

Sub-carrier allocation scheme based on a single carrier frequency division multiple access by using a relay selection

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Abstract: This article gives a scheme for the allocation of subscribers based on multiple access with a single carrier frequency division (SC-FDMA). A discrete Fourier (DFT) transform can be used for pre-coded solutions to the PAPR issue in the SC-FDMA. In a wireless signage system based on SC-FDMA, a multi-hop system using relays can extend communication coverage and solve the problem of the shaded area caused by the obstacle between the signages. In the conventional multi-hop system based on SC-FDMA, the communication between a source and relay does not use a communication resource efficiently. Therefore, this paper proposes a method that can usefully use a communication resource. Additionally, A multi-hop system has a significant impact on the relay selection scheme. For selecting a suitable relay, the new method for relay selection takes into account the channel between UE and the relay, and between the relay and the venue. When considering the channel between the source and the relay, the sub transporters used to communicate between the source and the relay are taken into account only. The system proposed will use the required relay selection scheme on the basis of SC-FDMA in the multi-hop system. Thus, a high signal-to-noise (SN) ratio of the received signal may be given by the proposed scheme. The results of the simulation show that the performance of the proposed system in different scenarios is higher than that of the traditional.

Keywords: Signage, SC-FDMA, Relay Selection, Multi-hop System, DFT.

I. BACKGROUND

Recently, wireless signage communication systems require the high throughput and reliability for high quality services. The wireless signal systems are thus based on an orthogonal multiplexing frequency division (OFDM), which can give high spectral power, performance and reliability through the use of orthogonal subcarriers [1]. The OFDM technology is robust in the channels which are interfered with a narrow band and have frequency selection properties [2]. The advantages are fantastic. However, the OFDM technology has high transmission signal envelope fluctuations, which poses a PAPR concern [3]. In other words, the use of the OFDM technique requires costly linear power amplifiers. The UE bears unwanted additional costs, particularly with the uplink [4].

SC-FDMA offers multiple access advantages in the orthogonal frequency segment (OFDMA). On the other hand, with the use of DFT algorithm the SC-FDMA can reduce the PAPR problem. Thus, the LTE uplink has implemented the SC-FDMA [5]. The SC-FDMA is also a promising multi-access transmission technology for future WiFi communications.

The transmitter of the SC-FDMA is shown in Figure 1. The input data $x[m]$ is spread with the DFT pre-coding to generate $X[i]$. The $X[i]$ is as follows,

$$X^{(u)}[i] = \sum_{m=0}^{M-1} x^{(u)}[m] e^{-j \frac{2\pi}{N} mi} \quad (1)$$

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and then, the $X[i]$ is allocated as

$$\begin{aligned} \tilde{X}^{(u)}[n] &= \frac{1}{N} \sum_{k=0}^{N-1} \tilde{X}^{(u)}[k] e^{j2\pi \frac{n}{N} k} = \frac{1}{S} \cdot \frac{1}{M} \sum_{m_1=0}^{M-1} X^{(u)}[m_1] e^{j2\pi \frac{n}{M} m_1} \\ &= \frac{1}{S} \cdot \frac{1}{M} \sum_{m_1=0}^{M-1} X^{(u)}[m_1] e^{j2\pi \frac{Ms+m}{M} m_1} \\ &= \frac{1}{S} \cdot \left(\frac{1}{M} \sum_{m_1=0}^{M-1} X^{(u)}[m_1] e^{j2\pi \frac{m}{M} m_1} \right) \\ &= \frac{1}{S} \cdot x^{(u)}[m], \end{aligned} \tag{2}$$

where $n = M \cdot s + m$, ($0 \leq s \leq S-1$, $0 \leq m \leq M-1$).

In the equations, the u means the index of the source.

