Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**Cooperative diversity in relay downlink**	
Data Submitted	**07-Nov-2006**	
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Re:	Call for Technical Proposals regarding IEEE Project P802.16j.	
Abstract	The document contains technical proposals for IEEE P802.16j that provides cooperative diversity in relay downlink.	
Purpose	This is a response to Call for Technical Proposals regarding IEEE Project P802.16j.	
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Cooperative diversity in relay downlink

1 Introduction

In generally, a single time-frequency resource within a frame is assigned to one RS in relay downlink to MS as shown in figure 1. While a relay station is transmitting a packet, other stations cannot transmit using the same time-frequency resource. But, if the transmission timing differences from multiple signal sources are within a CP period, an OFDMA system, which is robust in multi-path channel environment, can take advantage of the signal arrivals from multiple sources to obtain diversity gain. In relay transmission, by allowing a set of multiple signal sources to transmit using the same time-frequency resource, where the set of signal sources may composed of a combination of RSs and MMR-BS, we can achieve cooperative diversity gain to improve the performance of the relay network.

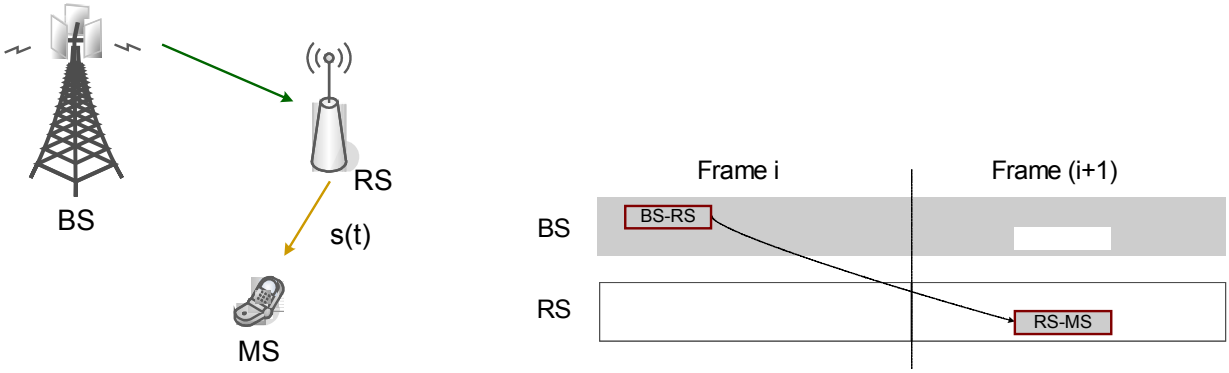


Figure 1. Example of general relay transmission

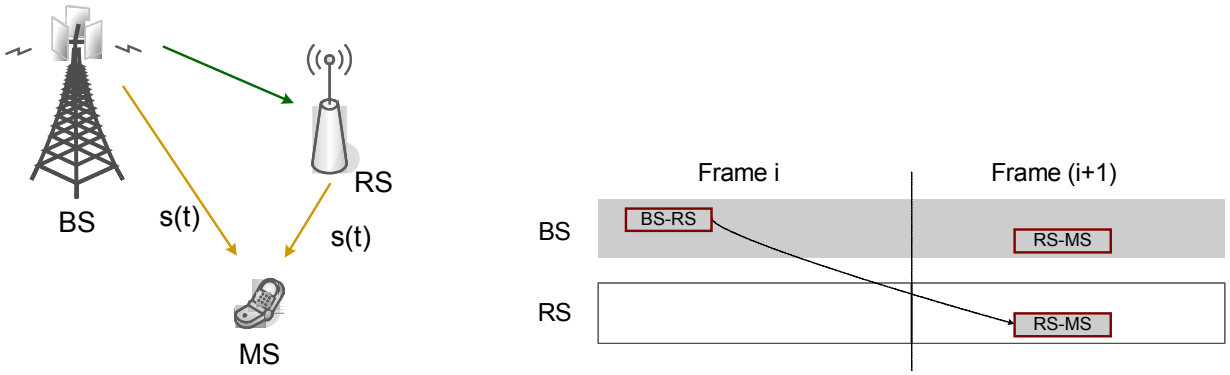
2 Proposed Solution

We propose three cooperative diversity schemes:

