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Improving Quality of Vehicle Tracking Systems in Hill Stations Using IEEE 802.16 Networks

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ABSTRACT

IEEE 802.16 standard was designed to support the vehicle tracking system applications with quality of service (QOS). Tracking system is used for tracking the vehicles in hill stations with quality of service (QOS). With the help of subscriber station (SS) can track the vehicles. Subscriber station's will provide signals to the mobiles and vehicles .In this paper, we propose a scheme, named vehicle tracking system, to track the vehicles without any interrupt in hill stations with quality of service (QOS). The idea of the proposed scheme is to track the vehicles in the roads of the hill stations which is coming in opposite direction and back of the vehicle. Analysis and simulations are used to evaluate the proposed scheme. Simulation and analysis results confirm that the proposed can track the vehicles with the help of subscriber station by given quality of service (QOS). Scheduling algorithms are proposed to improve the overall throughput. The simulation results show that our proposed algorithm improves the overall throughput by 40% in a steady network.

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1. INTRODUCTION:

The Worldwide Interoperability for Microwave Access(WiMAX), based on IEEE 802.16 standard standards [1][2], is designed to facilitate services with high transmission rates for data and multimedia applications inmetropolitan areas. The physical (PHY) and medium access control (MAC) layers of WiMAX have been specified in the IEEE 802.16 standard. Many advanced communication technologies such as Orthogonal Frequency-Division Multiple Access (OFDMA) and multiple-input and multiple-output (MIMO) are embraced in the standards. Supported by these modern technologies, WiMAX is able to provide a large service coverage, high data rates and QoS guaranteed services. Because of these features, WiMAX is considered as a promising alternative for last mile broadband wireless access (BWA).In order to provide QoS guaranteed services, the subscriber station (SS) is required to track the necessary vehicles from the base station (BS) before any tracking transmissions to the vehicles the SS tends to keep the track of the vehicles with the help of other subscriber station (neighbours) and base station. Show that vehicles in tracker with quality of service (QOS) to the driver. Thus all the time it is difficult to track the vehicles in the hill areas. Because of bad weather, bad signals, traffic jams in hill areas. To improve the quality of vehicle tracking system while maintaining the same quality guaranteed services, our research objective is twofold: 1) the vehicle tracking is done with the quality of service. 2) our research work focuses on tracking the vehicles by using fastest algorithms and good tracker systems. We proposed a scheme, named vehicle tracking system, which improves the quality of tracking for vehicles without any extra delays and interrupts. The general concept behind our scheme is to allow other SSs to track the vehicles left by the current tracking SS. Since the tracking vehicles is not supported to occur regularly, our scheme allows SSs with non-real time applications which have more flexibility of delay requirements, to track the bad weather, surrounding of environment vehicles. Consequently, the untracked vehicles in the current location can be identified. It is different from the vehicle tracking in which the tracked vehicle is enforced as early as in the next vehicle tracking. Moreover, the tracked vehicle is likely to be released temporarily (i.e., only in the current location) and Existed tracking vehicle does change in location. Therefore, our scheme improves the overall throughput while providing the same QOS guaranteed services. According to the IEEE 802.16 standard, SSs scheduled on the uplink (UL) map should have transmission opportunities in the current location. The SSs are called Transmission SSs (TSs) in this paper. The main idea of the proposed scheme is to allow the base station (BS) to schedule a backup SS for each TS. The backup SS is assigned to stand by for any opportunities to track the untracked vehicles of its corresponding TS. We call the backup SS as the complementary station (CS). In the IEEE 802.16 standard, Vehicle tracking system (VTS) are made in per vehicles to each connection locally in their areas. There fore, untracked vehicles is defined as the tracking vehicles by subscriber stations (SSs). In our scheme, when a TS has untracked vehicles, it should transmit a connection basis. However, the BS tracks vehicles in per SS basis. It gives the SS flexibility to track the available message, called releasing message (RM), to inform its corresponding CS to track the untracked vehicles. However because of the variety of geographical distance between TS and CS and the vehicle, transmission power of the TS, the CS may not receive RM. In this case, the benefit of our scheme may be reduced. In this researc, we investigate the probability that the CS receives a RM successfully. Our theoretical analysis shows that this probability is least 42%, which is confirmed by our simulation. By further investigating the factors, that affect the effectiveness of our scheme, two factors are concluded:1) the CS cannot receive the RM 2) the CS does not have non real time data to transmit while receiving a RM. To mitigate those factors, additional scheduling algorithms are proposed. Our analysis show that the proposed algorithm further improve the average throughput by 40% in a steady network (i.e. 15 to 75 second in our analysis). The rest of this paper is organized as follows. In section 2, we provide the background information of IEEE 802.16 motivation and related works are presented in section 3. The proposed scheme is presented in section 4. The analysis of the proposed scheme is placed in section 5 and section 6. The performance analysis of the scheme in section 7. At the end, the conclusion is given in section 8. Various attributes of web forum discussions and the firms stock behavior.

