at 5Km distance from each other. Hence RFID Y-coordinates will be 3m, which is represented in Fig.4.

Effect of RFID Tags Position:
Comparison of parameters listed in Table 1 carried out by considering three different cases as given below.

3.1 Traffic Volume
Case-1) RFID at road side
Case-2) RFID tags at center of lane

3. RESULTS & DISCUSSION
The RF-GPS system designed & implemented using a 3-lane freeway scenario in which all vehicles move in one direction with various speeds. Vehicles have 4m range RFID system and 250m range IEEE 802.11 radio. Table 1 describes default values of scenario parameters, which uses default values unless explicitly stated. The latency is measured until a vehicle acquires the first accurate position data, which tells us the ability of RFID-GPS integrated system to guarantee accurate positioning in representative traffic conditions. The interval between position acquisitions by Non-GPS vehicles is also measured to assess the ability to support such users.

The proposed localization system is evaluated for four different scenarios parameters. Initially, for different traffic volumes on the road. The total number of vehicles on the road is an important factor since the cars interact with each other to find accurate position. Fewer the vehicles, the fewer are the reference points. Thus, if there are not enough vehicles driving on the road, the probability of receiving the differential co-ordinates decreases. This also degrades the possibility that Non-GPS vehicles encounter GPS vehicles having accurate position.

Second, the percentage of GPS vehicles on the road is changed. This value is especially critical to Non-GPS vehicles. If the numbers of GPS vehicles decreases, Non-GPS vehicles have less chance to obtain travel data via the single peer localization scheme.

Third, the simulation is carried out with different speed ranges. Speed difference between vehicles increases the chance of encountering other vehicles, and thus increases RFID contact rate.

Finally, fraction of RFID enabled vehicles on the road is varied. More RFID capability on the road implies more reference vehicles which improve the position accuracy of nearby GPS vehicles. The impact of RFID penetration on localization performance will be evaluated.
The comparison of results shows that the three different cases for traffic volume parameter, for all vehicle (in Fig.5). Time required to get accurate position for all vehicles is 390 sec, 320 sec & 270 sec for case I, II, & III respectively, for 200 vehicles. Hence it is evident that less time is needed for case III.

For Non-GPS vehicles, time required to get accurate position is 320 sec, 278 sec & 270 sec for case I, II, & III respectively, for 200 vehicles. Hence best is the case III.

3.2 Fraction of Non-GPS vehicle

Case-1) RFID at road side

Case-2) RFID tags at center of lane

Case-3) RFID tags between 1st and 2nd lane (at divider)

Fig.5: Comparison of Three Cases for Traffic Volume Parameter

Fig.6: Comparison of Three Cases for Fraction of Non-GPS Vehicle Parameter

The comparison of results shows that the fraction of Non-GPS vehicles varied for the three cases (in Fig.6). Mean time to get accurate position for 60% population of Non-GPS vehicle on the road, for case I, it is around 58 sec, for case II it is around 38 sec & for case III it is around 33 sec. Hence, mean time to get accurate position is less in case III.
### 3.3 Impact of speed variables

Case-1) RFID at road side

![Graph showing CDF getting accurate position for all vehicles across different ranges.](image)

Case-2) RFID tags at center of lane

![Graph showing CDF getting accurate position for all vehicles across different ranges.](image)

Case-3) RFID tags between 1st and 2nd lane (at divider)

![Graph showing CDF getting accurate position for all vehicles across different ranges.](image)

**Fig.7 Results Comparison of Three Cases for Speed Variable Parameter**

The comparison result shows impact of speed variables for three different cases (in Fig.7). Consider 15-30 m/s range in the three cases. Simulation time for case I is 200 sec, for case II is 180 sec, & for case III is 150 sec. So simulation time is less in case III. It means all vehicles get its position in less time for case III.

### 3.4 Traffic Volume

Case-1) RFID at road side

![Graph showing CDF of GPS Vehicles for different fractions.](image)

Case-2) RFID tags at center of lane

![Graph showing CDF of GPS Vehicles for different fractions.](image)

Case-3) RFID tags at divider

![Graph showing CDF of GPS Vehicles for different fractions.](image)

**Fig.8: Comparison of Three Cases for Fraction of RFID-Enable Vehicle Parameter**

The comparison of results shows that the three different cases for fraction of RFID enable vehicle parameter (in Fig.8). For 20% RFID enable vehicles require simulation time more than 800 sec (case I), 325 sec (case II), for 310 sec (case III). So, even if the less number of RFID enabled vehicles are present on road case II & III gives good result. But best is case III.
4. CONCLUSION

A new localization system in VANETs i.e. Integrated System for Accurate Localization using GPS and RFID has presented use of a RFID system. It develops the mobile version of the DGPS system. RF-GPS calibrates GPS error and thus allows a vehicle to compute its accurate position. Moreover, a vehicle, which does not have a GPS receiver or cannot use the receiver temporarily, is also able to estimate its accurate position with the single peer localization scheme. This localization system has been evaluated extensively via simulations(MATLAB). The results shows that the impact of traffic volume, fraction of Non-GPS vehicles, speed variations & fraction of RFID enabled vehicles on the performance of the RF-GPS system. The simulations show feasibility and performance of the RF-GPS system with following three different cases, RFID at road side, RFID tags at centre of lane, and RFID tags at divider. Case III gives best and fast result as compared with case I & case II. This is due to RFID 4m entire range will be available along with its perimeter in the two lanes. Hence, maximum vehicles get its accurate position.

REFERENCES


[22] Eun-Kyu Lee et al. RFID Assisted Vehicle Positioning in VANETs

[23] Eun-Kyu Lee et al. Department of Computer Science University of California, Los Angeles, RF-GPS: RFID Assisted Localization in VANETs


[31] Utku Yıldırım & Erkan Kurt GPS Simulation Using MATLAB

AUTHOR

Mrs. Sunita S. Shinde received the Bachelor’s degree, the Masters degree in Electronics Engineering from from Shivaji University, Kolhapur, Maharashtra. She is having 14 years teaching experience. Her field of interest is Wireless communication, Adhoc Networks. She is a life member of ISTE. She wrote three books on Computer Networks.

Ravi M. Yadahalli received the Bachelor’s degree, the Masters degree, and the Ph.D. degree from the Gulbarga University, Gulbarga, India in 1990, 1993, and 2009, respectively. From 1993 to 2010, he worked in various positions at the SDM College of Engineering and Technology, Dharwad, India. Since 2010, he has been with the Department of Electronics and Communication Engineering, PES Institute of Technology and Management, where he is currently Professor and Head of the Department. His research interests cover several aspects of microwave engineering including microwave antennas. He has published over 50 papers in technical journals and conferences. He is the reviewer of the Journal of the Electromagnetic Waves and Applications (JEMWA) Progress in Electromagnetic Research (PIER, PIER B, C, M, PIER Letters), USA.