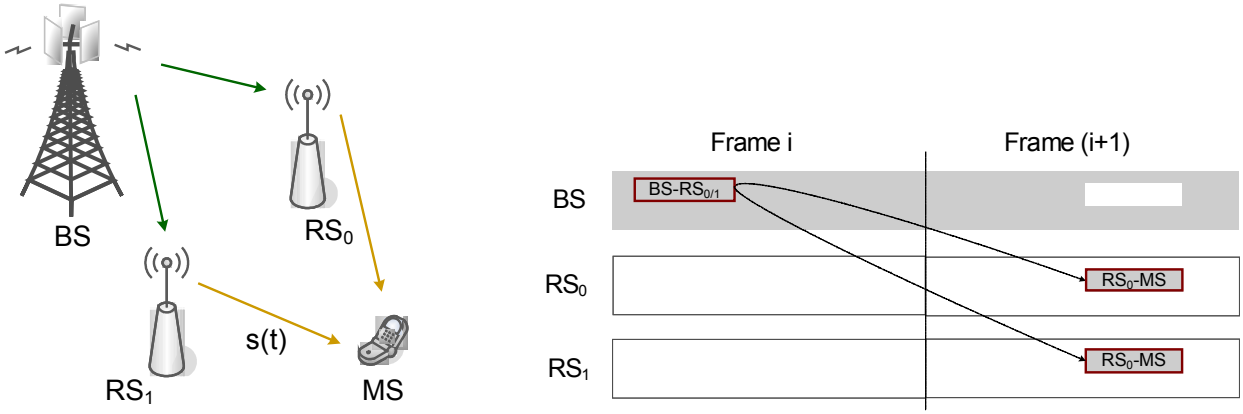
- Cooperative source diversity: Multiple signal sources simultaneously transmit the same signal using the same time-frequency resource.
- Cooperative transmit diversity: Multiple signal sources simultaneously transmit space-time encoded signals using the same time-frequency resource.
- Cooperative hybrid diversity: A combined diversity scheme of the cooperative source and cooperative transmit diversity.

2.1 Cooperative source diversity

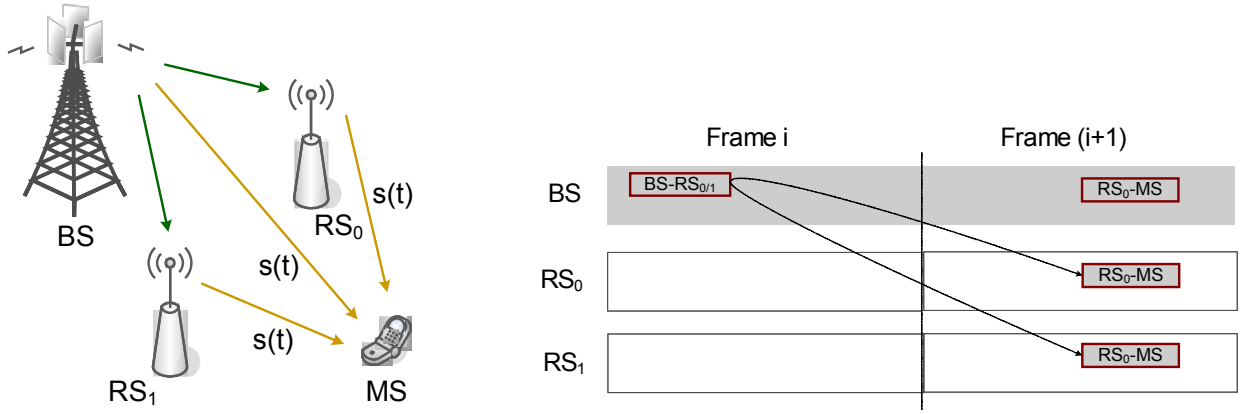
Figure 2 shows examples of cooperative source diversity. In figure 2(a), the diversity gain will obtained by combining the relay transmission from the RS and the transmission from the MMR-BS transmitted using the same time-frequency resource. Figure 2(b) illustrates a source diversity scheme, where multiple RSs transmitting at the same time using the same time-frequency reource. Figure 2(c) describes an example of cooperative source diversity, where signals from two RSs and an MMR-BS are combined. Figure 3 shows the simulation results of BER performance for the example shown in Fig. 2(a).