2. BACK GROUND ANALYSIS:

The IEEE 802.16 standard specifies three types of transmission mediums supported as the physical layer (PHY): single channel (SC), Orthogonal frequency-division multiplexing (OFDM) and Orthogonal Frequency-Division Multiple Access (OFDMA). We assume OFDMA as the PHY in our analytical model since it is employed to support mobility in IEEE 802.16e standard and the scheme working in OFDMA should also work in others. There are four types of modulations supported by OFDMA: BPSK, QPSK, 16-QAM and 64-QAM. This paper is focused on the point-to-multipoint (PMP) mode in which the SS is not allowed to communicate with any other SSs but the BS directly. Based on the transmission direction, the transmissions between BS and SSs are classified into downlink (DL) and uplink (UL) transmissions. The former are the transmissions from the BS to SSs. Conversely, the latter are the transmissions in the opposite direction. There are two transmission modes: Time Division Duplex (TDD) and Frequency Division Duplex (FDD) supported in IEEE 802.16. Both UL and DL transmissions cannot be operated simultaneously in TDD mode but in FDD mode. In this paper, our scheme is focused on the TDD mode. In WiMAX, the BS is responsible for scheduling both UL and DL transmissions. All scheduling behavior is expressed in a MAC frame. The structure of a MAC frame defined in IEEE 802.16 standard contains two parts: UL and DL sub frame. The UL sub frame is for UL transmissions. Similarly, the DL sub frame is for DL transmissions. In IEEE 802.16 networks, the SS is coordinated by the BS. All coordinating information including burst profiles and offsets is in the DL and UL maps, which are broadcasted at the beginning of a MAC frame.The IEEE 802.16 network is connection-oriented. It gives the advantage of having better control over network resource to provide QoS guaranteed services. In order to support wide variety of applications, the IEEE 802.16 standard classifies traffic into five scheduling classes: Unsolicited Grant Service (UGS), Real Time Polling Service (rtPS), Non-real Time Polling Service (nrtPS), Best Effort (BE) and Extended Real Time Polling Service (ertPS). Each application is classified into one of the scheduling classes and establishes a connection with the BS based on its scheduling class. The BS assigns a connection ID (CID) to each connection. The vehicle tracking is made based on the CID via sending a VTR(vehicle tracking request). When receiving a VTR, the BS and SS can either grant or reject the VTR depending on its available resources and scheduling policies. There are two types of VTR(vehicle tracking request) defined in the IEEE 802.16 standard : identifying and overall tracking VTRs. The Former allow the SS to indicate the next vehicle tracking required for tracking. Thus, the overall vehicle tracking can also be identified via overall tracking VTRs. The BS resets its perception of that services needs upon receiving the VTRs. Consequently the VTRs request will decrease.

3. MOTIVATIONS AND RELATED WORK:

Vehicle tracking system allows IEEE 802.16 networks to provide QOS guaranteed services. The SS tracks the required vehicle before any vehicles transmission. Due to the nature of applications, it is very difficult for the SS to make the optimal path vehicle tracking system. It is possible that the amount of requested vehicle tracking cannot be fully tracked. Although the requested vehicle is tracked via VTRs, however, the updated requested vehicle tracked is applied as early as to the next vehicle tracking system and there is no way to track the untrack vehicle in the current location. In our scheme, the SS track its untracked vehicles in the current location and another SS pre assigned by the BS has opportunities to track the untracked vehicles. This improves the vehicle tracking system. Moreover since the existed vehicle tracking is not changed, the same QOS guaranteed services are provided without any extra delay. Many research works related to vehicle tracking system improvement have been proposed in the literarture. In [2] the task is proposed is vision based vehicle detection has triggered vast improvement of autonomous vehicular technology in order to automatically detect moving vehicles in complex traffic scene. In [3] the paper is proposed a computer vision system for daytime vehicle detection a localization. As essential step in the development of several types of advanced driver assistance systems. In [4] they proposed a task to provides a better platform to track and disable a vehicle using wireless technology. This system shows embed a microcomputer which monitors the series of automotive systems like engine, fuel and braking system. In [5] they proposed in that paper theoretical foundations and a practical realization of a real-time traffic sign detection, tracking and recognition operating on board of a vehicle. The authors predict the QOS guaranteed based on the information of the backlogged with heavy traffic jams, bad weather in the future. In [17, 18,19], a dynamic resource reservation mechanism is proposed. It can dynamically change the amount of reserved resource depending on the actual number of active connections.

