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Cognitive Vehicular Network for Optimal Resource Allocation Using MINLP

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Abstract: Dedicated Short Range Communication (DSRC) band is incapable to remove increasing demand on wireless traffic in vehicular network. The TV white Space band by FCC for cognitive access provides additional bandwidth to solve the DCRS spectrum problem. However, create a challenging environment for portable (e.g., vehicular) and fixed (e.g., IEEE 802.22) network which is FCC required portable device to use significantly lower transmitting power than fixed device. In this paper, first formulate the Mixed-Integer Non Linear Programming (MINLP) program, to which three algorithms are refined. The first algorithm converts the MINLP to a convex problem and gives the near-optimal solution to the initial MINLP. The other two algorithms, first convert the MINLP into an Integer Programming (IP) problem. Then, solve the linear program relaxation of the IP and obtain fractional solution. Consequently, two rounding algorithms are developed to round the fractional solution based on the column-sparse packing and dependent rounding techniques. In conclusion, compare the performance of the proposed algorithms with the optimal MINLP solver.

Keywords: Channel Allocation, Cognitive Vehicular Network, Linear Programming, Submodular Set Function

I. INTRODUCTION

The Dedicated Short Range Communication (DSRC) appropriate vehicular communication having bandwidth 75 MHz. The IEEE wireless Access to support the vehicular communication in DSRC band. For both simulation and theoretical analysis the DSRC is insufficient to carry reliable safety message transmission. The growth of radio-equipped vehicles as well as wireless vehicular applications is become severer due to the spectrum scarcity problem. Using the TV White Space Band (TVWS) to solving the DSRC spectrum scarcity problem. These TVWS band has been released by FCC for cognitive access in U.S. The TVWS band is also raises the novel challenges as well as it is auspicious spectrum scarcity for vehicular network. In fixed devices can be used up to 4W transmission power and the portable TVWS band can be used at most 10mW transmit power. An IEEE 802.22 and cognitive vehicular network can be deal with the coexistence problem. The cognitive radio is dedicated to the coexistence between primary as well as secondary user networks.

The coexistence of multiple IEEE 802.22 network can be involved an inter-network coexistence scheme and the IEEE 802.19.1 standard in TVWS band can proposed a framework for coexistence of heterogeneous SU network. The propose coexistence of heterogeneous method includes no cognitive functionality and depends on the specific network type. In 802.22 network, the Consumer Premise Equipment (CPE) device are periodically broadcast by the 802.22 Base Station (BS) is included in the downstream messages. The upstream scheduling information can access the TVWS channel after receiving the downstream messages in CPE device. The 802.22 network and vehicular network are no additional signaling and still managed separately between the two network. The MINLP problem belongs to the coexistence problem between a CVN and IEEE 802.22 network as a resource allocation problem. The development of three algorithms are usually intractable the MINLP problem with provable performance guarantees. Since such problem are most existing works only or greedy algorithm, usually belongs to NP- complete MINLP problem. The IEEE 802.22 standard and FCC’s regulation on the protection of Pus in the TVWS band. We consider multiple source of interference in our formulated problem and the standard joint channel allocation problem formulation is more general.

II. LITERATURE REVIEW

In the year of 1998, the team of IBM Corporation and Delphi Delco Electronics system proposed a vehicular network concept which is aimed to provide the wide range of application. Also the concept of wireless communication technology has received huge amount of attention over the world. This has resulted to enable communication between vehicles, a strong significance in vehicular network.

In the year 2010, the advent of intelligent in vehicular network and it has to led fast convergence with ITS, which is prepare to transform driving style by safety that will fundamentally enclose our busy city streets and highways. Thus an intelligent vehicular network will provide a new versatile system that upgrade transportation safety and efficiency. In advance vehicular network provide a different type of programmable sensor node, better computing power, cognitive radios. By using this intelligent applications, can improve the traffic efficiency, driving safety and enhance ITS.

III. SYSTEM MODEL

IEEE 802.22 network consist of the one Base Station (BS) and multiple CPE and it was developed to prepare broadband access using TVWS band. In BS broadcast by every 10 millisecond which include the downstream messages for getting the information on upstream scheduling. On cognitive vehicular network and IEEE 802.22 standard consider a periodic scheduling model is performed by a Road Side Unit (RSU). A road is divided into segments with an RSU in each sector, a vehicle move from one sector to another sector it must register with the RSU. In RSU listen the downstream messages from 802.22 BS and broadcast the information to the vehicles in its sector.