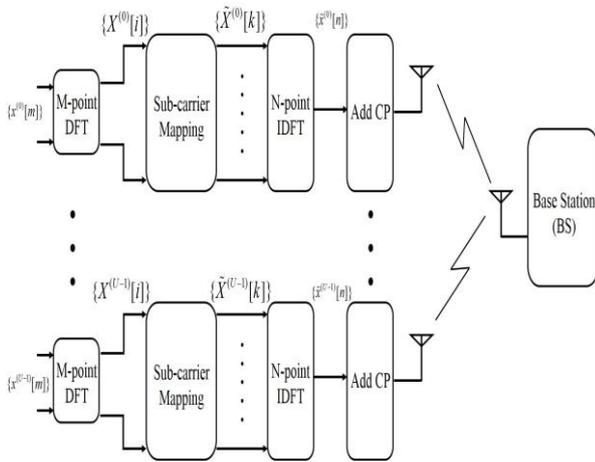


Fig. 1: A business-level Technology acceptance model

The SC-FDMA can be categorized into 2 types as localized and distributed ones according to the sub-carrier allocation schemes. Figure 2 shows the sub-carrier allocation schemes.

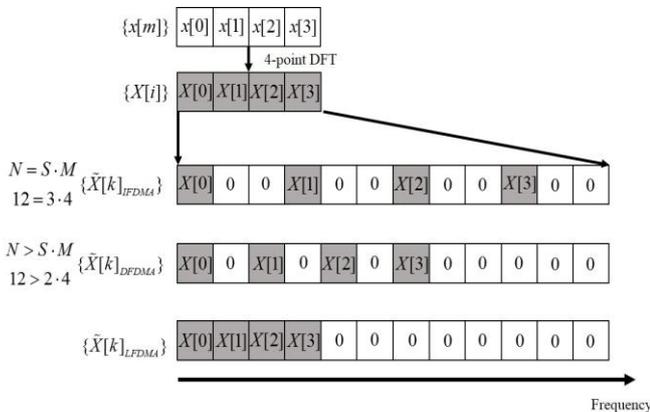


Fig. 2: Types of the SC-FDMA

Distributed FDMA (DFDMA) distributes the outputs of M -point DFT over the entire band of total $(N - M)$

unused sub-carriers. On the other hand, localized FDMA (LFDMA) allocates the outputs of M -point DFT to consecutive sub-carriers. The impact of PAPR decrease depends on how sub contractors are assigned [7].

The multi-hop system will increase the coverage of the wLAN communication system and solve the shaded area problem caused by a hurdle between destination and source with relays. The multi-hop method has therefore been used in different wireless communication systems. The relay selection scheme impacts the system's efficiency in the multi-hop system strongly. Therefore, when the relays are selected for the multi-hop system, the channel conditions are considered. Because the channel state information (CSI) is necessary for the relay selection scheme, the channel estimation is important.

The objective of this paper is to improve the trustworthiness of the multi-hop system by changing the SC-FDMA subscriber allocation scheme and by using a system for selecting relays that takes into account the condition of the Channel between the source and the destination.

II. METHODS

The System model is based on the SC-FDMA and multi-hop system of uplink. All signages can perform the function of the relay. Also, all relays use a decoded-and-forward (DF) method. There are one source, relay and destination in this scenario. In the system model, it is assumed that there is no the line-of-sight (LOS) between the source and destination.

The number of the relay candidates is C . There is not a direct path between the source and destination. The $H_{s,R}$ means the channel response (CR) between the source and relay, and the $H_{R,D}$ means the CR between the relay and destination. The solid lines mean the information signals and the dotted lines mean the feedback information signals.

Because the communication between a source and relay does not consider signals of other signage's, it can use a communication resource efficiently.