4. PROPOSED SCHEME:

The objectives of our research are two fold:1) the vehicle tracking system is done with quality of service.2) our research work focuses on tracking the vehicles by using fastest algorithms and good tracker systems. To achieve these objectives, our scheme named improving quality of vehicle tracking systems is proposed. The main idea of the proposed scheme is to allow the BS to pre assign a CS for each TS at the beginning of a location. The system has the ablity to detect the optimal path between source and destination, depending on many factors such as travel time, traffic jams, topography and bad weather. Here in this paper using greedy techniques (GT) such as Dijistra's and kruskal's algorithms to graph a weight depending on the proposed cost function (CF). The geofencing technique is applied to the system based on real coordinates and grants security and safety of vehicles. It has the ability to visualize the real position of vehicles in maps and to take decisions according to real-time information. We will discuss optimal transportation movement with real time information.

Cost function parameters: The proposed CF (cost function) will compute the time required to move from source(vehicles) to destination(SS or BS). The proposed design 'tracking system' receives real time or historical information from geo database and then it computes the optimal path of tracking depending on the following parameters:

1) **Time:** first of all, the proposed CF will compute the time depending on the distance between source(vehicles) and destination(SSs or BSs) and the average speed on the hill stations as follows:

$$\mathbf{T_1} = \frac{\textbf{Distance}}{\textbf{AVG speed}}$$

2) **Travel time:** CF divides a day to four intervals and the travelling time will affect the time as shown in Table 1.
3) **Bad Weather:** the time between this factor is shown in Table 2.
4) **Traffic jam factor:** the time after this factor is shown in Table 3.
5) **Hill station condition:** the time after this factor is shown in Table 4.

The results of CF will be the weight between two points; the authors used graph theory and Dijkstra's routing algorithm to compute the optimal path between source(vehicles) and destination(SSs or BSs). Modifications to Dijisktra's algorithm were made as follows:
The network may have cycles, but all arc lengths must be non-negative.

Table 1. Travel Time

Travel Time	Effect
(6-12)AM	T2=T1*0.20+T1
(12-6)PM	T2=T1*0.05+T1
(6-12)PM	T2=T1*0.17+T1
(12-6)AM	T2=T1*0.25+T1

Table 2. Bad weather Effect

Climate Temperature	Effect
Constant	T3=T2
25°	T3=T2+30
40°	T3=T2+60
12°	T3=T2+10
5°	Below driving mode

(30, 60,10) are the speed of the vehicles measuring through climate temperature in hill stations.

Table 3. Residential Against Effect

Residential	Effect
Dense	T4=T3*0.13+T3
Medium	T4=T3*0.08+T3
Low	T4=T3*0.01+T3

Table 4. Hill Station Areas

Topography	Effect
Bad weather	T5=T3+0.6+T4
Traffic Jam	T5=T3+0.1+T4
Accidents	T5=T3+1.0+T4
Road Problem	T5=T3+0.12+T4

Maintatins a partition of N into two subsets:
Set p: Permanently labeled nodes
Set T: Temporarily labeled nodes
Move nodes from T into S one at a time in an non decreasing order by the minimum path from the source node.

```
Begin
P:={}; T :=N;
d(i)=∞ for each node I in N
d(s)=0and  pred(S):=0;
While|P| < n do
Begin
Pick I in T with minimum d(i) value;// the value will be taken from our CF.
Move I from T to P;
For each (I,,j) in A do
If d( j) > d(i) + cij then
d(j):= d(i) + cij and pred (j):= i
End;
End;
```

An example of Dijikstra's algorithm and how to determine the minimum cost is shown in Fig 1
The modification to