(a) Usage of BS and RS transmit source



(b) Usage of multiple transmit source of RSs



(c) Usage of multiple transmit source of BS and RSs

Figure 2. Example of cooperative source diversity

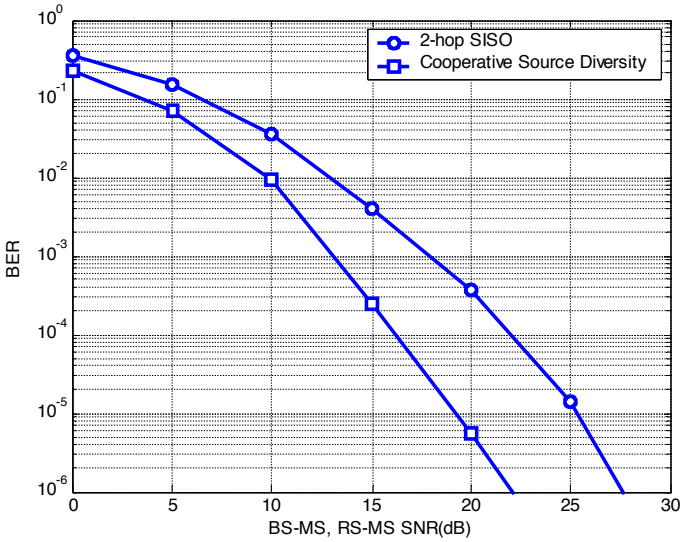


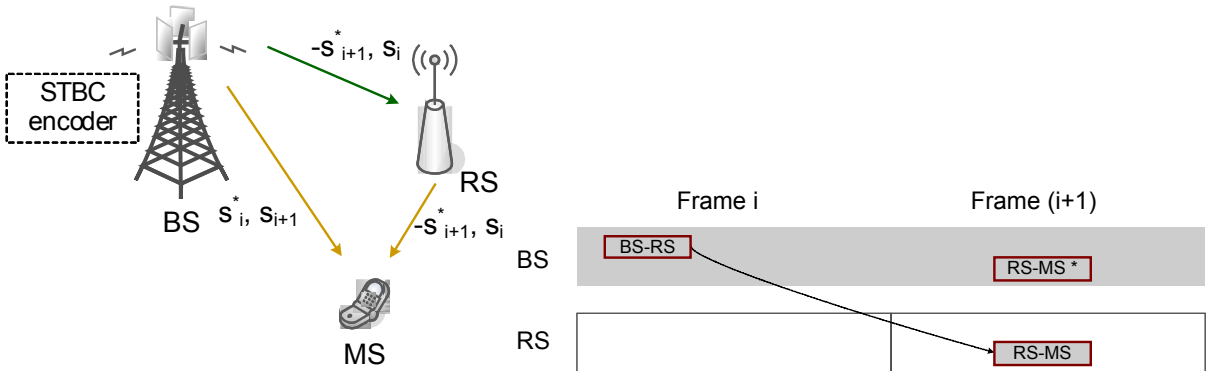
Figure 3. Simulation result of Figure 3(a).

Assumption: 1. Received signal powers at BS-MS and RS-MS are same.

