Cooperative Relaying in Downlink for IEEE 802.16j

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Source:

Jimmy Chui, Aik Chindapol
Siemens Corporate Research
Voice:+1 609 734 3364
E-mail:aik.chindapol@siemens.com

Kyu Ha Lee, Changkyoon Kim, Hyung Kee Kim
Samsung Thales Co., Ltd.
Voice:+ 82 31 280 9917
E-mail:kyuha.lee@samsung.com

Byung-Jae Kwak, Sungcheol Chang, D. H. Ahn, Young-il Kim
ETRI
Voice:+ 82 42 860 6618
E-mail:bjkwak@etri.re.kr

Anxin Li, Mingshu Wang, Xiangming Li, Hidetoshi Kayama, Daqing Gu
DoCoMo Beijing Labs
Voice:+ 86 10 82861501
Email: {liax, gu}@ docomolabsbeijing.com.cn

Fujio Watanabe
DoCoMo USA Labs
Voice: 650-496-4726
Email: watanabe@docomolabs-usa.com

Haihong Zheng, Adrian Boariu,Yousuf Saifullah, Shashikant Maheshwari
Nokia
Voice: 972 894 5000
Email: {peter.wang@nokia.com, Adrian.Boariu@nokia.com, haihong.1.zheng, Yousuf.saifullah}@nokia.com

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Purpose:

This is a response to Call for Technical Proposals regarding IEEE Project P802.16j.

Introduction

- General relay transmission using exclusive time-frequency resources
- How can we efficiently use resources?

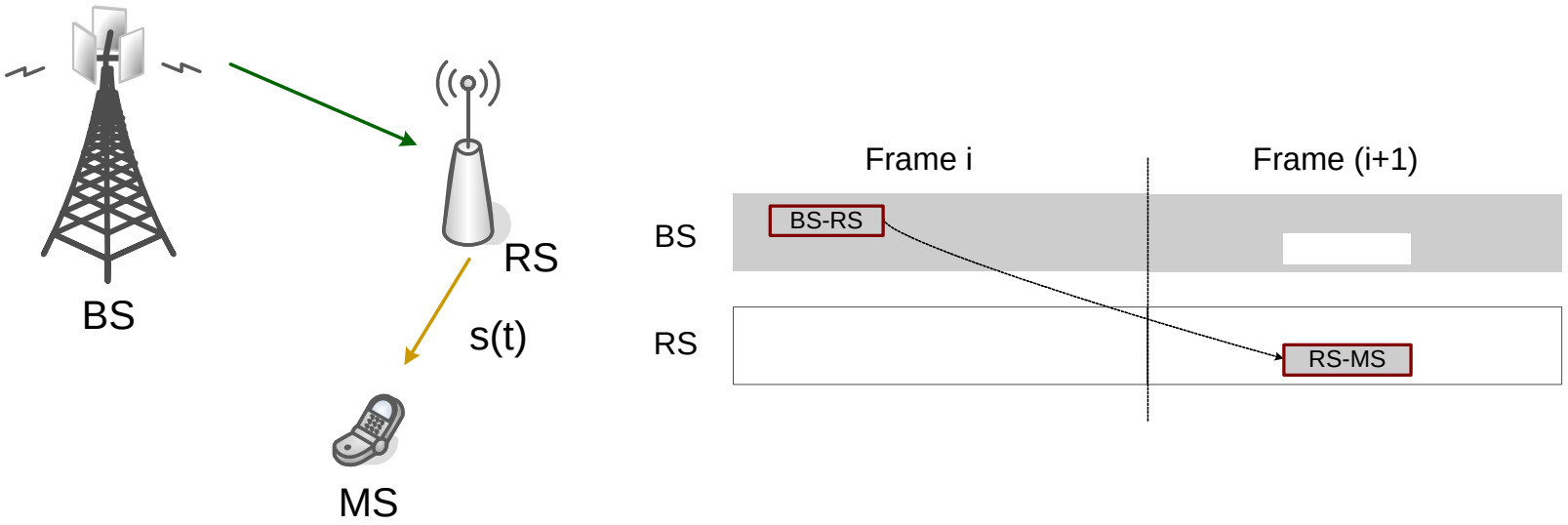


Fig. 1. Example of general relay transmission

Introduction

- General relay transmission using exclusive time-frequency resources
- How can we efficiently use resources?