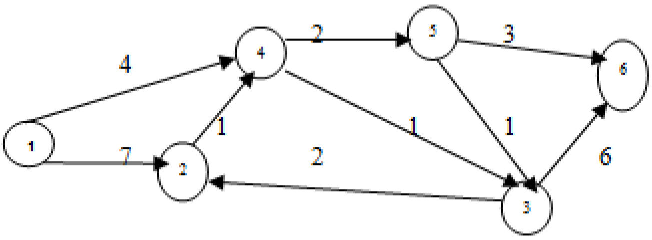


Figure 1. Example of Dijikstra's algorithm

Dijstkstra algorithm was made as follows:

P={},T={1,2,3,4,5,6}
P={1,4}, T={4,5,5,6}
P={1}, T={2,3,4,5,6}
P={1,4,5},T={5,6}
P={1,4,5,2},T={1,2,3,4,5,6}
P={1,4,5,2,6},T={}.

For each link, there are associated weight graphs computed with proposed CF as shown in Fig. 2. Compute the minimum cost map transverse depending on the proposed CF: In this section, the authors used kruskal's algorithm to do this task with proposed CF to compute the Weight between two points. The algorithm begins by sorting the map street weights in non –decreasing order and then starting with the empty sub graph. It scans the sorted list adding the next edge on the list to the current sub graph if such an inclusion does not create a cycle; it simply skips the edge otherwise.

Algorithm Minimum cost transverse (map G) {//kruskal's algorithm for constructing the minimum spanning tree//Input: a weighted connected graph G=(V,E)//Output: ET, the set of edges composing the minimum spanning tree of G. sort E in non-decreasing order of the edge weights ET=0; counter=0; =0; While e counter<|v|-1K=k+1; If ET U {eik}; E counter= e counter+1; Return ET;}

The weight graph of the proposed CF is shown in FIG3

Fig 2 weight graph of the Proposed CF

Fig 3 Weight graph of the Proposed CF

Geofencing: the authors developed this process to apply the geofencing technique to generate a bufferzone and it will help to provide information for Subscriber station(SSs) and Base station(BSs) as well as vehicles. The response of the proposed system is shown in Fig. 4

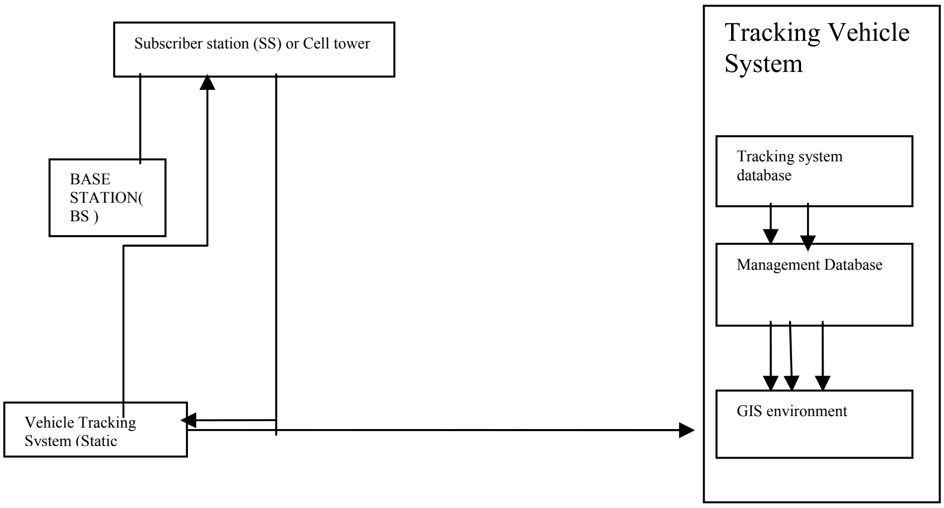
Driver Name	Car Label	Device Type
Ahmad Al-Azu	78845	Falcom
Labib Burhan	7677	Falcom
Anas Shamasi	45	Falcom
Hind Shajrawi	4545	Falcom
Nisreen Jarwa	4545	Falcom

Location Time Interva : 20

The Fleet out Of Range

X: 770.943.8627 Y: 3.539.334.5109

Fig 4 Response of the Proposed system



Management phase (database): the management phase contains functions of organizing drivers information, received data from the Base station(BS)/Subscriber station(SSs)(tracking data) and GIS data(check-points).
This phase was built using microcontroller database

1) **User tab**: the user tab contains drivers(vehicles) information, with functions like 'add', 'edit 'and delete concerned with the drivers information. The reports button allow browsing reports for available drivers.
2) **Tracking tab**: this tab contains the core of the system, which is divided into 'online tracking' as shown in Fig. 7.
3) **Online tracking**: online tracking implements the interface between both connection ID(CID) such as SS/BS and vehicles. This part is concerned with tracking real time data of vehicle positions, where the data received from the BSs/SSs are displayed directly on the related map in the vehicle in front of the driver seat.