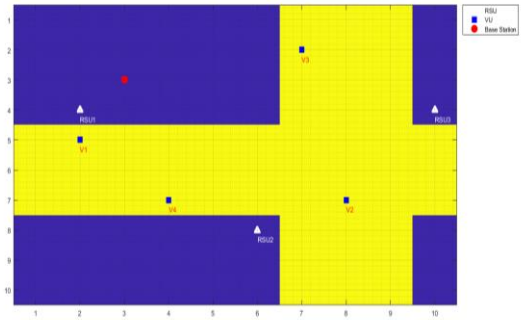

Fig.(1) System Model

Let us consider, N be the number of vehicles and M be the number of CPE bursts. There are four burst can be used in CPEs as well as three RSU units can used. In 802.22, burst can be define as two dimensional sector of OFDM e.g. frequency domain and time domain. According to the standard, two type of upstream bursts first burst is mapped over the full upstream sub-frame and second burst is mapped over an interval.

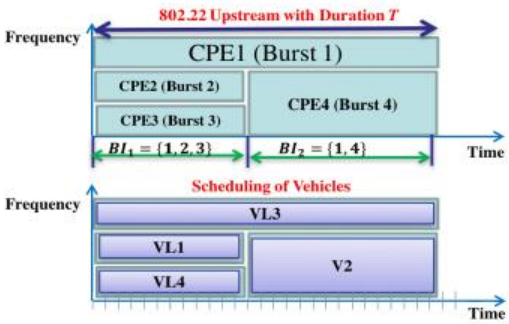

Fig. (2) Problem Formulation

Given the definition, our objectives is maximize the weighted conventional throughput of vehicles. Let $x_{ij} \in \{0,1\}, \forall i, j$ be practice variable (i.e., $x_{ij} = 1$) if vehicle i is scheduled to burst j, and $x_{ij} = 0$ otherwise), and the problem can be formulated as

$$\max_{x_{ij}\in\{0,1\} p_{ij}\geq 0} \sum_{i=1}^{N}\sum_{j=1}^{M}\frac{1}{T} A_i\, x_{ij}\, R_{ij}\, T_j$$

$$\text{Where, } R_{ij} = B_j \log_2\left(1 + \frac{p_{ij}\, G_{ij}}{p_j^c\, G_{ij} + N_0}\right)$$

Parameters:

C1: The upstream transmission of CPE j cannot larger than β_j for the interference caused by the vehicular transmission.
C2: Meet FCC's specification on a TVWS channel must be less than a threshold.
C3: A vehicle can be expected to more one burst for give and take among vehicles.
C4: A burst can be assigned to more one vehicle to avert mutual interference.

The 802.22-CVN is different from conventional PU-SU coexistence problem. Firstly formulate the PU-SU problem and maximize SU network is subjected to PU protected. The PU protection, the high- power 802.22 network coexists the low- power CVN safety. We consider PHY/MAC of the 802.22 network and CVN, while existing work consider PU and SU networks. The MINLP problems are NP- complete to dual method are belongs. Hence these problem solved using branch and bound using numerical algorithms. Most of these solutions have exponential time complexity and attend the nearest solution.

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IV. EXTENDED ROUNDING BASED METHOD

In MINLP problems results from non-convexity and integer constrains difficulty can be solved by using the dual method. CSP - based method has more positive complexity than dual algorithm, its nearest ratio is still low.

$$\max_{x_{ijk}\epsilon[0,1]} \sum_{i=1}^{N}\sum_{j=1}^{M}\sum_{k=1}^{K} x_{ijk}\, r_{ijk}$$

s.t.: C1, C2, C3, C4

A. Proposed Extended Rounding Algorithm

The proposed algorithm rounds the fractional variables with the following invariants.

1) Once a variable is rounded into 0 or 1, it will never change in remaining iterations.
2) Once a constraint becomes tight, it remains tight in the remaining iterations.
3) Once a constraint is dropped, it will never be reinstated.

Define set of fractional variables at iteration t as $X(t) := \{x_{ij} \mid 0 < x_{ijk}(t) < 1, \forall i, j, k\}$. Furthermore, define $F_m(t)$ to be the set of bursts with m fractional variables in $X(t)$, i.e., for any burst $j \epsilon F_m(t)$, there are exactly m vehicle-power pairs (i, k) such that $0 < x_{jk} < 1$.