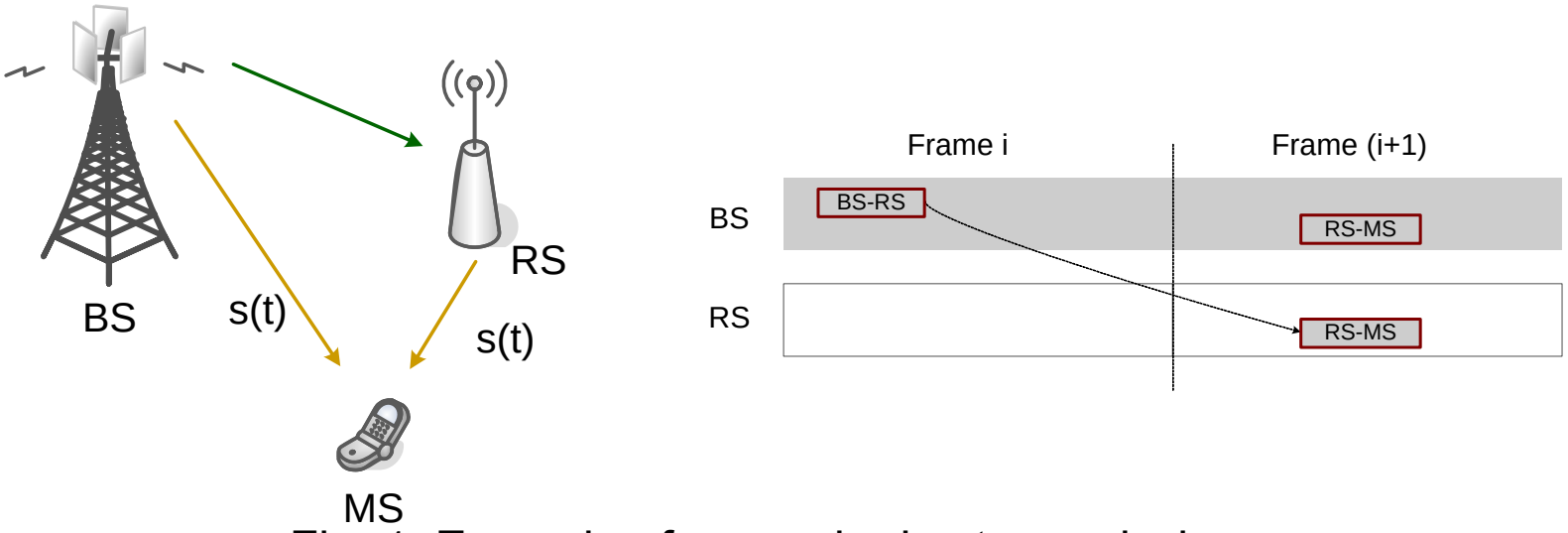


Fig. 1. Example of general relay transmission

Cooperative Relaying in R-DL

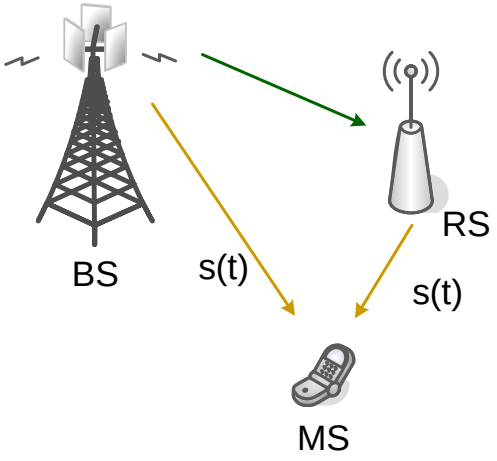
- Cooperative source diversity
  - Multiple sources with the same signals
- Cooperative transmit diversity
  - Multiple sources with STC-coded signals
- Cooperative hybrid diversity
  - Combination of source and transmit diversity

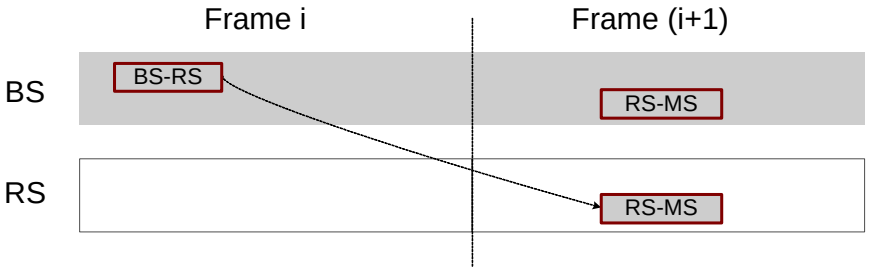
Cooperative source diversity

- Legacy SS/MS: no STBC support req'd
- Proposed method
  - Diversity gain using multiple signal sources
  - Simultaneous transmission in one or multiple RS & BS using the same media & data
  - Effective solution to the pilot collision problem
  - No additional functionality for MS
- Requirement :
  - Timing difference between sources < CP duration

