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# ANALYSIS OF SELECTION AND SWITCHING DIVERSITY SCHEMES ON THE BASIS OF SUM RATE & FAIRNESS

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**ABSTARCT: In this paper, the performance of selection diversity and switched diversity is studied. In this paper we use the channel parameter to maximize the sum rate. A user qualifies as an acceptable user and is selected by the base station when the reported channel quality is above a predefined switching threshold. The comparison between selection diversity and switched diversity shown by graphs in terms of fairness index, and sum rate. Numerical results shows the flexibility of threshold selection, where a potentially different threshold can be used for each user, the proposed scheme provides the maximum value of fairness in switched diversity. The fairness of selection diversity is always maximum and equal to one almost. In addition, it is argued that the proposed multiuser access schemes can be quite attractive also from a fairness perspective. The feedback can also increased by using the locally connective method.**

**Keywords: Multiuser scheduling, switched multiuser access and selection multiuser access.**

## 1. INTRODUCTION

Multiuser diversity is one of the key enabling technologies that allow schedulers to achieve high system performance [1]. Unlike the long-established belief that fading effects of wireless channels have a negative impact on the performance of the systems, fading channels can actually be used to obtain multiuser diversity and thus even help greatly improve the overall system performance in a multiuser environment when used with a proper scheduler [2]. Adding performance gain based on multiuser diversity, however, is not a simple task for schedulers especially when supporting a plethora of users, since the optimal scheduling algorithm is a function of numerous variables, such as available resources, user channel quality, user priorities, and so on. Given the fact that schedulers often become much more complicated as the number of users in the system increases, it is often a practical interest to come up with a low complexity scheduling algorithm with a reasonable system performance. Using a sequential search to identify an acceptable user can contribute to increase fairness in a multiuser system, since the sequence in which to probe the users can be made different from one time-slot to the next. When independent and identically distributed channels are assumed, the users will be competing for the channel on equal terms. In this case,
On average, all $K$ users will have accessed the channel after $K$ time-slots.

## 2. LITERATURE REVIEW

In past few years, we use opportunistic scheduling schemes to access the channel by a user. In these schemes any priority conditions are not provided. The different parameter’s fairness, centralized optimization and capacity feedback tradeoff are not fully satisfied so to overcome these technical challenges parameters the other technique named switching scheduling is introduced. In this a particular threshold level is given. The priority provided to each user depend upon this particular level of threshold so to provide equal priority to each user this multiuser switch diversity scheduling scheme is used. Multiuser switched-diversity scheduling schemes were recently proposed in order to overcome the heavy feedback requirements of conventional opportunistic scheduling schemes by applying a threshold-based, distributed, and ordered scheduling mechanism. The main idea behind these schemes is that slight reduction in the prospected multiuser diversity gains is acceptable tradeoff for great savings in terms of required Channel state-information feedback messages. We characterize the achievable rate region of multiuser switched diversity systems and compare it with the rate region of full feedback multiuser diversity systems. The basic principle in MUSwiD scheduling schemes is to find any acceptable user instead of finding the best user among all. It was suggested in to use a scheduling strategy based on examining the CSI of the users sequentially instead of jointly. Once a good-channel user is found, the process of examining the channel conditions terminates, and that user is scheduled. The decision whether the channel condition of a specific user is acceptable or not is assessed by a predefined threshold.

## 3. SWITCH DIVERSITY

In order to simplify user selection process, [3] proposed a switched multiuser access scheme, which extends the concept of switched diversity in multiple antennas [5]–[6] to a multiuser scenario by analogously linking spatial diversity with multiuser diversity. The basic principle of this scheme is to find any acceptable user a user whose channel quality is higher than the pre-determined threshold instead of the best user. In this scheme, the base station probes the users one after another so only a single user has an opportunity to send a feedback at one time. In order for each user to decide whether to send a feedback or not, a single feedback threshold is used for all the users. Although selection of the feedback threshold is crucial to the performance of such systems, finding the optimal threshold is not very well studied in the literature. This paper first is revisits the conventional switched multiuser

