Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Interference and SINR prediction for IEEE 802.16j Multi-hop Relay network**
Date Submitted	**2007-3-5**
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Re:	IEEE 802.16j-07/007r2:"Call for Technical Comments and Contributions regarding IEEE Project 802.16j"
Abstract	This contribution proposes a simple method to predict the potential interference and SINR level for different MR network topologies and radio resource reuse patterns, which is based on the RSSI reported from each RS.
Purpose	For TG members to adopt the enclosed text proposal into the IEEE 802.16j baseline document.
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Interference and SINR Prediction for IEEE 802.16j Multi-hop Relay Network

In order to determine the topology and radio resource reuse pattern for MR network, a simple interference and SINR prediction method is introduced in this contribution. Based on the RSSI reported by each RS, the MR-BS can predict the received interference and SINR of each relay link under different MR network topologies and radio resource reuse patterns. By taking advantage on this prediction results, various algorithms can be used to configure/re-configure the MR network in response to time variant traffic distribution and interference distribution.

I. The concept of the proposed interference and SINR prediction method

Consider an MR network in Figure 1(a) with its topology given in Figure 1(b). According to the aforementioned RS neighborhood discovery mechanism, each station can measure the received signal strength (RSS) of the relay amble transmitted from other stations. Therefore, the following matrix will be available at the MR-BS:

$$\begin{bmatrix} P_{R,0,0} & P_{R,0,1} & P_{R,0,2} & P_{R,0,3} \\ P_{R,1,0} & P_{R,1,1} & P_{R,1,2} & P_{R,1,3} \\ P_{R,2,0} & P_{R,2,1} & P_{R,2,2} & P_{R,2,3} \\ P_{R,3,0} & P_{R,3,1} & P_{R,3,2} & P_{R,3,3} \end{bmatrix},$$

where $P_{R,i,j}$ is the RSS of the signal transmitted from node #*i* and received by node #*j*, and $P_{R,j,j}$ is the thermal noise and background interference power received by node #*j*. According to the topology in Figure 3(b), the relay traffic will be transmitted in the radio links MR-BS↔RS_1, RS_1↔RS_2 and RS_2↔RS_3. The multiple access interference may exist in the links MR-BS↔RS_2, MR-BS↔RS_3 and RS_1↔RS_3 if the radio resources are reused in different transmission links.

In Table 1, the possible resource reuse patterns are listed by the notation $L_{i,j}$ and $\{\cdot\}$, where the $L_{i,j}$ indicates the radio link from node #*i* to node #*j*, and $\{\cdot\}$ indicates the allocation of the individual radio resources to the links inside. For example, $\{L_{i,j}, L_{x,y}\}$ means that the radio links $L_{i,j}$ and $L_{x,y}$ are allocated with "the same radio resources" but transmitting "different radio signal". Therefore, the multiple access interference will exist in $L_{i,y}$ and $L_{x,j}$. On the other hand, $\{L_{i,j}\},\{L_{x,y}\}$ means that the radio resources are exclusively allocated to the links $L_{i,j}$ and $L_{x,y}$, so there will be no multiple access interference in the radio link $L_{i,y}$ and $L_{x,j}$.

The method for interference and SINR prediction for different topology and radio resource reuse pattern is summarized as follows.

Step 1: Prediction of the interference plus noise power received by node #*i*. The interference is the summation of (1) the thermal noise plus background interference power received by node #*i* and (2) the signal power not intended for node #*i*.

Step 2: Prediction of the received SINR of node #*i*: The SINR is the ratio of the total signal power destined to node # *i* to the interference plus noise power obtained in Step 1.

Note that the relay amble may have different power boosting level from data burst, and the RSS matrix shall be updated to include this difference when calculating the interference or SINR for data burst. According to this SINR prediction method, the MR network can determine its radio resource reuse pattern without the complicated cell planning in advance.

In addition, the proposed prediction method can be extended to support the access links if the corresponding RSS matrix is available. In order to obtain the RSS of access downlinks, the legacy SS scanning mechanism defined in IEEE 802.16e can be used. On the other hand, the sounding mechanism proposed in [1] can obtain the RSS of access uplinks. However, the RSS matrix for access links may need to be updated frequently due to SS mobility, which will result in too much reporting overhead. Using the prediction results in relay link as a guideline for resource reuse in access link may be an alternative solution [2].