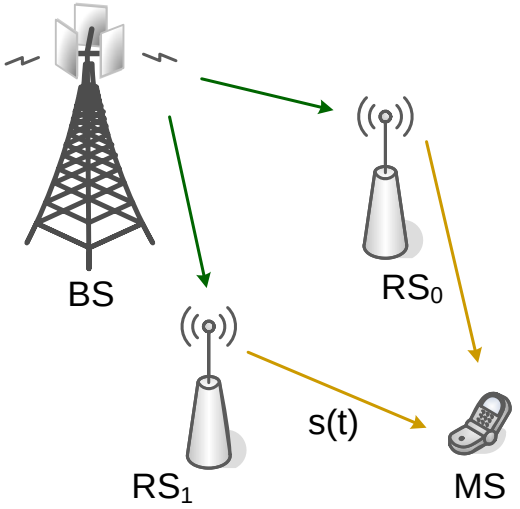
Cooperative source diversity (cont.)

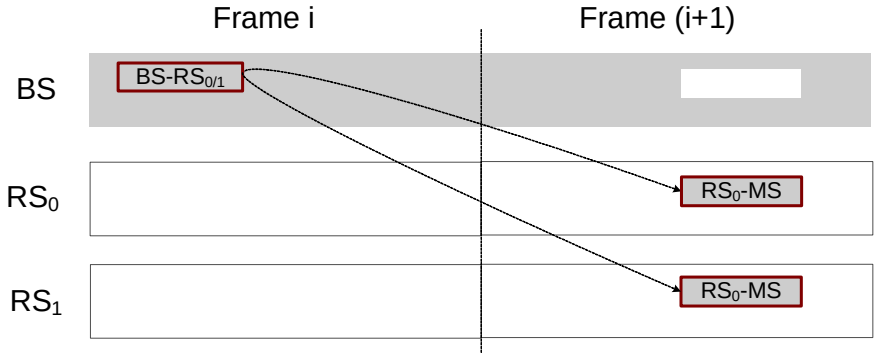
- Example





(a) Usage of BS & RS

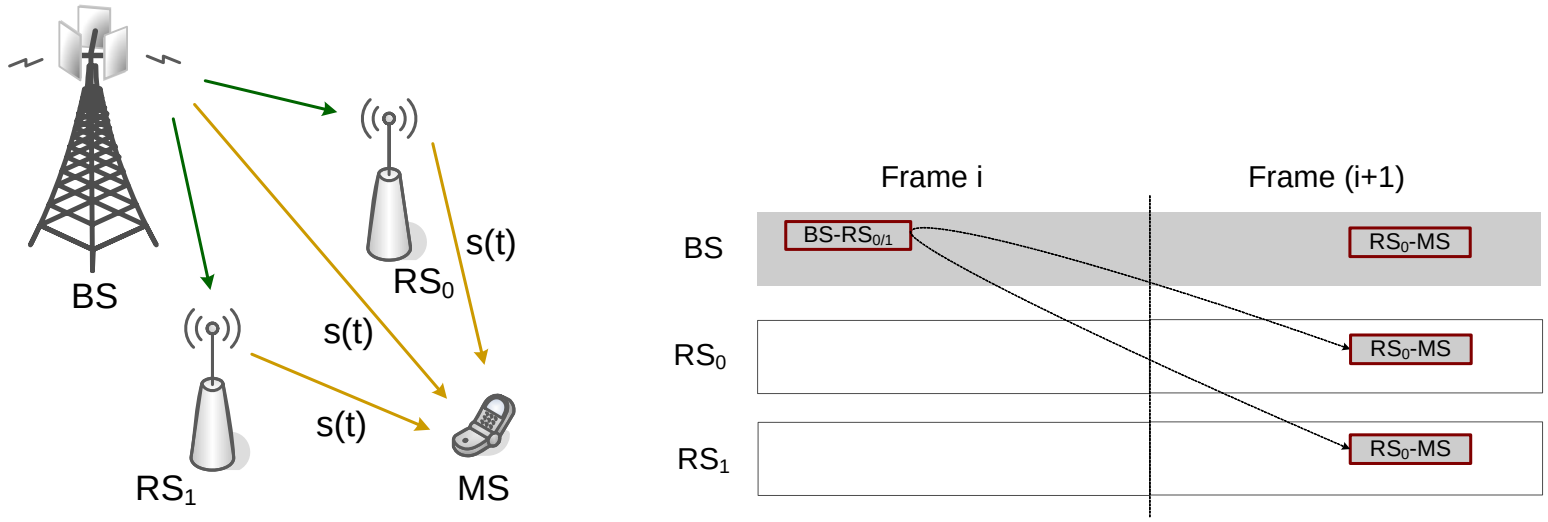




(b) Usage of multiple RSs