Access scheme and describes briefly how to obtain the optimal single feedback threshold. Then we propose a switched multiuser access scheme with a sequence of feedback thresholds, where each user may use a different feedback threshold, and discuss the sequence of optimal feedback thresholds that maximizes the system capacity. Since the conventional scheme uses the same feedback threshold for every user but the proposed scheme can allow a different threshold per user, it is easy to see that the conventional scheme is a special case of the proposed scheme. Unlike the conventional scheme where the optimal single feedback threshold is a function of all the users in the system, the proposed scheme allows each feedback threshold in the sequence to be optimized based on a subset of users, i.e., the remaining users in the user sequence waiting for a feedback transmission opportunity, the proposed

Scheme allows a simple analytical way to calculate each feedback threshold in the sequence as shown later in this paper.

## 4. SELECTION DIVERSITY

This type of multiuser selection diversity was studied from a different perspective, namely, the tradeoff between the system throughput and the fairness among different users. It was argued that although the selection diversity based on the best channel criterion maximizes the system throughput, it can result in an unfair scheduling of the system

resources across users. Indeed, with this system, users with the strongest channels on average will end up monopolizing the resources most of the time. For this reason, proportional fair scheduling that uses a modified selection criterion based on the relative channel strength was then proposed to exploit multiuser diversity while maintaining fairness among users. The basic idea is to pick the user with the best channel compared to its own average. A variant of this scheduling algorithm was also proposed in [4] by taking into consideration the tradeoff between the multiuser diversity gain and the mobility of users. The basic idea is to pick the user with the best channel compared to its own average. A variant of this scheduling algorithm was also proposed in [4] by taking into consideration the tradeoff between the multiuser diversity gain and the mobility of users. The viability of such scheduling schemes largely depends in practice on the number of active users and how fast the channel changes. While more users increase the multiuser diversity gain, the average amount of time each individual user is picked to communicate decreases. On the other hand, if the channel varies too fast, an accurate estimate of the channel strength would be difficult. However, the channel fading must be fast enough so that the average time any user accesses the channel is not too long to ensure certain fairness among all users.

## 5. PROPOSED WORK

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In this purposed work we follow the following process:
1. Firstly, we set the value of signal to noise ratio and number of user.
2. Compute the rate threshold for each user & then compute the rate of all the users based on the signal to noise ration of system.
3. Schedule the user whose rate is greater than the threshold rate & also schedule the user whose rate is less than the threshold rate.
4. Obtain the sum rate of all the users whose value is greater than threshold value & also obtain the sum rate of all the users whose value is less than the threshold value.
5. In last step add both the sum rates to achieve the sum achievable rate.