When clicking on the start track button, the vehicle tracking database starts listening on port number '655' for any SSs/BSs request to make a connection with the satellites. When the connection is established(between BS/SS and database), the BS/SS starts sending information about the vehicle through satellite that data contain the location,speed,time and sensor parameters to the vehicle tracking database, as shown Fig. 5.

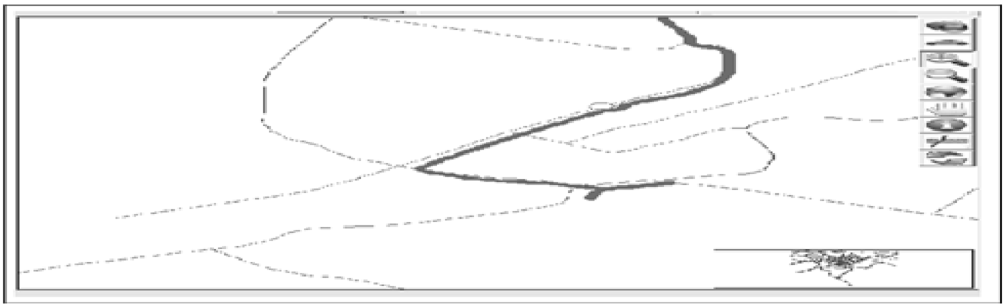


Figure 5 Tracking paths of vehicles

Next fold is to find the QOS between CSs and TSs in a MAC frame information(e.g burst profile) residing in the CL may be reduced to the mapping information between the CS and its corresponding TS. The BS only specifies the burst profiles for the SSs which are only scheduled on the CL. For example as shown that CS_i is scheduled as the corresponding CS of TS_i, where 1<=j<=k. when TS_i has untracked vehicle , it performs our protocols. If CS_i receives the message sent from TS_i, it starts to transmit data about vehicle by using the agreed burst profile. The burst profile of a CS is resided on either the UL map if the CS is also scheduled on CL. Our Proposed scheme is presented into: the scheduling algorithm. The scheduling algorithm helps the BS to schedule a CS for each TS.

5. SCHEDULING ALGORITHM

Assume Q represents the set of SSs serving non-real time connections (i.e., nrtPS or BE connections) and T is the set of TSs. Due to the feature of TDD that the UL and DL operations cannot be performed simultaneously, we cannot schedule the SS which UL transmission interval is overlapped with the target TS. For any TS, St, let Ot be the set of SSs which UL transmission interval overlaps with that of St in Q. Thus, the possible corresponding CS of St must be in Q−Ot. All SSs in Q−Ot are considered as candidates of the CS for St. A scheduling algorithm, called Priority-based Scheduling Algorithm (PSA), shown in Algorithm is used to schedule a SS with the highest priority as the CS. The priority of each candidate is decided based on the scheduling factor (SF) defined as the ratio of the current vehicle tracking request (VTR) to the current tracked vehicle. The SS with higher SF has more priority to track that vehicle. Thus, we give the higher priority to those SSs vehicles. The highest priority is given to the SSs vehicles with zero CG. Non real-time connections include nrtPS connections should have higher priority the BE connections because of the QOS requirements. The priority of vehicles of CSs is concluded with high to low as:nrtPS with zero CG,BE with Zero CG,nrtps with non-zero CGand BE with Non zero CG. If there are more than one than SS vehicle with highest priority, we select one with the largest CR as the CS in order to decrease the probability of overflow.