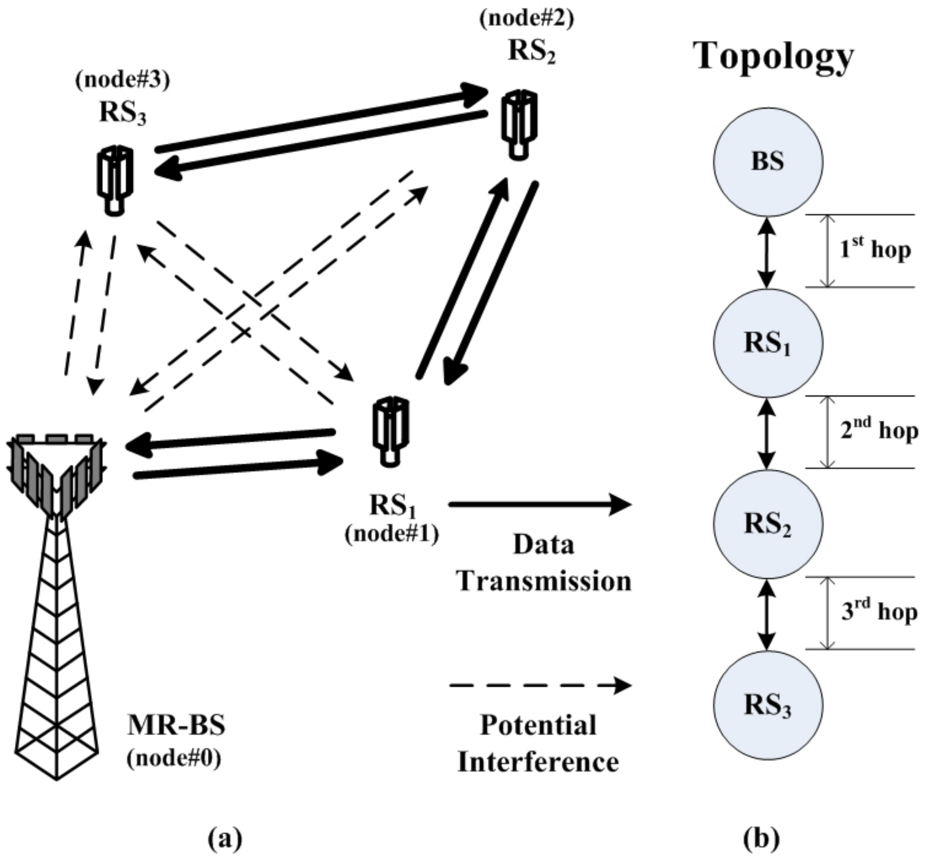

Figure.3 An example to illustrate the proposed SINR prediction method

Table.2 Interference and SINR Prediction Results

Radio Resources Reuse Pattern		Prediction on Received Interference Level			
		Node #0	**Node #1**	**Node #2**	**Node #3**
DL	$\{L_{0,1}\},\{L_{1,2}\},\{L_{2,3}\}$	*Null*	$P_{R,1,1}$	$P_{R,2,2}$	$P_{R,3,3}$
	$\{L_{0,1}, L_{2,3}\},\{L_{1,2}\}$	*Null*	$P_{R,2,1}+P_{R,1,1}$	$P_{R,2,2}$	$P_{R,0,3}+P_{R,3,3}$
UL	$\{L_{3,2}\},\{L_{2,1}\},\{L_{1,0}\}$	$P_{R,0,0}$	$P_{R,1,1}$	$P_{R,2,2}$	*Null*
	$\{L_{1,0}, L_{3,2}\},\{L_{2,1}\}$	$P_{R,3,0}+P_{R,0,0}$	$P_{R,1,1}$	$P_{R,1,2}+P_{R,2,2}$	*Null*
Radio Resources Reuse Pattern		**Prediction on Received SINR Level**			
		Node #0	**Node #1**	**Node #2**	**Node #3**
DL	$\{L_{0,1}\},\{L_{1,2}\},\{L_{2,3}\}$	*Null*	$\frac{P_{R,0,1}}{P_{R,1,1}}$	$\frac{P_{R,1,2}}{P_{R,2,2}}$	$\frac{P_{R,2,3}}{P_{R,3,3}}$
	$\{L_{0,1}, L_{2,3}\},\{L_{1,2}\}$	*Null*	$\frac{P_{R,0,1}}{P_{R,2,1}+P_{R,1,1}}$	$\frac{P_{R,1,2}}{P_{R,2,2}}$	$\frac{P_{R,2,3}}{P_{R,0,3}+P_{R,3,3}}$

UL	$\{ L_{3,2} \},\{ L_{2,1} \},\{ L_{1,0} \}$	$\frac{P_{R,1,0}}{P_{R,0,0}}$	$\frac{P_{R,2,1}}{P_{R,1,1}}$	$\frac{P_{R,3,2}}{P_{R,2,2}}$	*Null*
	$\{ L_{1,0}, L_{3,2} \},\{L_{2,1} \}$	$\frac{P_{R,1,0}}{P_{R,3,0}+P_{R,0,0}}$	$\frac{P_{R,2,1}}{P_{R,1,1}}$	$\frac{P_{R,3,2}}{P_{R,1,2}+P_{R,2,2}}$	*Null*

II. Text proposal

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[TBD]

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III. References

[1] W. P. Chen et al,"Interference Detection and Measurement in OFDMA Relay Networks," Technical Contribution, *IEEE C802.16j-07/020r4*, Jan. 2007.

[2] W. P. Chen et al,"Interference Measurement by RS Sounding in MR Networks," Technical Contribution, *IEEE C802.16j-07/019*, Jan. 2007.