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Re:	IEEE802.16j-06/027: “Call for Technical Proposals regarding IEEEP802.16j”
Abstract	This contribution proposes two type of relaying scheme.
Purpose	To propose text to describe two types of relaying scheme
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Relaying methods proposal for 802.16j

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Introduction

In this document, two types of relay stations, transparent and non-transparent RS are proposed.

The transparent RS does not transmit its own preamble, FCH and MAPs on its access link. Deploying this type of RS around the cell edge area of a MR-BS, MSs in the cell edge can get higher CINR with the RS than with BS. As a consequence, those MS can get higher per-user throughput using the intermediate RS. Besides, improvement of CINR in cell edge area results in increase of system capacity, even though two-hop communication is necessary for relay system because we can generally assume that the relay link is good and stable enough for using high modulation and coding rate.

This type of RS does not transmit preamble signal, so the coverage where preamble and MAPs can be received does not expand. But, we need to consider imbalance between uplink and downlink budget. Usually uplink budget is severer than downlink because of smaller transmission power of MS. But this type of RS can improve uplink to relay upstream traffic from MS, of which uplink signal is never received by the MR-BS. Therefore, the RS is expected to improve the uplink budget and slightly expand MR cell coverage in practice, too.

To investigate the advantageous effect of transparent RS, the DL SINR distribution and the DL SINR CDF (cumulative distribution function) were simulated. Table 1 is the list of some simulation parameters.

Table 1 Simulation assumptions

Parameter	Value
Carrier frequency	2.5 [GHz]
Bandwidth	10 [MHz], 1024-FFT
Number of sectors	3
BS Antenna pattern	70 deg (-3 dB) with 20 dB front-to-back ratio
BS transmission power	43 [dBm]
RS transmission power	33 [dBm]
Number of RS antennas	1 (omni antenna)
Antenna gain (BS/RS/MS)	10 / 10 / 0 [dBi]
MS noise figure	9 [dB]
Path loss model	-
BS-RS	LOS
BS-MS, RS-MS	NLOS (128+37.6*$\log_{10}$(R[km]))
Shadowing std. division	8 [dB]

Figure 1 shows the DL SINR distribution of MSs with transparent RS. In this simulation, RS was allocated in the direction of each BS antenna (1RS per a sector), and the distance between BS and RS was set to 0.8 cell radius. As shown figure 1, MSs in the each cell edge can get high DL SINR from RS.

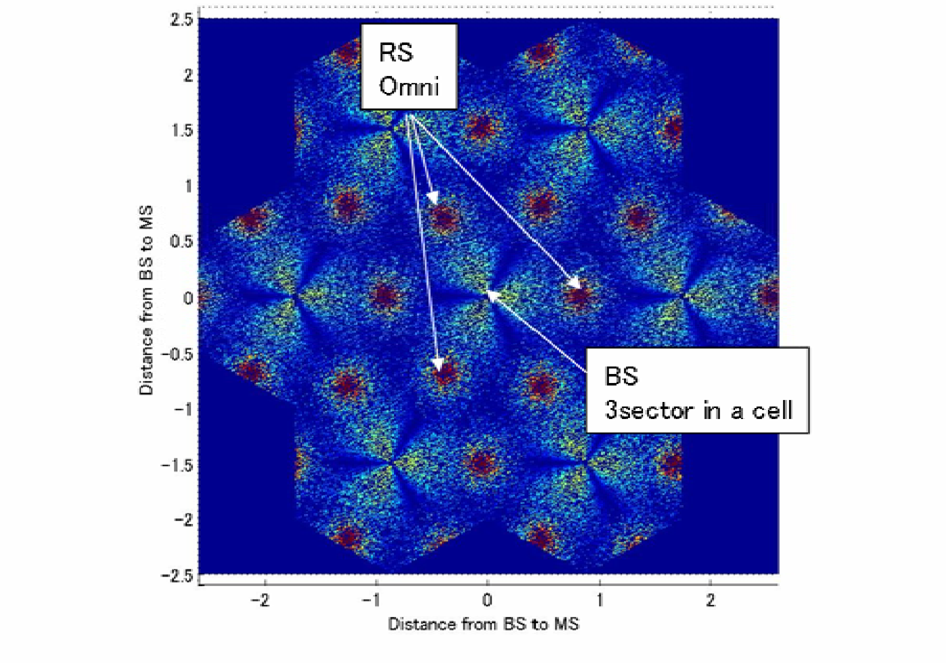

Figure 1 DL SINR distribution with transparent RS

Figure 2 shows the DL SINR CDF of the 802.16j system with 3 transparent RS and the 802.16e system. According to the figure, we can find the transparent RS improves the DL SINR CDF. Calculating the throughput from the DL SINR CDF, the transparent RS improves cell throughput (downlink) of MR-cell by 24.6% compared with the 802.16e system (no RS). Please note this improvement is calculated with considering two-hop relay in which MS under RS consumes radio resource twice on the relay and the access link.