Algorithm Extended Rounding Algorithm

Input: Fractional solution obtained by solving : $X^* = \{x^*_{ijk} \mid 0 \le x^*_{ijk} \le 1, \forall i, j, k\}$
Output: Integer solution: $X = \{x_{ijk} \mid x_{ijk} \epsilon \{0,1\}, \forall i, j, k\}$
Initialization : $\vec{x}(0) = X^*$
1: **while** there exist fractional variables in $\vec{x}(t)$ **do**
2: treat all integer variables in $\vec{x}(t)$ as constants and update all constraints by moving constant items to the right hand side of equalities
3: **if** $\Phi(t)$ is determined **then**
4: **if** $|F(t)| > 2L$ **then**
5: for burst in $F_1(t)$, $F_2(t)$, drop their corresponding $C1(t)$ and $C4(t)$ constraints from $\Phi(t)$ (if any); For burst in $F_3(t)$, $F_4(t)$, drop their corresponding $C1(t)$ constraints from $\Phi(t)$ (if any)
6: **else**
7: drop all $C2(t)$ constraints from $\Phi(t)$ (if any); for burst in $F_1(t)$, $F_2(t)$, drop their corresponding $C1(t)$ and $C4(t)$ constraints from $\Phi(t)$ (if any); for burst in $F_3(t)$, $F_4(t)$,drop their corresponding $C1(t)$ constraints from $\Phi(t)$ (if any)
8: **end if**
9: **end if**
10: find the null-space S of the new $A(t)$
11: choose a nonzero vector $\vec{s} \epsilon S$
12: find scalars θ_1, θ_2 as described
13: compute $\vec{x}(t+1)$
14: **end while**
15: **return** $\vec{x}(t+1)$

V. SIMULATION RESULT

A. Utility: Dual Rounding (DR) can oppose some constraints so that DR obtains higher utility than OS and the specifically view the problem of initial MINLP. By using the Rounding Based Method obtain the fractional solution, therefore the optimum of Number of vehicles is less than the optimum of Weighted throughput. Since, prove that DR is optimal in expectation, also it can be achieved higher utility than the optimal solver. As a result, the higher utility in both CPE and DR because imply more detailed approximation of transmit power value.

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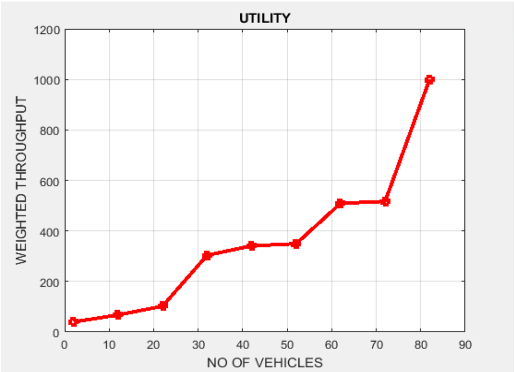
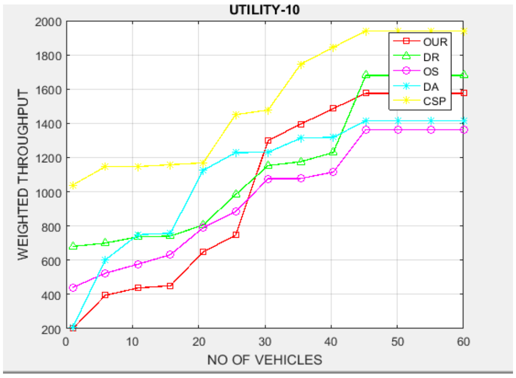


Fig(3)Utility



Utility with K=10

B. Time Comlexity: Compare the time complexity of the three algorithms and time complexity depends on the running time of simulation code. MATLAB simulation codes run on windows with 8GB memory. It can calculate the Number of vehicles on which time period can be done. Fig.(4) Shows the running time of DA is higher than CSP and DR.