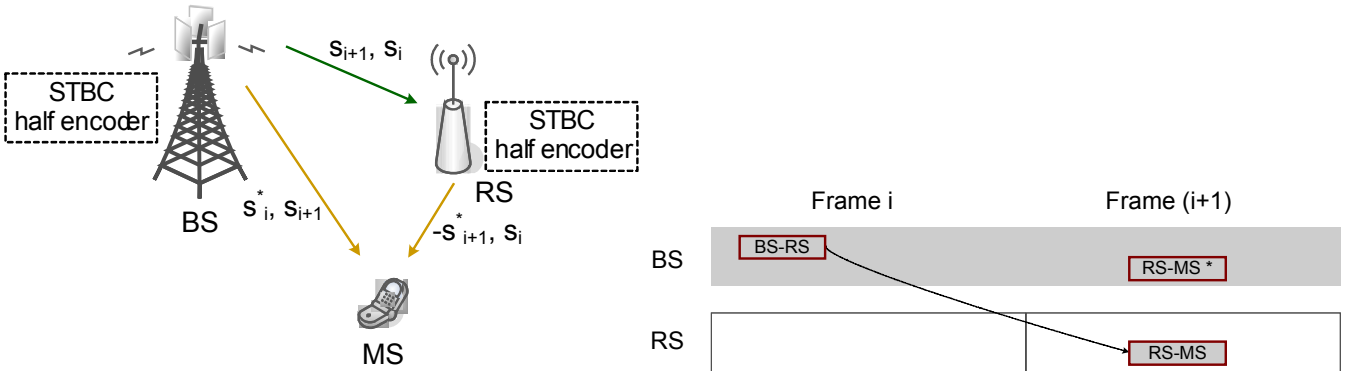
2. SNR of BS-RS is 30dB

2.2 Cooperative transmit diversity

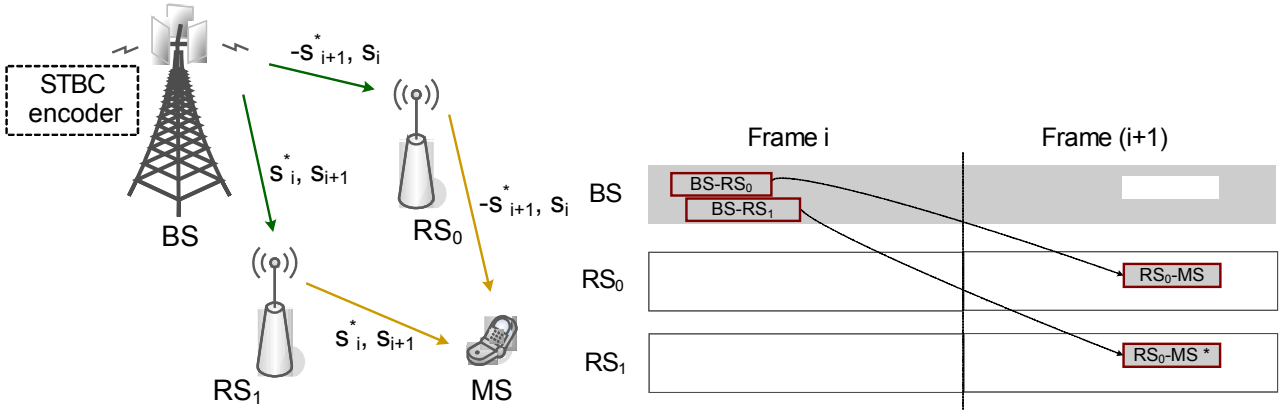
The proposed method is based on MS supporting transmit diversity using STC. The transmit structures of the cooperative transmit diversity and the cooperative source diversity are identical. However, in the cooperative transmit diversity scheme, the received signals from different sources are different, each signal source playing the role of different transmit antenna in the conventional STC. If the STC encoding is performed at the MMR-BS, the RSs simply need to relay the packets. However, if the STC encoding is performed at the RSs, the channel utilization will be more efficient because the MMR-BS needs to transmit the packet only once in the example illustrated in Fig. 4(d). Figure 5 shows the simulation results of the BER performance of the examples shown in Fig. 4(a) and (b).



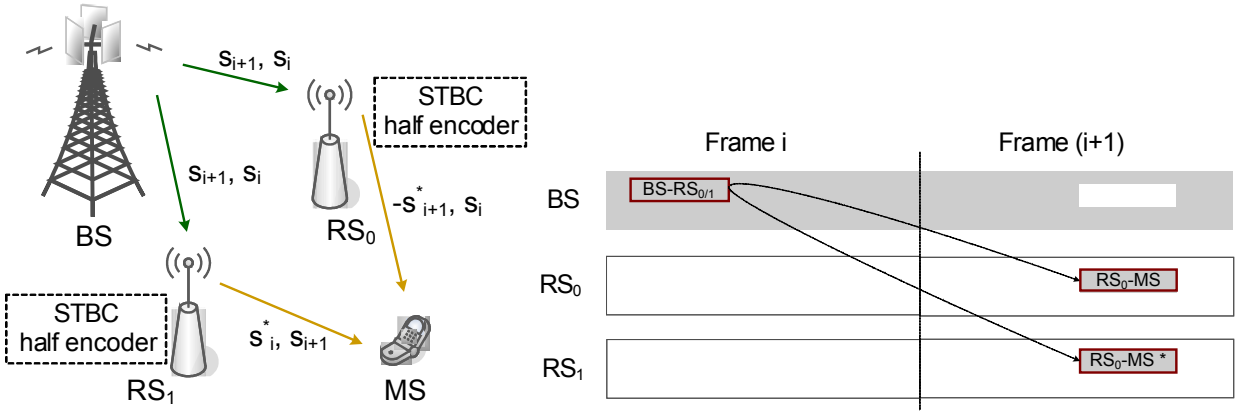
(a) Usage of BS and RS transmit source – full encoding in BS



