IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

Optimal Power Allocation strategy in HSR

[1]P. Krishna, [2]U. Naresh Kumar, [3]D. Akhil, [4]M. Naresh
[1,2,3] BE Student , [4] Assistant Professor
[1,2,3,4] Department of Electronics & Communication Engineering
[1,2,3,4] Matrusri Engineering College, Hyderabad, Telangana State

Abstract: This paper focuses on assessing the transmission execution of wireless links with in the HSRs and trying to derive this scenario from an optimal power allocation strategy. Considering the fact, that the information transmitted between the train and the base station usually has diverse quality-of-service (QoS) requirements for different services. QoS-distinguished power allocation algorithm is derived to achieve the largest achievable rate region. It is proved that the traditional water-filling algorithm and the channel inverse algorithm are often considered two specific cases of this Constant Power algorithm.

***Index Terms* – QoS, HSR, Constant power algorithm**

I. INTRODUCTION

HSR/HST (High speed Railways/Trains) communication has been considered as a typical scenario in future 5G systems, as shown in Figure 1, where the HSR users desire the reliable and high data rate wireless communication service to support their various information applications including online shopping, online video, online games and file downloading[1-4]. Many key technologies in wireless communication system need to be reconsidered under high mobility scenario, such as channel estimation, synchronization, multiple antenna technique, resource allocation, etc[5-8,10]. Among them, power allocation, one of the most important methods to guarantee the reliability and efficiency of information transmission, is the main problem that this paper will concentrate on. There are a large amount of literatures in this research field. As we know, constant transmit power strategy is optimal in a time-invariant additive white Gaussian noise channel (AWGN) environment [12]. If the channel is time varying, water-filling algorithm is a better choice in terms of throughput maximization. On the other hand, if the information is sensitive to transmission delay, channel inversion algorithm presented in is optimal. Effective capacity is another powerful method to describe the channel transmission capability for delay limited information transmission. In it investigated the maximal ergodic throughput when outage probability is constrained. Besides, fairness among different users is also an important factor that needs to take into account in multi-user networks.

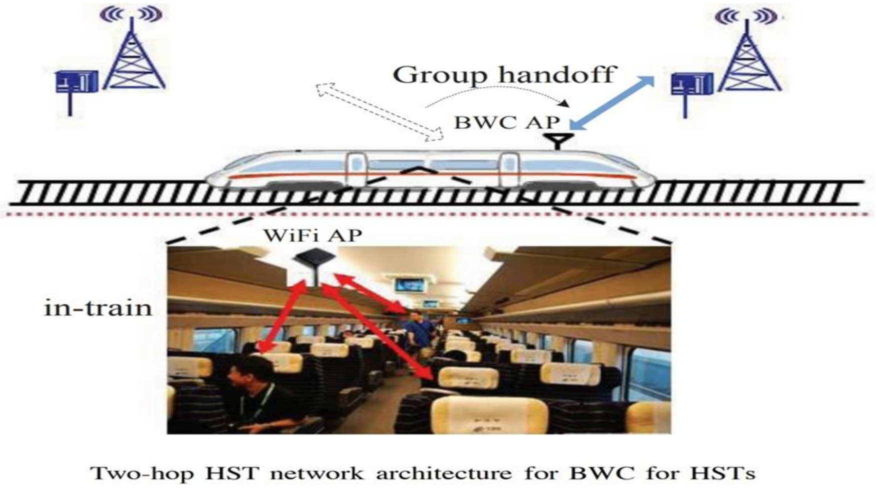


Figure 1.Two hop architecture model

II. LITRATURE SURVEY:

Water filling algorithm:

In the present a new water-filling algorithm for power allocation in Orthogonal Frequency Division Multiplexing (OFDM) – based cognitive radio systems. The conventional water-filling algorithm cannot be directly employed for power allocation in a cognitive radio system, because there are more power constraints in the cognitive radio power allocation problem than in the classic OFDM system. In this paper, a novel algorithm based on iterative water-filling is presented to overcome such limitations. However, the computational complexity in iterative water-filling is very high. Thus, we explore features of the water-filling algorithm and propose a low-complexity algorithm using power-increment or power-decrement water-filling processes. Simulation results show that our proposed algorithms can achieve the optimal power allocation performance in less time than the iterative water-filling algorithms. In case, to classify the set A and set B, (N-1) runs of water-filling algorithm have to be performed. To determine the unique water levels of the sub channels in set B, an additional (N-1) runs of the water filling algorithm must be performed. Thus, the water-filling algorithm must be run 2(N-1) times. By exploring the properties of the water-filling, we propose a low computational complexity power allocation algorithm which requires performing only single water filling calculation. Network devices that originate, route and terminate data are called nodes. These are generally identified by their network addresses and can include hosts such as personal computers, phones, servers as well as networking hardware such as routers and switches.