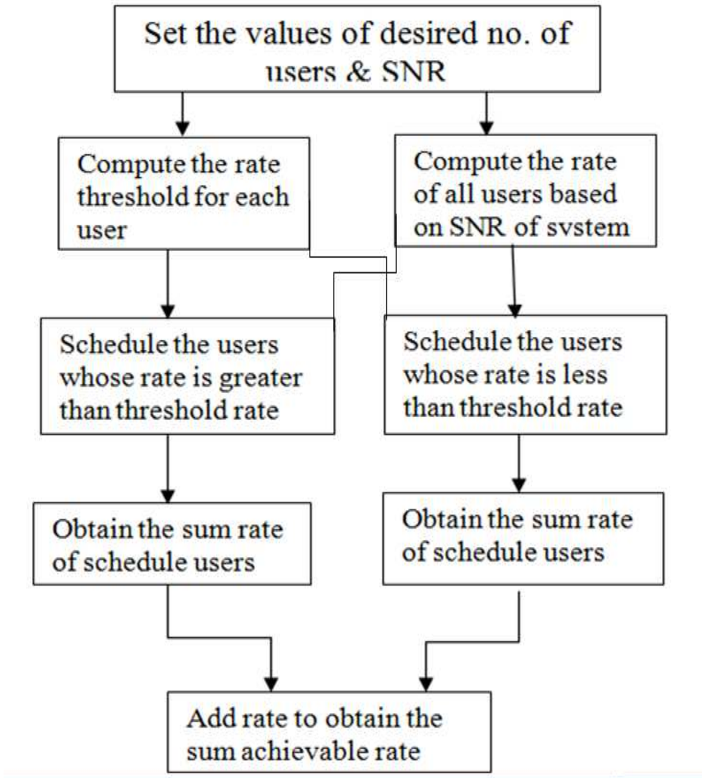


Fig.1 Flow Chart for scheme

The vector of signals received by user *k* at time *t* can be given by

$$\mathbf{y}k(t) = \mathbf{H}k\mathbf{s}(t) + \mathbf{n}k(t) \ (1) \qquad (1)$$

where **s**(*t*) is the NT × 1 vector of signals sent by the BS, **n**k(t) is an NR × 1 vector of additive white complex Gaussian noise experienced by user k (k = 1, . . . , K), and **H**k is the NR × NT channel matrix between the BS and user *k* for the current time slot. The covariance matrix of the noise is σ2N **I**NR, where **I***NR* is the NR × NR identity matrix. Each MS channel encounters path loss, lognormal shadow fading, and multipath fading. We also assume that the fading coefficients at the receiver antennas are spatially uncorrelated. The channel matrix **H**k between the BS and user k (k = 1, . . . , K) for each time slot can be calculated as

$$\mathrm{H}_k = \sqrt{\mathrm{SNR}_0 (l_k/D)^{-\beta_{\mathrm{PL}}} \times 10^{S_k/10}} \times \mathrm{G}_k \qquad (2)$$

where SNR0 is the median SNR, lk is the distance between the BS and user k, *D* is the cell radius (lk ≤ D), βPL is the path loss exponent, Sk is a real Gaussian random variable with zero mean and a variance of σ2S, and the elements of NR × NT matrix **G***k* are independent identically distributed complex Gaussian random variables with zero mean and unit variance and represent Rayleigh-distributed multipath fading. Note that lk in the current time slot is correlated to lk in the previous time slot because of the system mobility . If the scheduler assigns the

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transmit antenna *n* (*n* =1, . . . , *NT* ) to user *k* (*k* = 1, . . . , *K*) in the current time slot (for simplicity, we say that channel *n* is assigned to user *k*), then the SINR at user *k* for data transmitted on that channel can be given by

$$\gamma_{k,n} = \frac{|[\mathrm{W}_k\mathrm{H}_k]_{nn}|^2}{(\sigma_N^2/P_T)N_T\sum_{m=1}^{N_T}|[\mathrm{W}_k]_{nm}|^2+\sum_{m=1,m\neq n}^{N_T}|[\mathrm{W}_k\mathrm{H}_k]_{nm}|^2} \quad (3)$$

where PT is the total transmitted signal power, and **W***k* is the MMSE receive weight matrix. The weight matrix **W**k in (3) is given as

$$\mathrm{W}_k = \left(\mathrm{H}_k^H\mathrm{H}_k + \left(\sigma_N^2 N_T/P_T\right)\mathrm{I}_{N_T}\right)^{-1}\mathrm{H}_k^H \quad (4)$$

where H denotes the conjugate transpose, and **I**NT is the NT × NT identity matrix.

## 6. NUMERICAL RESULTS

By using these above equations, we calculate these numerical results. We use two performance measures in our comparisons:

(i)The sum achievable rate in the network.

(ii)The degree of fairness (DOF) among the users.

We opt in this work to use the well-known Jain's fairness index

$$\mathbf{DOF} \equiv \frac{\left(\sum_{i=1}^{M} x_i\right)^2}{M\sum_{i=1}^{M} x_i^2}, \quad (5)$$

where *xi* is a user-related metric. In our numerical examples we used two metrics for *xi*:

• Resource sharing fairness: *xi* is selected to be the expected channel access ratio AR*i*.