Cooperative source diversity (cont.)

- Example

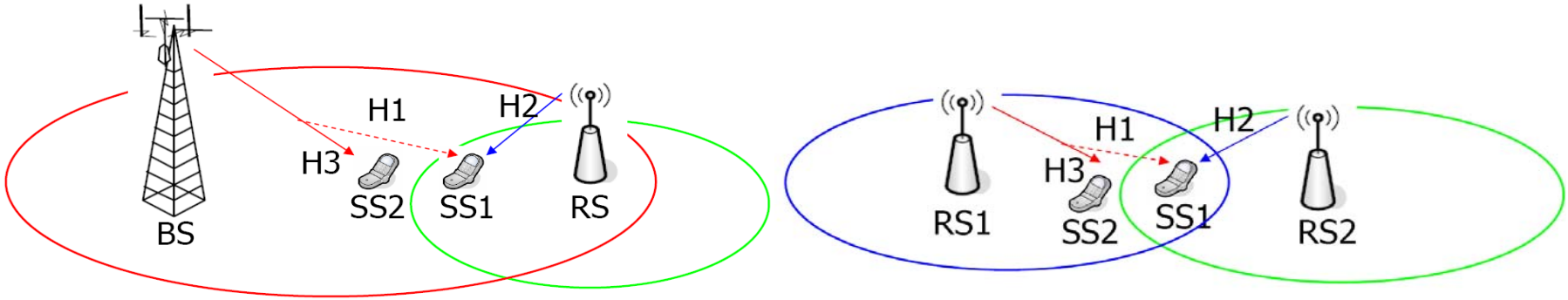


(c) Usage of BS & multiple RSs

Fig. 2. Examples of cooperative source diversity

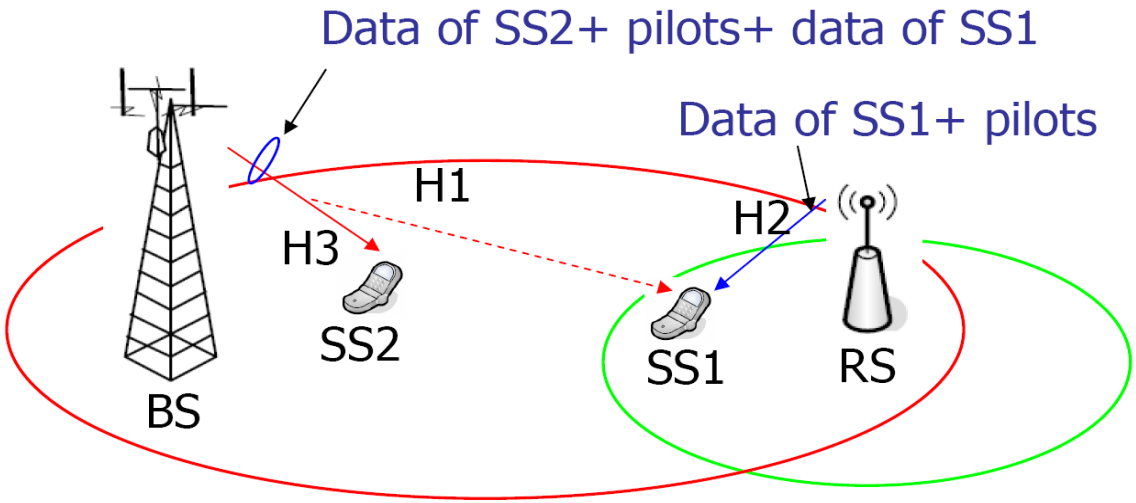
Cooperative source diversity (cont.)