Properties of the water-filling algorithm we consider a water-filling problem with N channels and a total power constraint P_{total} . The water level is w. The allocated power vector is P= {P_i , i=1,2,…,N }. The CNR of each channel is H_i(i=1, 2,…N). When some power is added or subtracted from the total power, how can the power allocation problem be solved with power constraints with the total power constraints $P_{total}+\Delta$ or $P_{total}-\Delta$? Should we have to perform another water filling calculation? Our answer is no. To solve this power allocation problem we treat it as power increment water-filling or power decrement water-filling, respectively. First we consider power increment water-filling.

$$Q = \{P_i | H_i^{-1} \leq w\}, \qquad \text{eq., 1}$$

$$R = \{P_i | w < H_i^{-1} < w + \frac{\Delta}{N}\}, \qquad \text{eq., 2}$$

$$S = \{P_i | w + \frac{\Delta}{N} < H_i^{-1}\}. \qquad \text{eq.,.3}$$

Channel inversion algorithm

For the general case in which neither *Rdi* nor *Rds* is zero, it is obvious that the rate pair (*Rdi*; *Rds*) is located within the two-dimensional region [0; *R*max*di*]_[0; *R*max*ds*]. Two objective functions *Rdi* and *Rds* should be considered together, which isa typical multi-objective optimization problem[11-12]. That is to say,the main task in this subsection is to maximize the achievablerate region under the total average transmit power constraint. Since the QoS requirement of delay-sensitive informationstream is more rigorous than that of delay-insensitive information stream, *Rds* should be given priority in time-variantscenario. Thus, in order to obtain the boundary line of QoS based achievable rate region, the basic idea of our methodto explore it is to maximize the delay-insensitive average information rate *Rdi* with the limited average transmit powerconstraint after the delay-sensitive average information rate requirement *Rds* has been satisfied. Channel inversion algorithm is optimal if and only if Rdi = 0, and water-filling algorithm is optimal if and only if Rds= 0. Service oriented allocation algorithm bridges the gap between channel inversion algorithm and water-filling algorithm, and provides the largest achievable rate region. The achievable rate region in other traditional algorithms is just a subset of that in service-oriented power allocation algorithm. It has been demonstrated that new proposed power allocation algorithm is the most powerful strategy when both delay-sensitive and delay-insensitive information streams are simultaneously transmitted over the same wireless channel.

III. PROPOSED SYSTEM

Constant power algorithm:

Constant power algorithm is optimal only if the channel is constant with respect to the time .i.e., the channel is not varying with respect to time. Constant power algorithm is not optimal for all cases due to the time-varying characteristic of channel, which accords with the intuition. In this new proposed algorithm, delay sensitive information transmission requirement is considered separately with the delay-insensitive information, which makes the system more efficient in the respect of hybrid information transmission. In simultaneous transmission scheduling, the transmit power is optimized based on QoS requirements by the service-oriented allocation algorithm. On the other hand, in separated transmission scheduling, water-filling algorithm is used for the channel that loads delay-insensitive information flow while channel inversion algorithm is used for the channel that loads delay-sensitive information flow. It can be seen from Fig 3 and Fig. 4 that the performance of simultaneous transmission scheduling is apparently better than that of separated transmission scheduling in terms of achievable rate region. Besides, according to the , it can be observed that P ∗hb(t) will degrade to channel inversion algorithm P ∗ ci(t) when Rds is equal to Rds, max and P ∗hb(t) will degrade to water-filling algorithm P ∗wf (t) when Rds is equal to 0. Consequently, channel inversion algorithm and water-filling algorithm can be regarded as two extreme cases of the results . That is to say, the service-oriented power allocation algorithm, bridging the gap between traditional water-filling algorithm and channel inversion algorithm, is a more efficient method to improve the transmission performance of hybrid information flows with diverse QoS requirements.