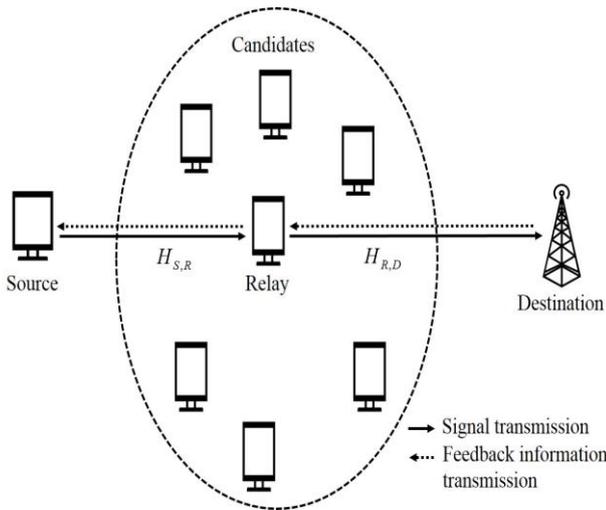


Fig. 3: System model

When the sub-carrier mapping step progresses, the conventional SC-FDM schemes use consecutive or constant interval sub-carriers. As a result, when the multi-hop system uses the conventional SC-FDMA such as the LFDMA and DFDMA, the system can not use the suitable sub-carrier that has good channel condition. Therefore, this paper proposes the new SC-FDMA scheme. In the new scheme, the source can know the channel conditions between the source and the relay through the feedback information. and then, the source determines the ranking of the sub-carrier via the channel amplitudes and selects the sub-carriers that will be used. The ranking index r has range from 1 to IDFT size N . If the ranking index is small, the channel condition is good. Also, if the ranking index is large, the channel condition is poor. The number of sub-carriers that will be used is the DFT size M . In other words, only sub-carriers with an index between 1 and M are used for the communication between the source and relay. As a result, because the multi-hop system can use suitable sub-carriers that have good channel condition, the performance of the system is improved. In the proposed scheme, the $X[i]$ is allocated as

$$\tilde{X}_{pro}[k] = \begin{cases} X[i], & i = \text{ranking}(k) \\ 0, & \text{otherwise} \end{cases}, \quad (3)$$

Where $0 \leq i \leq M - 1$.

Figure 4 shows that only sub-carriers with ranking 1, 2, 3

and 4 are used. Because the communication between the relay and the destination considers the signals of other users, it uses the communication resource allocated to each user. If the proposed SC-FDMA is used for this communication, users that use the sub-carriers of low channel ranking have the serious performance degradation. So, the IFDMA is used for the communication between the relay and destination.

In the proposed multi-hop system, when the source selects the relay, the channel amplitudes are considered. The proposed relay selection scheme can help the source select the suitable relay in the multi-hop system based on the SC-FDMA system. The communication between the source and relay only uses the sub-carriers that have the ranking index r between 1 and M . Therefore, when the channel amplitudes are considered, the channel amplitudes between the source and relay are used according to $\text{ranking}(k)$.

The source calculated the values in order to select the relay, and then selects the largest value relay. The value is as follows,

$$V_{SC}[c] = \frac{\sum_{r=1}^M |H_{S,R}^r[c]|}{M} + \frac{\sum_{n=0}^{N-1} |H_{R,D}^n[c]|}{N}, \quad (4)$$

Where $r = \text{ranking}(k)$, $0 \leq k \leq N - 1$ and c means the relay candidate index. Because the relay that is selected by using proposed relay selection scheme has good channel condition, it can provide the high reliability.

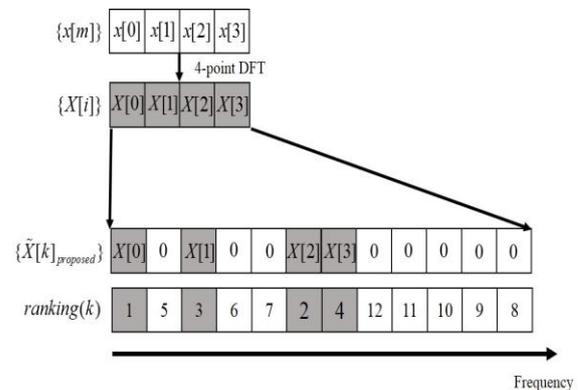


Fig. 4: Sub-carrier mapping method of the proposed scheme.