- To keep SS unchanged, RS shall use the same OFDMA subcarrier allocation algorithm for downlink transmissions, i.e. RS will insert pilot signals at the same locations as BS.
- During concurrent transmissions of BS and RSs, SS in the overlap area will hear superposed pilots, and thus estimate a sum of the channel rather than the true data channel response. The performance of the involved SSs will be greatly degraded by using wrong channel estimation for data detection.
- This problem, named as pilot collision, is a special problem after the introduction of RS.



Cooperative source diversity (cont.)

- Cooperative source diversity is an effective solution to the pilot collision problem.
- Pilot collision will be solved because SS not only received the “collided pilot” but also the “collided data”.

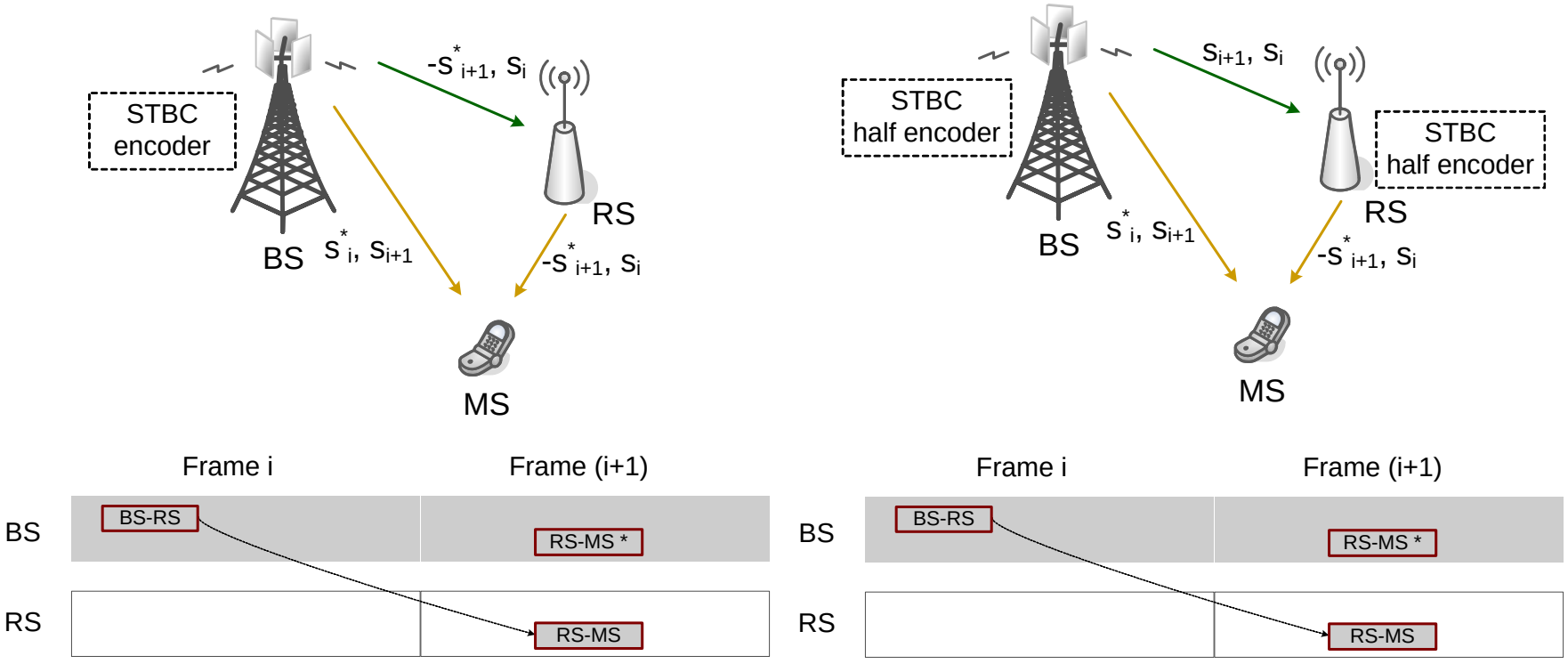


Cooperative transmit diversity

- For SS/MS having STBC decoder
- Proposed method
  - Transmit diversity using multiple signal source
  - Usage of different STC encoding in each signal source
  - Two choices: No processing at RS or Low processing at RS
- Requirement :
  - Timing difference between sources < CP duration

Cooperative transmit diversity (cont.)