When information data rate requirements (Rdi;Rds) are given, the optimal allocation strategy in terms of minimizing energy consumption is

$$P_m^*(t) = \left(\frac{d(t)^\alpha \sigma_0^2}{G}(2^{\frac{R_{ds}}{B}} - 1), \frac{B}{\lambda_4 \ln 2} - \frac{d(t)^\alpha \sigma_0^2}{G}\right)^+ \cdot \frac{1}{|\beta(t)|^2}, \quad t \in \left[-\frac{L}{v_0}, \frac{L}{v_0}\right],$$

eq. ,4

where the constant value 4 is determined by the following constraint

$$R_{di} = \frac{v_0}{2L} \int_{-\frac{L}{v_0}}^{\frac{L}{v_0}} \left[B \log_2\left(1 + \frac{G P_m^*(t) |\beta(t)|^2}{d(t)^\alpha \sigma_0^2}\right) - R_{ds}\right] dt.$$

eq.,5

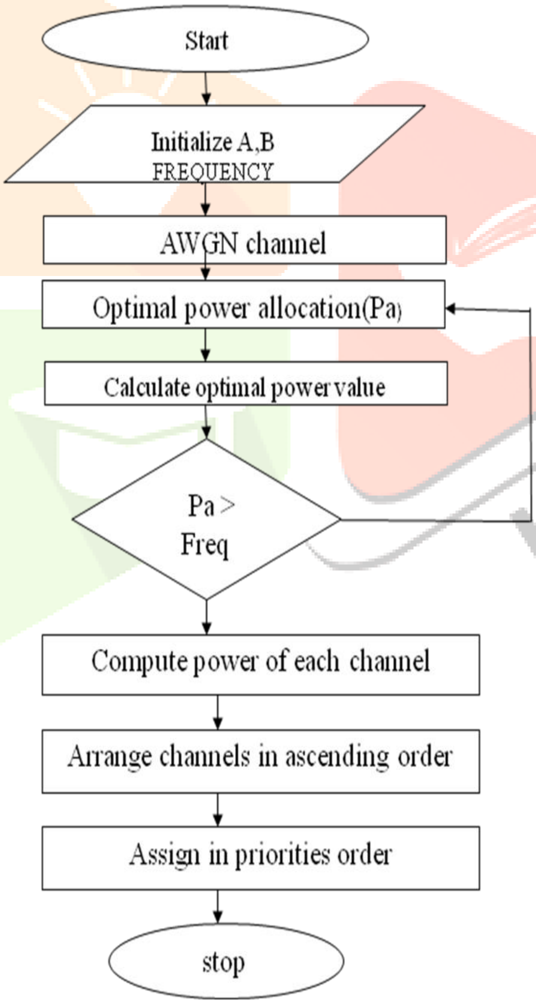
The minimum transmit power P_{min} can be expressed as:

$$P_{min} = \mathbb{E}\left\{\frac{v_0}{2L} \int_{-\frac{L}{v_0}}^{\frac{L}{v_0}} P_m^*(t) dt\right\}.$$

eq.,6

Flow chart:

Here, first the input is initialized after that a AWGN channel is selected. The AWGN channel is a good model for many satellite and deep space communication links. It is not a good model for most terrestrial links because of multipath, terrain blocking, interference, etc. However, for terrestrial path modeling, AWGN is commonly used to simulate background noise of the channel under study, in addition to multipath, terrain blocking, interference, ground clutter and self interference that modern radio systems encounter in terrestrial operation. After that the power is allocated to the channels based on the QoS requirements. Now optimal power allocated to the channels is calculated along with the channel frequency, if the frequency is greater than the power allocated to channels then it again goes back to power allocation stage, otherwise each channel power is computed. After computing the power, all channels are served in ascending order based on priorities or QoS requirements.



Algorithm:

```
Require:
1.The data rate requirements pair (Rds,Rdi);
2.The parameters for system deployment d0,h0an L;
Ensure:
The optimal power allocation strategy Pm(t);
The minimal requirement average transmit power Pmin;
Step1:  Set an original value :$\lambda_{4,min} =0$ and $\lambda_{4,max} =A0$;
Step 2: $\lambda_4 = 1/2 \quad \lambda_{4,min} + \lambda_{4,max}$ ;
Step 3:  Calculate current data rate of delay-insenstive information Rdi($\lambda_4$) on condition of by substituting into Pmin.
Step 4:  If |Rdi($\lambda_4$) - Rdi|< then
Step 5:  Go to step(15)
Step 6:  else
Step 7:  If Rdi($\lambda_4$) > Rdi then
Step 8: $\lambda_{4,max} =\lambda_4$
Step 9:  else
Step 10: $\lambda_4 =\lambda_{4,min}$
Step 11: end if
Step 12:return to step(2)
Step 13:end if
Step14: calculating the optimal power allocation strategy Pm(t) by substituting
Step 15: calculating minimal average transmit power $P_{min}$ by substituting $P_{min}$ by substituting Pm(t).
```

IV. RESULTS AND DISCUSSION

In practical HSR system, the whole train is accurately controlled by a servo system. However, due to some non-ideal factors of system, the practical instantaneous speed of the train is usually time varying around the mean value so that $v(t)$ should be modeled as a stochastic process. Before formulating the problem, we need to consider the characteristics of $v(t)$, which will play an important role in the following discussion. Provided that the mean value of $v(t)$ is $v0$, most of all, $v(t)$ should be limited within a small range in normal running state, to guarantee the operation security. Secondly, the running time of each high-speed train must be coinciding with time table strictly. So it is reasonable to assume that the average time that the train takes to pass through the whole coverage of one BS is equal to $2Lv0$, since driver has enough time to control the train to meet the operation time requirement during this period. Thus, considering the operation characteristics of practical HSRs, $v(t)$ under normal operation state must satisfy the following constraints.