• Multiuser diversity gains fairness: we propose the following metric as well for the fairness measure.

where *Ri* is the achievable rate of user *i* according to the applied scheduling scheme.

$$x_i \equiv \frac{R_i}{\int_0^\infty r\, f_{R_i}(r)dr}, \quad (6)$$

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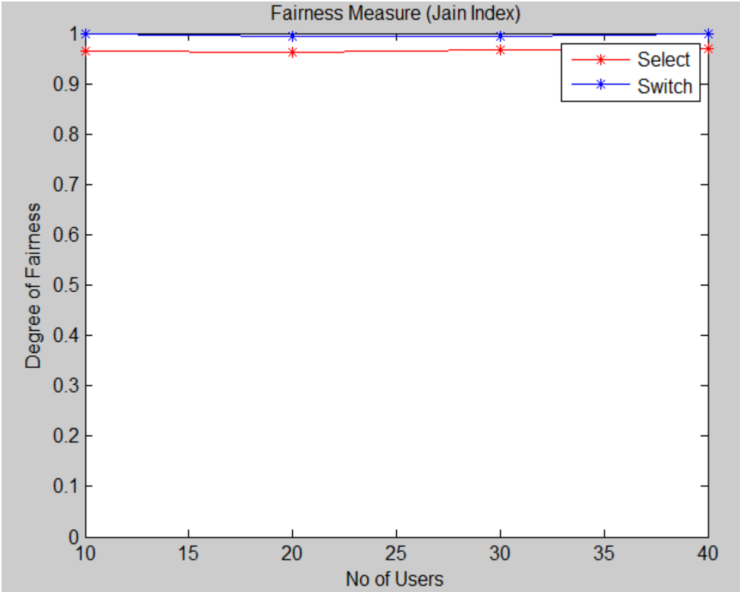


Fig.1 Fairness measure by applying Jain's index ( with ($xi$ = AR$i$) the average channel access ratio. The users have Rayleigh block-fading channels with average SNR distributed. The red colour star line indicates the selection diversity & blue colour star line indicates the switch diversity.

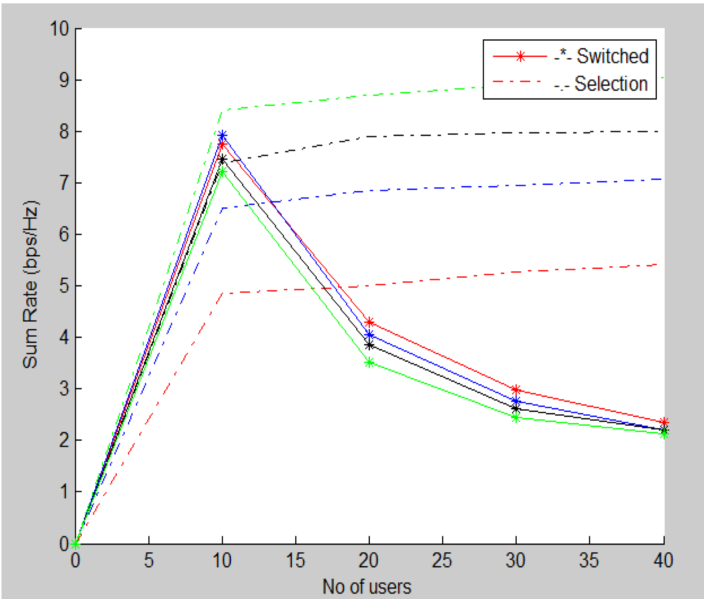


Fig. 2. Sum achievable rate comparison between the selection diversity system and the switched diversity system as a function of the number of users for maximum sum rate scheduling and proportional fairness scheduling .The red solid line indicates the switch diversity & the red dashed line indicates the selection diversity.

## 7. CONCLUSION

In this paper, we studied the performance of the multiuser selection diversity and multiuser switched diversity schemes. In order to maximize the sum capacity of the network, we should always schedule the user with the best instantaneous channel quality. It was argued that although the selection diversity based on the best channel criterion maximizes the system throughput. By using the channel parameter which we used in this paper, the fairness value of switched diversity schemes is almost equal to one. The first graph showed the numerical result between number of users and degree of fairness. The degree of fairness using the Jain index formula. The second graph showed the result between number of users & sum rate.

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