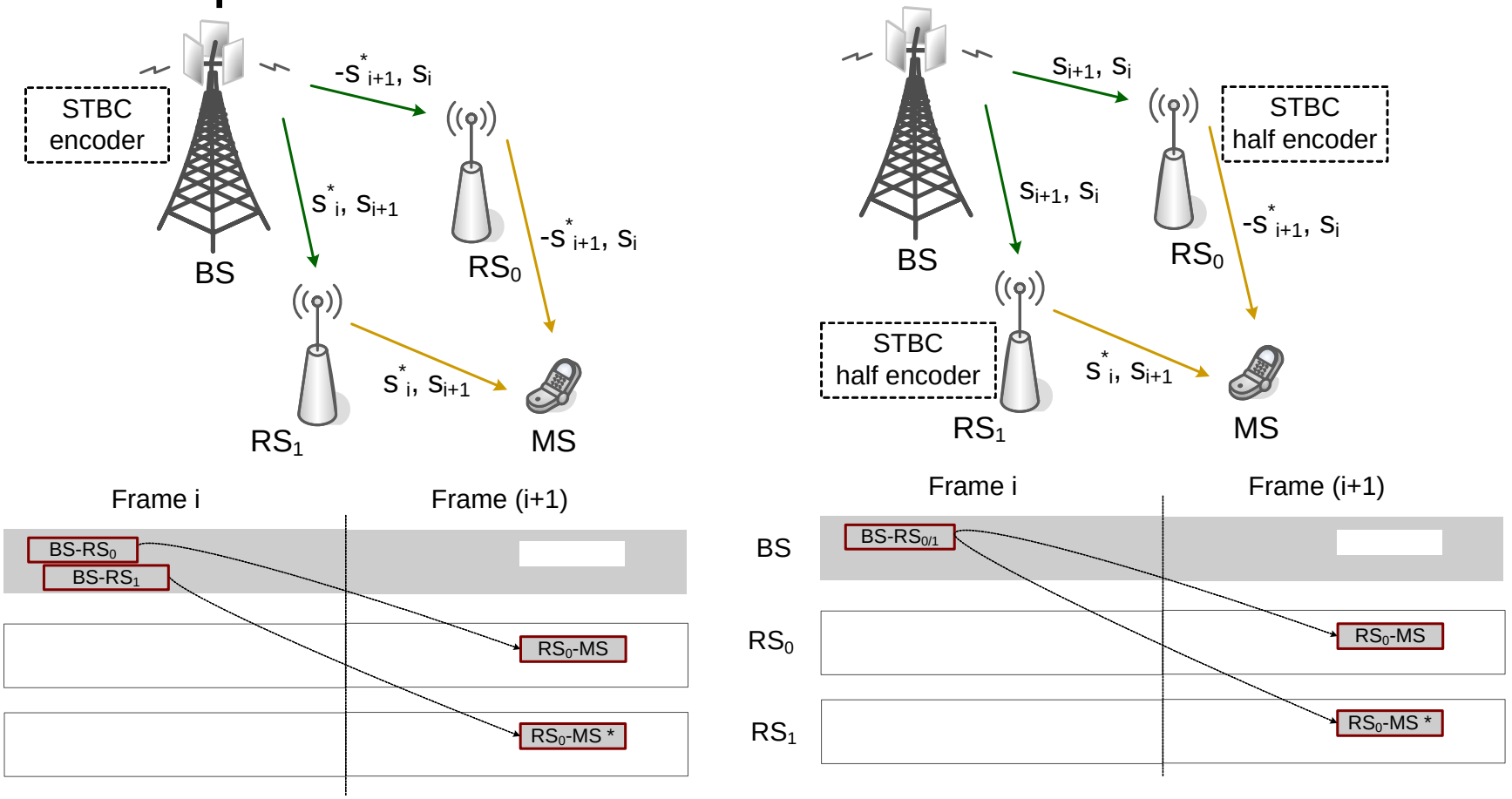
- Example



(a) Usage of the different STC encoded BS & RS

Cooperative transmit diversity (cont.)