It has been demonstrated that new proposed power allocation algorithm is the most powerful strategy when both delay-sensitive and delay-insensitive information streams are simultaneously transmitted over the same wireless channel. Then, as a comparison, we consider another case in which two sub-channels are available, denoted as sub-channel A and sub-channel B. Here we have taken the input signal in analog form that is in terms of amplitude and time shown in Fig.2. The second graph in above figure indicates the sub-carriers which are used to carry the information. The analog information is coverted into discrete and the power is allocated based on the information requirement.

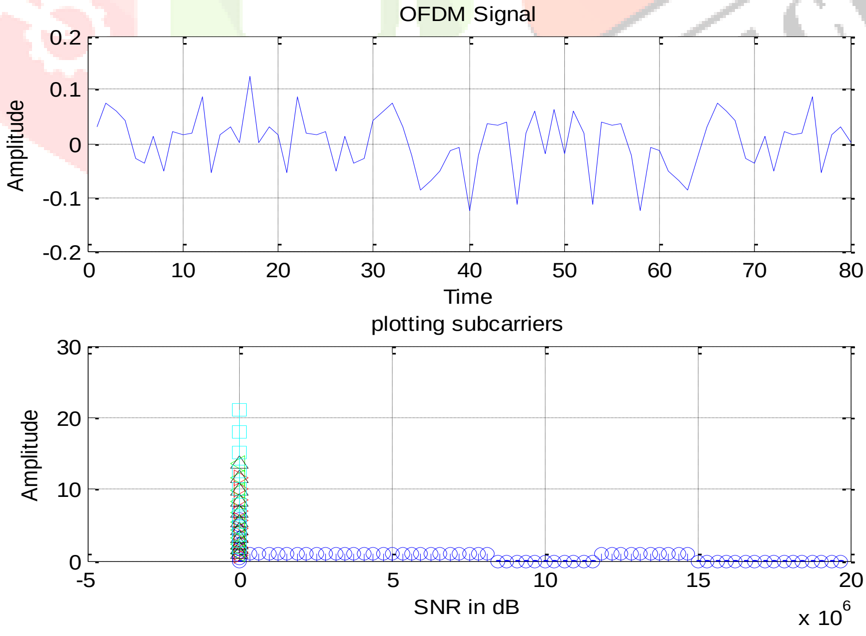


Figure 2. Input signal

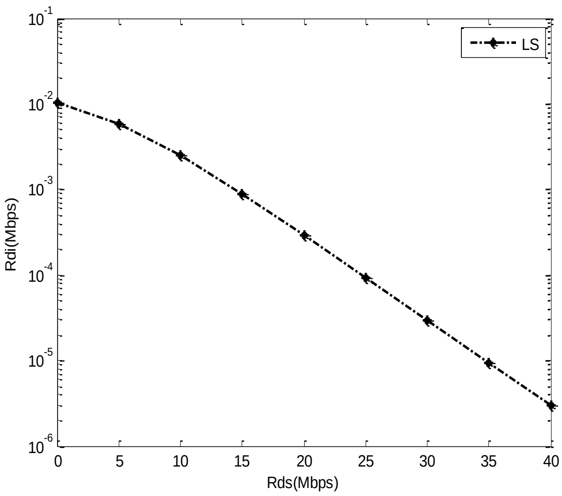


Figure 3. QoS based achievable region for Constant power algorithm

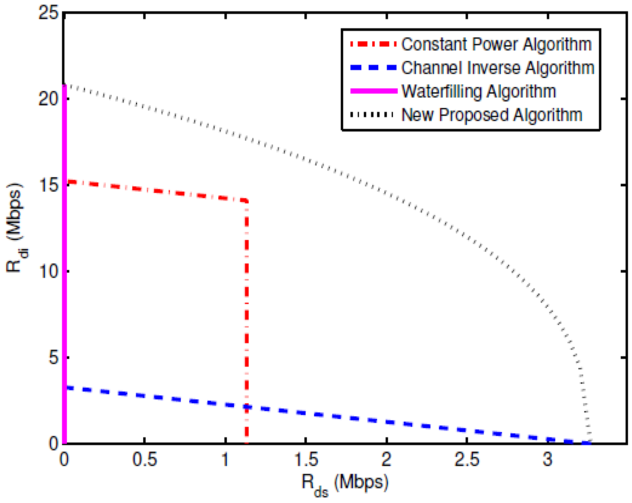


Figure 4.The QoS-based achievable rate regions under four different power allocation strategies when average signal to noise ratio P0=2 0 is 30dB,

