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	**2007-3-14**
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Re:	IEEE 802.16j-07/007r2:"Call for Technical Comments and Contributions regarding IEEE Project 802.16j"
Abstract	This contribution introduce a simple method to predict the potential interference and SINR level in MR network under for different MR network topologies and radio resource reuse patterns The text proposal will introduce how this prediction result can be utilized when composing the neighbor list for each RS or designating the radio resource reuse pattern for MR network.
Purpose	For TG members to discuss the benefit of the proposed interference/SINR prediction method and adopt the text proposal into the IEEE 802.16j baseline document for information sharing.
Notice	
Release	
Patent Policy and Procedures	

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. The objective of the proposed method is to predict the received interference and SINR level of each relay link in advance of determining the radio resource reuse pattern and/or the topology for MR network and composing the neighbor list for each RS.

According to the RSSI reported by each RS, the MR-BS has the knowledge on how each station may potentially interfere to other stations. Based on the simple criteria proposed in this contribution, the MR-BS can easily predict the possible interference and SINR level received by each RS in relay link under various radio resource reuse pattern and MR network topology. Therefore, complicated network planning may be prevented before deploying the new RS or before reconfiguring the MR network. In addition, the proposed method can also be used to compose the neighbor list in the MR_NBR-INFO for each RS.

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

Consider an MR network in Figure 1(a) with the topology defined in Figure 1(b). According to the RS neighborhood discovery mechanism defined in 6.3.26, each station can measure the received signal strength (RSS) of the relay amble transmitted from other stations. Therefore, the following matrix can 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, the radio resource reuse pattern $\{L_{i,j}, L_{x,y}\}$ 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, the radio resource reuse pattern $\{L_{i,j}\},\{L_{x,y}\}$ 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].

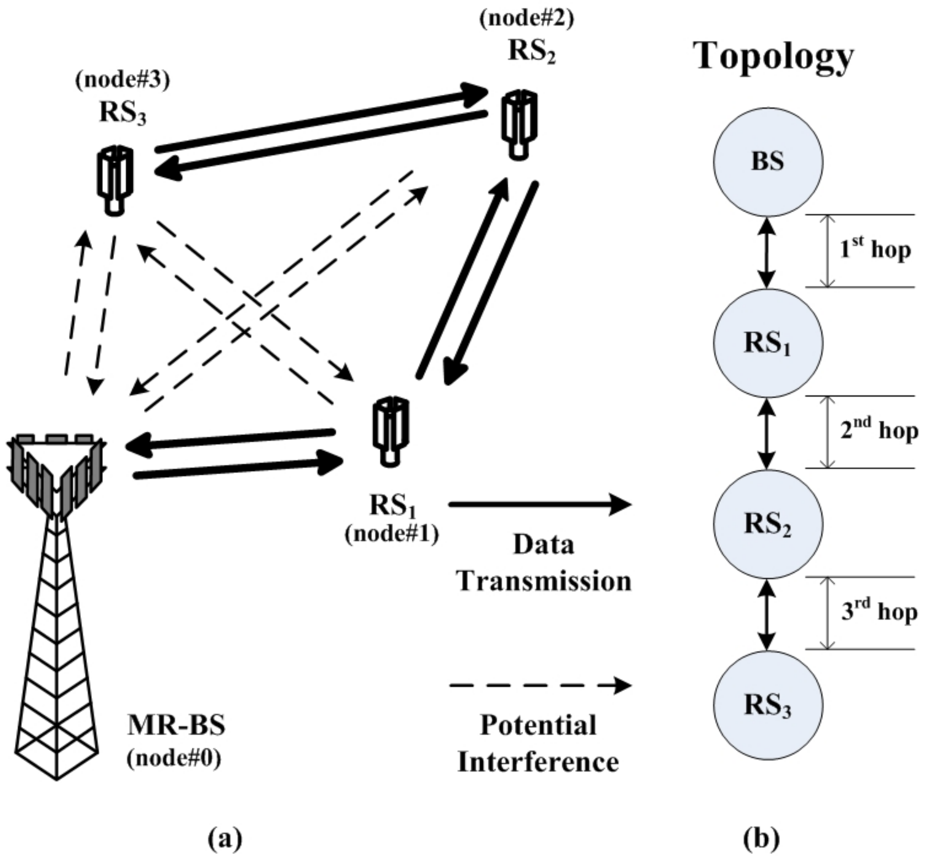

Figure.3 An example to illustrate the proposed SINR prediction method

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

---Start of the text--

6.3.27 Interference measurement for MR

6.3.27.1 Interference prediction by RS neighborhood measurement

[Add the following text at the start of 6.3.27.1]

According to the neighborhood discovery mechanism defined in 6.3.26 or the R-amble repetition scheme defined in 8.4.6.1.1.3, the RS can measure the RSSI of its neighbor stations and then report to the MR-BS. The RSSI can be treated as a kind of the prediction on potential interference from another station which reuses the same radio resource. Alone this line, the MR network may predict the interference level of the relay link before designating the radio resource reuse pattern or the topology for MR network. In addition, MR-BS may also configure the segment or maximum transmit power of the RS based on the prediction of the potential interference.

---End of the text--

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.