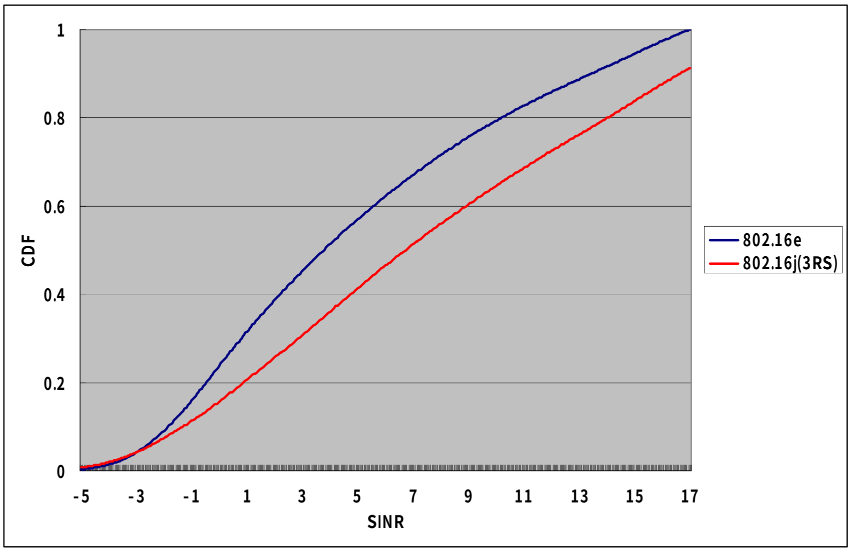

Figure 2 DL SINR CDF (transparent RS)

The non-transparent RS transmits its own preamble, FCH and MAPs on its access link as an ordinary BS. Therefore, this type of RS is indispensable to drastically expand coverage area.

For this type of RS, coverage expantion by RS was also evaluated by simulation. In the simulation, the parameters of table 1 were used, and 6 non-transparent RSs were deployed around the isolated MR-BS.

Figure 3 shows the geographical DL SINR distribution in the MR cell comprised of a single MR-BS and 6 non-transparent RS. When RS transmission power is 1/10 of MR-BS (33 and 43 [dBm]), maximum MR-cell radius where MS can receive QPSK R=1/2 (no repetition) is twice larger than a single BS cell. Evaluating the effect from transmission power point of view, the 16e BS transmission power must be 54[dBm] (251[W]) to cover the same coverage as the MR-cell.

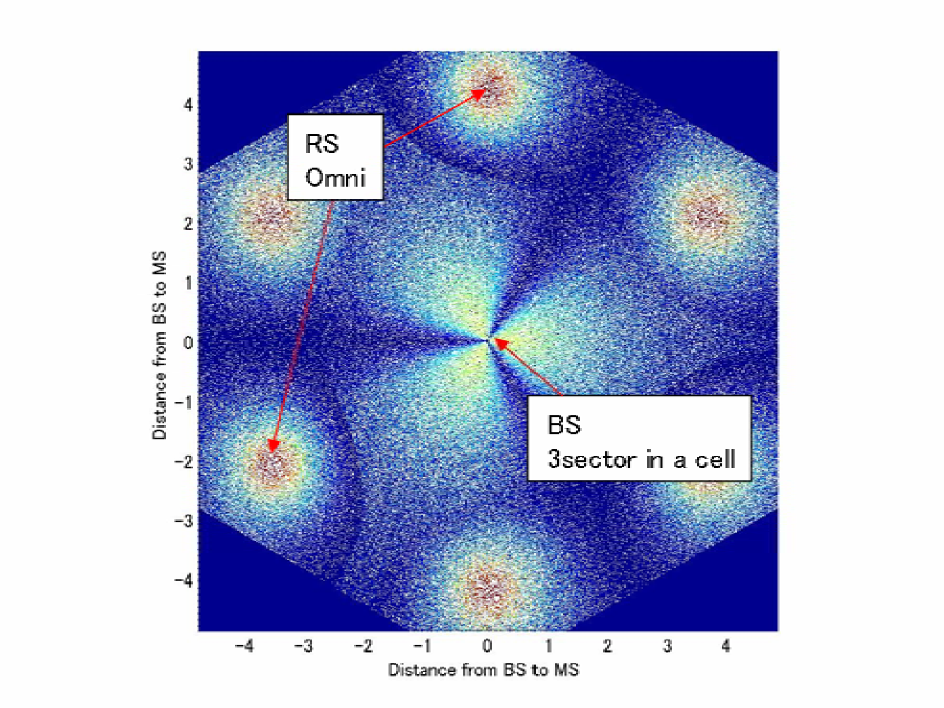

Figure 3 DL SINR distribution with non-transparent RS

Specific Text Changes

Insert the new text in 6.1.1 Relaying extension:

6.1.1 Relaying extension

In order to improve per-user throughput and system capacity and/or expand coverage, a relay station relays downstream and upstream traffic between MR-BS and MS. User data and control information may be relayed through one or more relay stations. The RS does not need to perform MS management (e.g. authentication, registration, etc) and connection management (e.g. CID allocation, classification, etc.) which are done at the MR-BS.