(b) Usage of BS and RS transmit source – partial encoding in BS and RS



(c) Usage of multiple transmit source of RSs – full encoding in BS



(d) Usage of multiple transmit source of RSs – partial encoding in BS and RS

Figure 4. Examples of cooperative transmit diversity

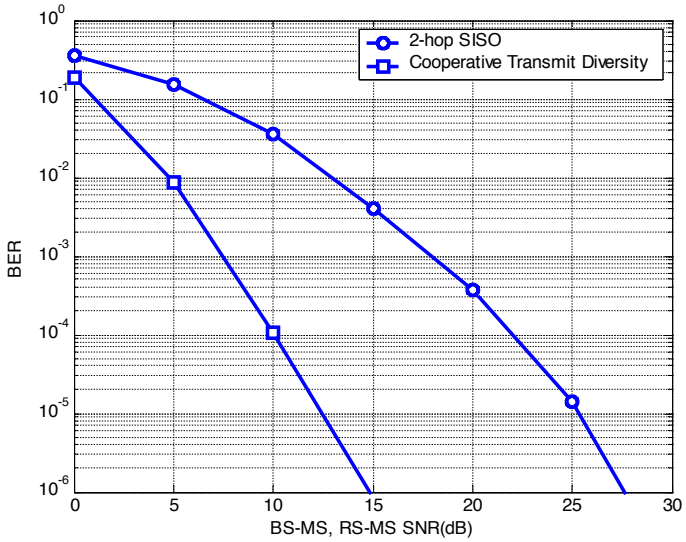


Figure 5. Simulation result of Figure 5(a)(b).

Assumption: 1. Received signal powers at BS-MS and RS-MS are same.

2. SNR of BS-RS is 30dB

2.3 Cooperative hybrid diversity

In case of multiple signal sources, the two cooperative diversity scheme can be combined. If the number of signal sources are greater than the number M in a Mx1 STC scheme, multiple signal sources can transmit the same STC encoded signal to implement an Mx1 STC scheme. Figure 6 shows an example of this hybrid cooperative source and transmit diversity scheme, where three signal sources are cooperating to perform Alamouti space time coding.

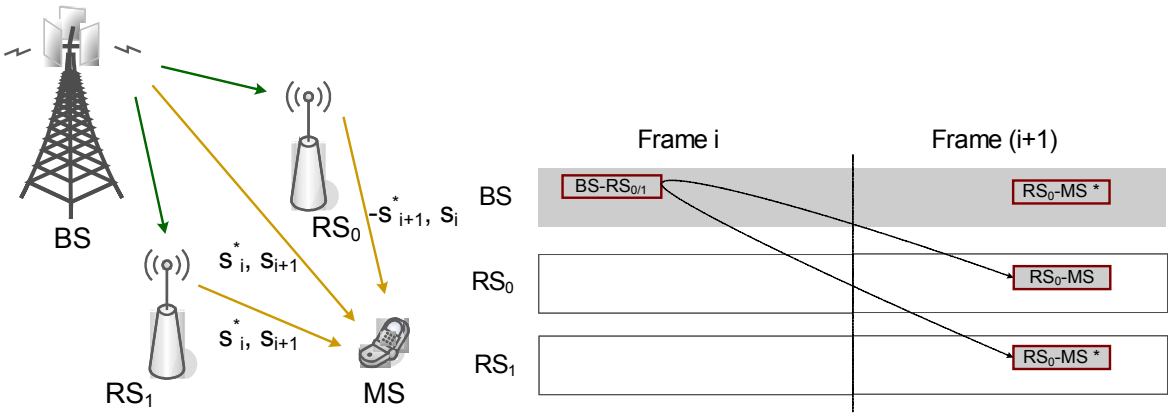


Figure 6. Example of cooperative joint diversity

3. Text Proposals

Insert new subclause 8.4.8.10:

8.4.8.10 Cooperative source diversity in relay

With one relay signal from an RS to an MS and the same signals of MMR-BS or neighbor RSs using the same time-frequency resource of the relay signal, source diversity shall be performed.

Insert new subclause 8.4.8.11:

8.4.8.11 STC using multiple sources

Transmission schemes of multiple antennas in 8.4.8.3 shall be extended to ones of multiple signal sources in the same way. The each column of matrix shall be used in one or multiple sources such as MMR-BS and RSs.