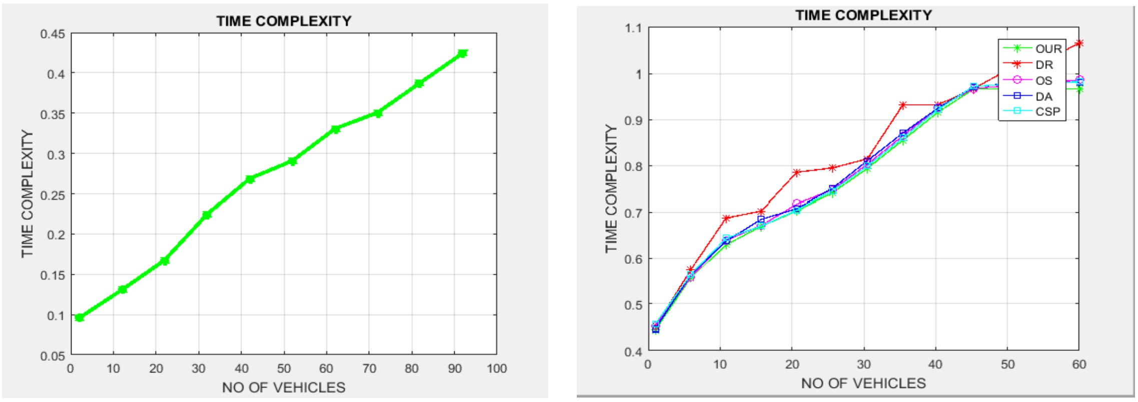


Fig.(4) Time complexity

C. Constraint Voilation: As shown in fig.(5), calculate violation ratio. When to increase the number of vehicles then that time violation ratio can be decrease. The average constraint violation and worst case constraint violation in DR algorithm can be shown.

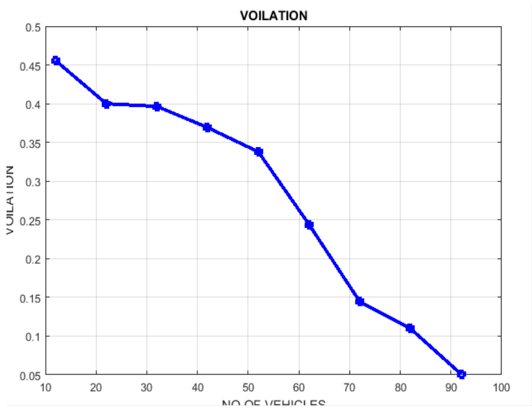


Fig. (5) Violation

Firstly, Fig. (5.1) demonstrates that the worst case constraint violations satisfy the upper bounds derived. More specifically, in this lemma, the worst case violations for C1, C3, and C4 constraints are proved to be upper bounded. Fig.(5.4) shows the worst case violations for C1, C3, and C4 constraints are all less than 1,which verifies Lemma. Secondly, Fig.(5.1) and Fig.(5.2) show that larger N and K value result in lower worst case and average constraint violations. This is because larger N and K values introduce more random variable than constraint.

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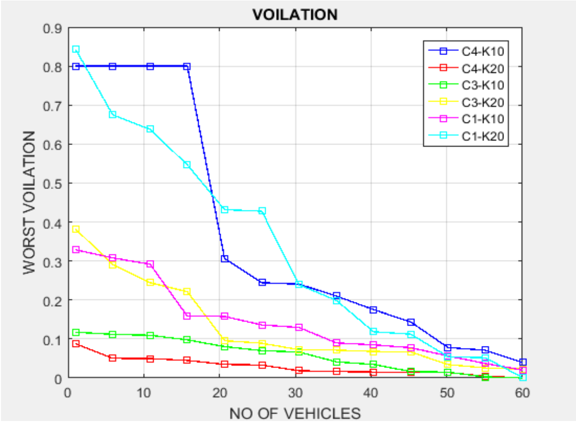

Fig.(5.1) Worst case violation

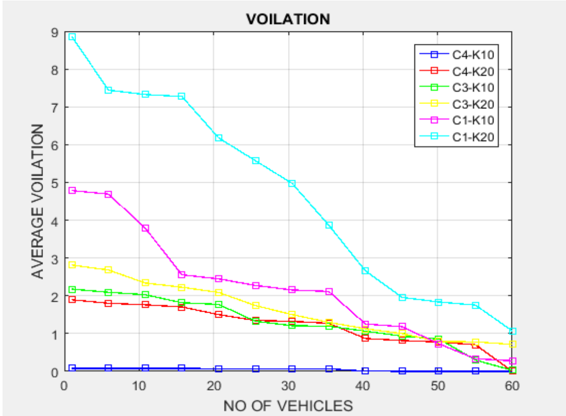

Fig.(5.2) Average constraint violation

D. Overall Comparison:

Our proposed algorithm (DA) shows simulation results is achieves the near- optimal solution. Therefore, applied scenarios can required time complexity with sufficiently powerful hardware. Hence, its time complexity is higher than the others. The lowest time complexity achieves the lowest utility. The applied scenarios where time complexity is main concern. Finally, algorithm achieves moderate time complexity with higher utility.