6. ANALYSIS

The percentage of potentially tracking un tracked vehicles occupied in the tracked vehicles SS is critical for the potential performance gain of our scheme. We investigate this percentage on network traffics which is popularly used today. Additionally In our scheme each TS should transmit a RM to inform its corresponding CS when it has tracking untracked vehicles at SS. However, the transmission range of the the TS may not be able to cover the corresponding CS. It depends on the location and the transmission power of the TS. It is possible that the un tracked vehicles cannot be tracked because the CS does not not receive the RM. Therefore the benefit of our scheme is reduced. In this section, we analze mathematically the probability of a CS to receive a RM successfully obviously

Algortithm 1 Priority-base Scheduling algorithm

```
Input: T is the set of TSs scheduled on the UL map.
        Q is the set of SSs scheduled on the non-realtime applications.
Output: Schedule CSs for all TSsin T.
For i=1 to ||T|| do
    a. $S_t \longleftarrow TS_i$
    b. $Q_t \longleftarrow Q--- O_t$
```

```
   c. Calculate the SF for each SS in $Q_t$
   d. IF Any SS € $Q_t$ has zero granted bandwidth,
      IF ANYSSs have nrtPS traffics and zero granted
      Bandwidth
      Choose one running nrtPS traffics with largestCR.
      Else
         Choose one with largest SF and CR.
   e. Schedule the SS ad the corresponding CS of $S_t$
 End For
```

This probability effects the vehicle tracking rate (VVR). VVR stands for the percentage of the un tracked vehicles which is not tracked. Moreover the performance analysis is presented in terms of through put gain (TG).

7. PERFORMANCE ANALYSIS OF PROPOSED SCHEME

The traffic load in a network may vary dynamically. Thus, the network status can be classified into four stages: light, moderate, heavy and fully loaded. The performance of the proposed scheme may be variant in different stages. We investigate the performance of our scheme in each stage. Suppose B_{all} represents the total tracked vehicles supported by the BS. Assume represents the vehicle tracked by real time connections and VTrt is the number of additional vehicles tracked by them via VTRs.

$$\{i-1\} \qquad \text{where } \max\{0; Q_{nrt}\, i-1-W_{nrt}\, i-1\} \qquad (1)$$

is the amount of queued vehicles arriving before frame i − 1. Since $Y_i{-}1$ cannot be negative, the probability of the CS, denoted as S_u, which has data to calculate the recalculate bandwidth can be obtained as:

$$P_u(u) = \int^{\gamma\ nrt\ max} P(X)dX \qquad Y_{i-1} \qquad (2)$$

Where _nrt max is the maximal amount of non-real time vehicles arriving in a frame and vehicles occupying. A CS which retraces the untracked vehicles successfully while receiving a RM must be scheduled on the CS and have non-real time data to be transmitted and retraced. From equations (1) and (2), the probability that a CS satisfies these two conditions is derived as:

$$\|Q_n\|$$

Based on the three metrics: 1) Throughput gain (TG): It represents the percentage of throughput which is improved by implementing our scheme. The formal definition can be expressed as:

$$TG = T_{Tracks} - T_{no\ tracks}$$

Where $T_{retraces}$ and $T_{no\ retraces}$ represent the throughput with and without implementing our scheme, respectively. The higher TG achieved shows the higher performance that our scheme can make. 2) Tracking untracked vehicle rate (VVR). It is defined as the percentage of the untracked vehicles occupied in the total identified vehicles in the system without using vehicle retracking.

$$VVR = V_{tracks}\ V_{untracks}$$

1) Throughput gain (TG):

$$TG = \frac{\text{pretracked VT}}{V_g - V_T}$$

Suppose Vg is the total tracked vehicles in the system and the un tracked vehicles of the system is $V_{T.}$ by equation, the total throughput gain, is solved. Delay is a critical factor affecting the QOS of services. IN our scheme, we preserve the existing vehicle tracking. Moreover the CS cannot track the vehicles until receiving the RM which is sent by TS.

8. CONCLUSION

It is very challenging task for SS to predict the arriving vehicles precisely. Although the existing system allows the SS vehicles to adjust the tracked vehicles via risk of failing to satisfy the QOS requirements. Our research does focuses on proposed vehicle tracking system to track the untracked vehicles once it occurs with improving quality. It allows the BS to schedule a complementary station monitors the entire UL transmissions interval of its corresponding TS and stand by for any opportunities to track the untracked vehicles. If we are observing the tracking system has the ability to trace and co-ordinate a fleet of vehicles, with integration of BS (satellite)/SS (cell tower) technology. It ensures that the tracking process is within an accurate and acceptable range, since it allows managers to supervise vehicle status(i.e fuel, temperature). This proposed system can be used in monitoring and controlling applications. But it is difficult task to connect in hill stations. Signal strength will not be good in hill stations.

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