This improves the SNR of the received signal at the destination. Therefore, the new scheme can provide the extended coverage and solve the problem of the shaded area without degraded performance of the system.

III. RESULTS

This section explains the results and parameters of the simulation. For communication between the source and the relay, the proposed SC-FDMA scheme is used and the IFDM A scheme is used for communication between the relay and the destination. The proposed scheme assumes that between source and destination there is no LOS scenario. The channel calculation is believed to be perfect. Table 1 displays the parameters of the simulation.

Table 1: Description of the samples

Parameters	Type & Value
IDFT Size	256
DFT Size	64
CP Size	(IDFT Size) / 4
Channel Model	Rayleigh fading channel
Multi Path	7-path
Modulation Order	16-QAM
Channel Coding	Convolutional
Code Rate	0.5

The performance of the proposed and traditional systems based on signal-to-noise (SNR) ratios is shown in Figure 5. In Figure 5, the proposed random relay method selects the RRS without the proposed RRS. The traditional approach to RAM uses IFDMA and chooses the RAM without a selection process suggested for RAM. IFDMA transmitting systems use the traditional method of relay selection and pick the relay by the proposed type of relay selection.. The results of the simulation indicate the superiority of the proposed method over conventional schemes.

In the simulation result, the proposed sub company assignment process shows a higher BER efficiency than standard schemes in all SNR environments. In addition, without the use of the relay selection regime, the performance of the proposed sub-company allocation

scheme is still larger than the standard sub-company allocation scheme. Moreover, when the proposed method for relay selection is used only without an assignment system from the Sub company, the performance of the system is greater than the random relief. This paper provides an improved allocation of the multihop signaling system based on SC-FDMA as well as a relay preference tool. The proposed subsidiary assignment scheme will assist the source by using the appropriate relay for the multi-hop system. Therefore in the relay the signal distortion caused by the amplification of the signal is reduced. The proposed framework for relay selection may also allow the source to choose the correct relay. Thus the high SNR of the received signals will be used. Therefore, the new system will provide higher performance and improved signage contact coverage.

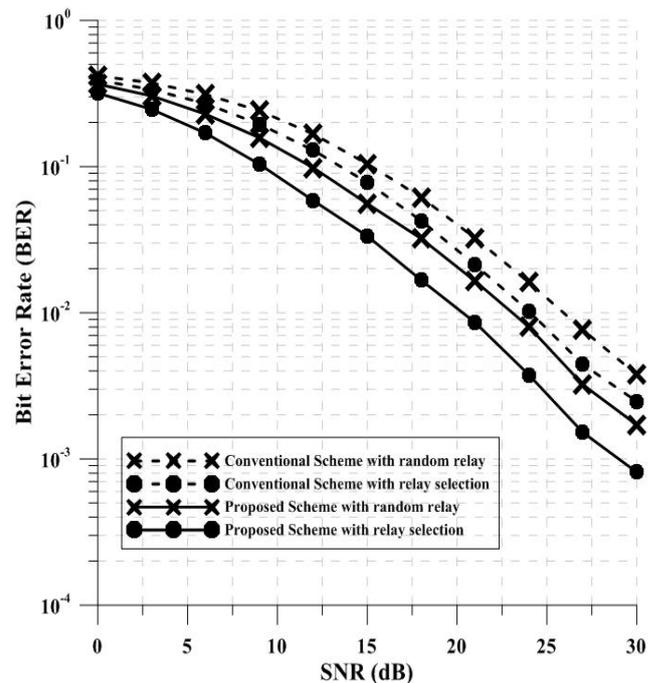


Fig. 5: The BER's efficiency of the proposed and traditional SNR schemes.

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