CONCLUSION

In this paper, propose the efficient centralized algorithms and formulate an MINLP resource allocation problem also study the CVN and an 802.22 network. The algorithms convert the coexistence problem to convex problem and solve this convex problem using the dual base method. After solving convex problem propose algorithm to round the fractional solution into an integer solution. Finally, compare the algorithm to optimal MINLP solver. The design algorithm with certain performance is one of our future works.

REFERENCES

[1]. You Han, Eylem Ekici, Haris Kremo, Onur Altintas,"Enabling Coexistance of a Cognitive Vehicular Network and an IEEE 802.22 Network via Optimal Resource Allocation",Citation information: DOI 10.1109/TWC.2016.2636280,IEEE Transaction on Wireless Communications, vol. 11, no. 6, pp. 2024-2035, June 2012.
[2]. Md Whaiduzzaman, mehedi Shokhak, Abdullah Gani, Rajkumar Buyya, " A Survey on Vehicular Cloud Computing", Journal on Network and Computer Application 40(2014) 325-344.
[3]. M. Hassan, H. Vu, and T. Sakurai, "Performance analysis of the IEEE 802.11 MAC protocol and DSRC safety application," Vehicular Technology, IEEE Transaction on, vol.60, no.8,pp. 3882-3896, Oct 2011.
[4]. K. Fawaz, A. Ghandour, M. Olleik, and H. Artail, "Improving reliability of safety applications in vehicles ad hoc networks through the implimentation of a cognitive network," in Telecommunications (ICT), 2010,IEEE 17th International Conference on, April 2010,pp.798-805.
[5]. Z. Wang and M. Hassan,"How much of DSRC is available for nonsafety use?" in proceedng of the fifth ACM Internatinal Workshop on vehicular Inter-Networking, ser,VANET'.
[6]. IEEE Standards for Information technology Telecommuications Part 22: Cognitive Wireless RAN MAC and PHY specifications: Policies and procedures for operation in the TV bands, IEEE Std. 802.22,2011.
[7]. T. Shu and M. Krunz, "Coordinated channel access in cognitive radio network: amultu-level spectrum opportunity perspective," in INFOCOM 2009,IEEE 2009,pp. 2976-2980.
[8]. Y.Han, E.Ekici, H. Kremo, and o. Altintas, "Throughput-efficient channel allocation in multi-channel cognitive vehicular network," in IEEE INFOCOM 2014-IEEE Conference on Computer Communica-tions, April 2014, pp. 2724-2732.
[9]. X. Zhang and K. G. Shine, "Enabling coexistance of heterogeneous wireless system: Case for ZigBee and WiFi,"' in proceeding of MobiHoc'11. New York, NY, USA: ACM,2011, pp.6:1-6:11.
[10]. Y. Tachwali, B.F.Lo,I.F.Akyildiz, and R. Agusti, Multiuser resource allocation optimization using bandwidth-power produce in cognitive radio networks," IEEE Journal on Selected Areas in Communicatons, vol.31,no.3. pp. 451-463,March 2013.
[11]. S. Senthuran,A. Anpalagan, and O. Das, "Throughput analysis of opportunistic access strategies in hybrid underlay-overlay cognitive radio networks," IEEE Transactions on Wireless Communications, VOL, 11, no. , pp. 2024-2035, June 2012.
[12]. A. Beck and M. Teboulle, "Mirror desent and nonlinear projected subgradient methods for convex optimization," Operations Research Letters, VOL. 31, no. 3, pp. 167-175, 2003.
[13]. B. Saha, "Approximation algorithms for resource allocation," Ph.D. dissertation, University of Maryland, College Park, Department of Computer Science, 2011.
[14]. Y. Han, E. Ekici, H. Kremo, and O. Altintas, "Optimal spectrum utilization in joint automotive radar and communication networks," in 2016 14th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Network (WiOpt), May 2016, pp. 1-8.
[15]. R. Gandhi, S. Khuller, S. Parthasarathy, and A. Srinivasan, "Dependent rounding and its applications to approximations algorithms," Journal of the ACM (JACM), vol. 53, no. 3, pp. 324-360, 2006.
[16]. L. Hogben, Handbook of Linear Algebra, Second Edition, ser. Discrete Mathematics and Its Applications, 2013.