- Example



(b) Usage of the different STC encoded RSs

Fig. 3. Examples of cooperative source diversity

Cooperative hybrid diversity

- Combination of source & transmit diversity
- Example

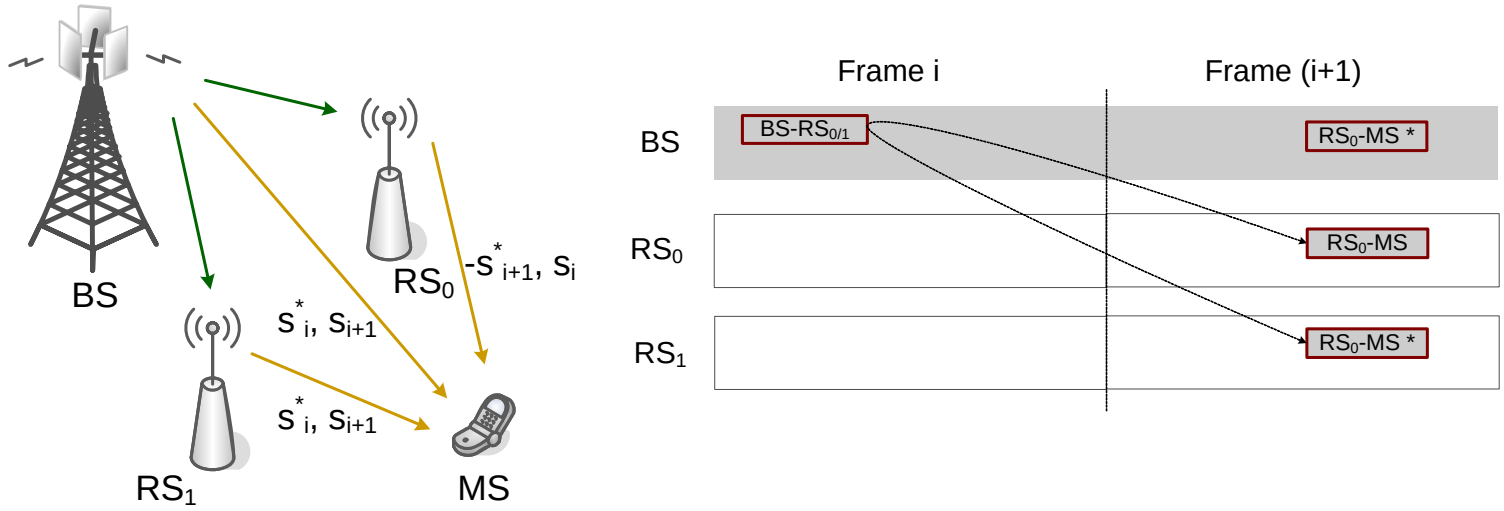
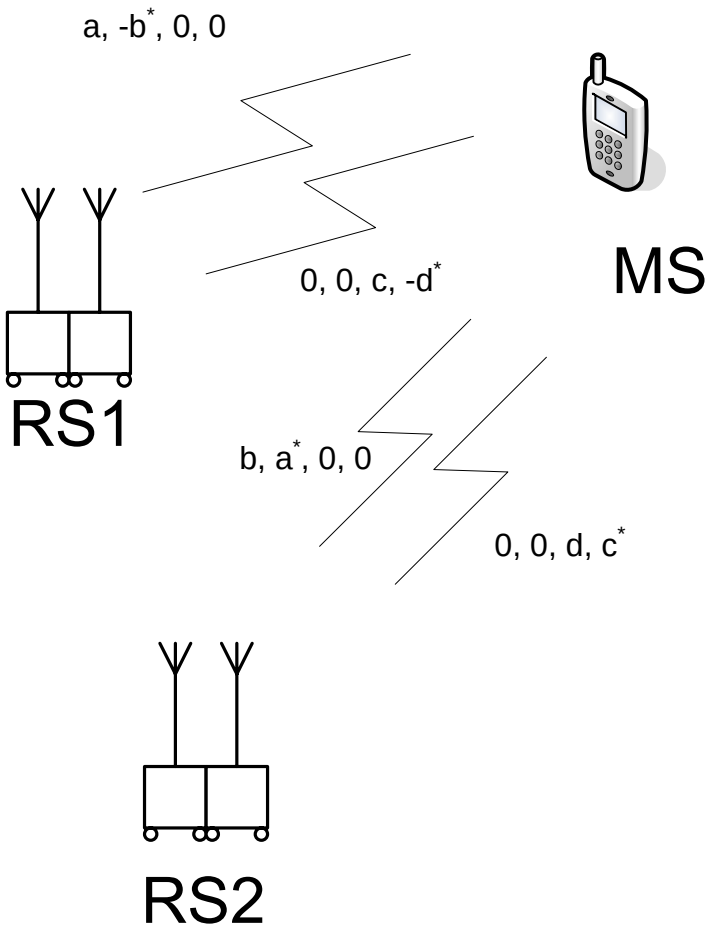