Table 1. The minimum AVERAGE TRANSMIT POWER under four different Power allocation algorithms when (*Rdi, Rds*) Is given:

Data rate pair (Rdi, Rds) (Mbps)	CPA(Mw)	WFA(Mw)	CIA(Mw)	NPA(Mw)
20,0	2332.4	1263.5	11356	1263.5
15,1	6440.8	29126	11356	2809.4
10,1.5	14101	36785	11356	4974
5,2	23209	45895	11356	7801
0,2.5	34041	56726	11356	11356

This paper investigated the transmission problem for the wireless links that connects high-speed train and the cellular network. The corresponding service-oriented power allocation algorithm was also derived to achieve the largest achievable rate region, which can bridge the gap between traditional water-filling algorithm and channel inverse algorithm. In the non-uniform motion scenario, we discussed the robust performance of the new proposed allocation algorithm. The performance loss of it was evaluated in terms of both achievable rate region and energy consumption minimization

ACKNOWLEDGMENT:

Furthermore, we would like to appreciate the reviewer(s) for their valuable comments on the proposed work.

REFERENCES

[1] J. Wu and P. Fan, ‘‘A survey on high mobility wireless communications: Challenges, opportunities and solutions,’’ *IEEE Access*, vol. 4, pp. 450–476, 2016.

[2] C. Zhang, P. Fan, K. Xiong, and P. Fan, ‘‘Optimal power allocation with delayconstraintforsignaltransmissionfromamovingtraintobasestations in high-speed railway scenarios,’’ *IEEE Trans. Veh. Technol.*, vol. 64, no. 12, pp. 5775–5788, Dec.2015.

[3] C. Zhang, P. Fan, Y. Dong, and K. Xiong, ‘‘Channel service based high- speed railway base station arrangement, ’’in *Proc .IEEEH MWC*, Chengdu, China, Nov. 2012, pp.1–5.

[4] C. Zhang, P. Fan, Y. Dong, and K. Xiong, ‘‘Service-based high-speed railway base station arrangement,’’ *Wireless Commun. Mobile Comput.*, vol. 15, no. 13, pp. 1681–1694, Sep.2015.

[5] R. G. Gallager, *Principles of Digital Communication*. Cambridge, U.K.: Cambridge Univ. Press,2008.

[6] D. N. C. TseandS. V. Hanly, ‘‘Multi access fading channels. I .Polymatroid structure, optimal resource allocation and throughput capacities,’’ *IEEE Trans. Inf. Theory*, vol. 44, no. 7, pp. 2796–2815, Nov.1998.

[7] A. J. Goldsmith and P. P. Varaiya, ‘‘Capacity of fading channels with channel side information,’’ *IEEE Trans. Inf. Theory*, vol. 43, no. 6,pp. 1986–1992, Jun. 1997.

[8] D. Wu and R. Negi, ‘‘Effective capacity: A wireless link model for support of quality of service,’’ *IEEE Trans. Wireless Commun.*, vol. 2, no. 4, pp. 630–643, Jul. 2003.

[9] Y. Dong, C. Zhang, P. Fan, and P. Fan, ‘‘Power-space functions in high

speedrailwaywirelesscommunications,’’*J.Commun.Netw.*,vol.17,no.3, pp. 231–240, Jun. 2015.

[10] S. Efazati, and P. Azmi, “Effective capacity maximization in multi relay networks with a novel cross-layer transmission frame- work and power-allocation scheme,” IEEE Trans. Veh. Technol., vol. 63, no. 4, pp. 1691-1702, May. 2014.

[11] J. Luo, R. Yates and P. Spasojevic, “Service outage based power and rate allocation for parallel fading channels,” IEEE Trans. Inf. Theory, vol. 51, no. 7, pp. 2594-2611, Jul. 2005.

[12] Y. Q. Dong, P. Y. Fan and K. B. Letaief, “High-speed rail- way wireless communications: efficiency versus fairness,” IEEE Trans. Veh. Technol., vol. 63, no. 2, pp. 925-930, 2014.