There are two types of relay stations, transparent and non-transparent RS, in terms of transmission of preamble and broadcast management information.

Insert the new subclause 6.1.1.1:

6.1.1.1 Transparent RS

A transparent RS does not transmit preamble, FCH and DL-/UL-MAP to MS. Therefore, MS never recognizes the transparent RS as a BS even though it communicates with MR-BS through a transparent RS.

The transparent RS synchronizes with its superordinate station, which may be a MR-BS or a non-transparent RS, and receives DL-MAP/UL-MAP from it. Then the transparent RS relays downstream and upstream traffic in accordance with the received DL-MAP/ULD-MAP.

The figure xxx shows an example of MR cell deployed a transparent RS.

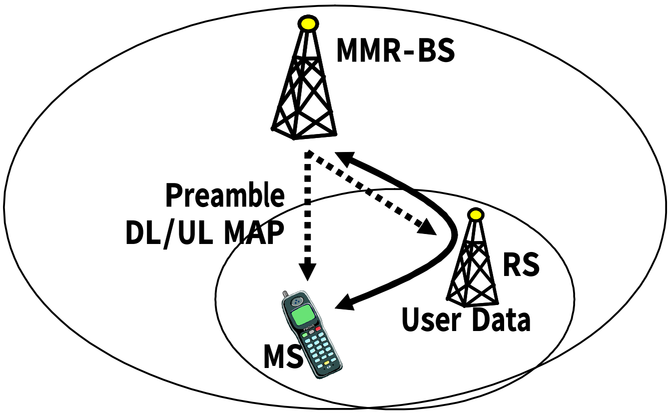

Figure xxx Example of transparent RS system

The transparent RS may need to know MAP information and have downstream traffic before the frame in which DL-MAP is sent to MS because of processing delay at the transparent RS.

The transparent RS also needs to perform uplink channel measurement and forward measurement result as well as feedback information received from MS to the MR-BS in order for MR-BS to select appropriate burst profile and communication route of each MS.

Insert the new subclause 6.1.1.2:

6.1.1.2 Non-transparent RS

A non-transparent RS transmits preamble, FCH and DL-/UL-MAP to MS as an ordinary BS. Therefore, receiving preamble and MAPs, a MS recognizes the non-transparent RS as a BS.

The figure xxx shows an example of MR cell deployed a non-transparent RS.

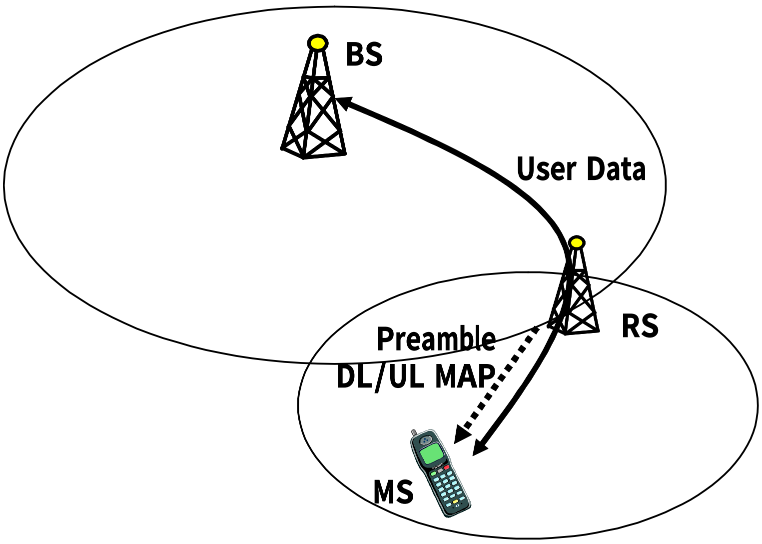

Figure xxx Example of non-transparent RS system

DL-MAP and UL-MAP transmitted by the non-transparent RS can be created by either its associated MR-BS or the non-transparent RS itself. Depending on which station creates MAPs, there are two types of non-transparent RS, centralized and distributed scheduling type.

For the centralized scheduling type, DL-/UL-MAP for the non-transparent RS controlling access link are created by the MR-BS and forwarded to the non-transparent RS. The non-transparent RS broadcasts the received MAPs and controls its transmission and reception in accordance with them. In a similar manner of a transparent RS, this type of RS needs to perform uplink channel measurement and forward measurement results as well as feedback information received from MS to the MR-BS.

For the distributed scheduling type, DL-/UL-MAP are created by the non-transparent RS itself. Therefore, channel measurement information of access link is used by the non-transparent RS itself to select appropriate burst profile of each MS.

The distributed scheduling type non-transparent RS may monitor management messages during network entry or connection setup signaling, and derives capability information, QoS parameters and so on in order to performs scheduling on its access link.

Reference

[1] M.Okuda, “MS network entry for transparent Relay Station”, IEEE C802.16j-06_124, IEEE 802.16 meeting #46, Dallas, November 2006.

[2] M.Okuda, et al., “MS network entry for non-transparent Relay Station”, IEEE C802.16j-06_133, IEEE 802.16 meeting #46, Dallas, November 2006.