Fig. 4. Example of the same STC encoded sources of BS & a RS and another STC encoded source of RS

Example with STBC for 4 Tx

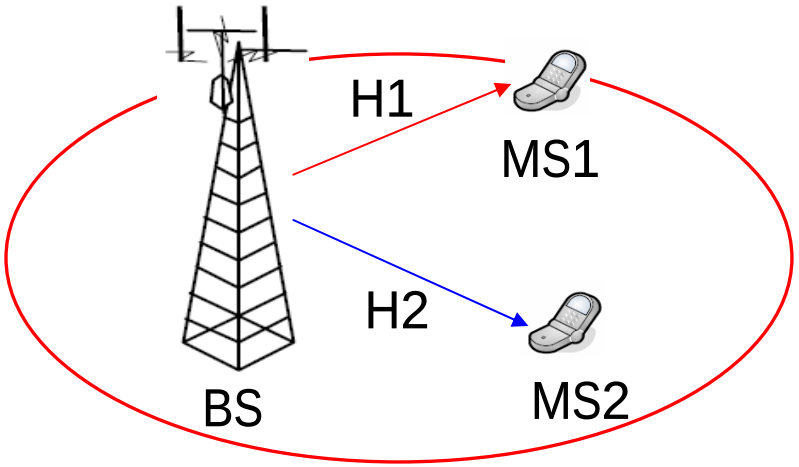


Summary

- Cooperative transmission is a promising technique for mobile relay network
- Three cooperative relay schemes are proposed
  - Cooperative source diversity
  - Cooperative transmit diversity
  - Cooperative hybrid diversity
- Advantages
  - Large diversity gain
  - Effectively combat pilot collision

Backup Slides

Example of Pilot Collision



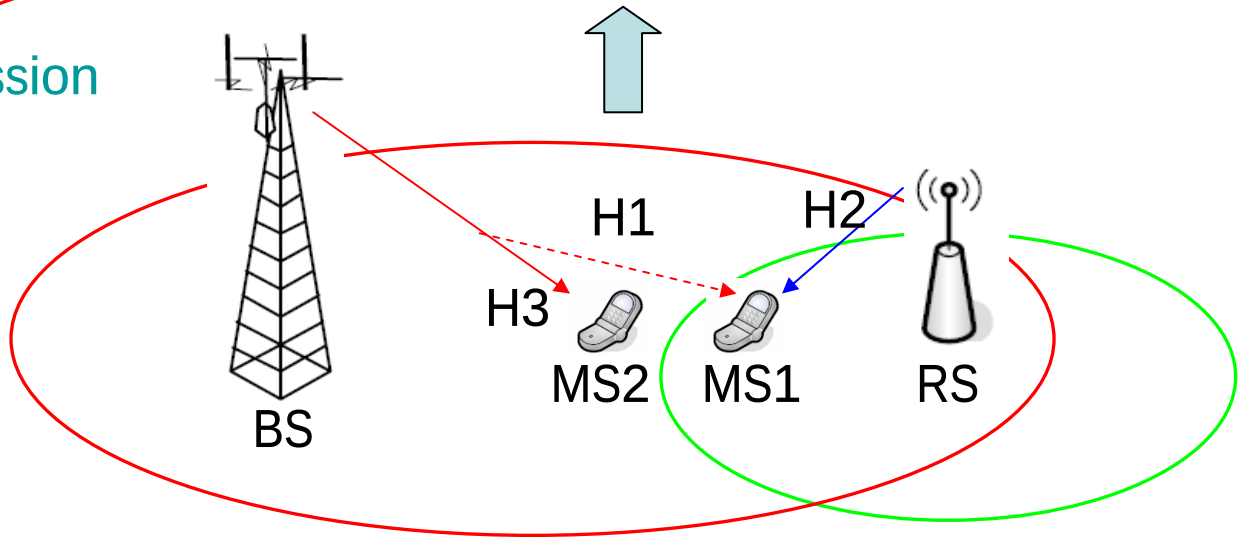
Traditional PMP transmission

➢MS1 estimates H1 on subchannel 1 by pilots;
➢MS2 estimates H2 on subchannel 2 by pilots;

Pilot Collision

➢MS1 overhears the pilots of BS and get a estimation of H1+H2 on subchannel 1;

➢However, the true data subchannel response of MS1 is H2;



Transmission in 802.16j