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Re:	This contribution is response to call for technical proposal (IEEE 802.16j-06/034).
Abstract	This contribution proposes to add the stability of link quality as a metric of multi-hop path selection.
Purpose	To discuss and adopt the proposed text into the P802.16j baseline document.
Notice	
Release	
Patent Policy and Procedures	

A new metric for multi-hop path selection

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1. Introduction

In 802.16j system, a multi-hop path selection is one of the important functionalities for the efficient usage of radio resource in the network. This contribution proposes to add the stability of link quality as a metric of multi-hop path selection.

2. Background

In IEEE 802.16e-2005 standard, there are mechanisms to measure and acquire the quality of radio link in physical layer. Examples of link quality parameters are shown in Table 1. These parameters can be used by BS for monitoring the status of BS-MS links, and for the purpose of handover, scheduling, and so on.

Table 1 Link quality parameters in IEEE 802.16e-2005 standard

Link quality parameter	Mechanism to report link quality parameters
RSSI mean	REP-RSP message
RSSI standard deviation	
CINR mean	
CINR standard deviation	
CQI value	fast-feedback channel (CQICH)

In general, the radio link quality changes in time (The word “link quality” is used here as a meaning of SINR or CINR level). A fluctuation of link quality may occur because of movement of nodes, environmental factors (radio noise, obstacles, weather condition, etc.).

The example of 802.16j system is shown in Figure 1. The link quality between MMR-BS and RS1 slightly fluctuates in time, but the one between MMR-BS and RS2 dramatically changes. In this case the former link can be regarded as a stable radio link, and the latter one as a unstable radio link. Therefore it is appropriate to select the path via RS1.

In 802.16j system, a multi-hop path selection, which is defined as an optional functional requirement, is an important functionality for the efficient usage of radio resource in the network. To select an appropriate path, the stability of link quality should be considered.

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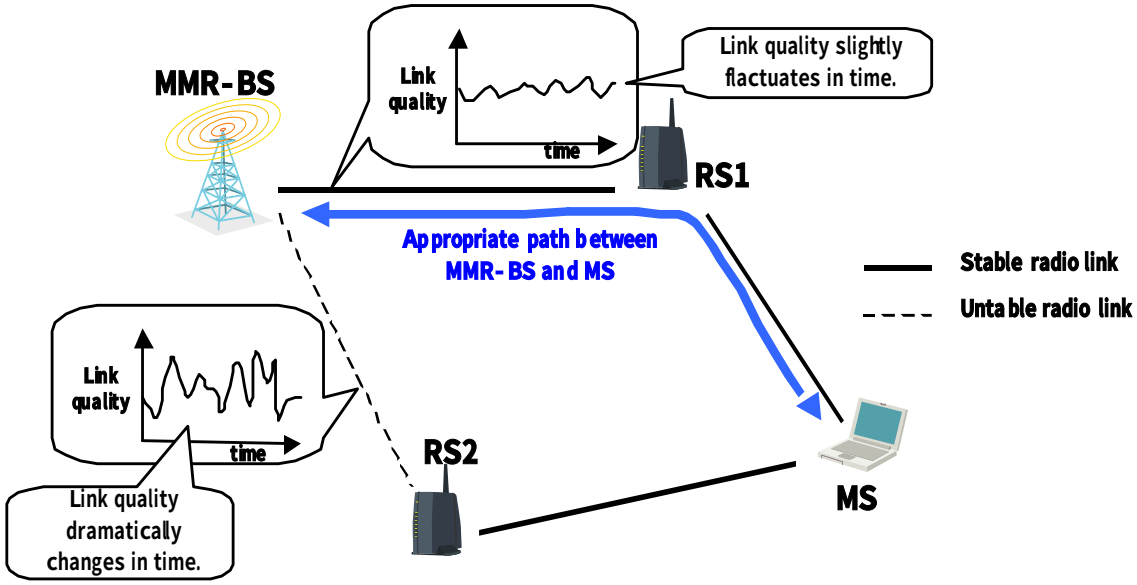

Figure 1 An appropriate path selection based on stability of link quality in 802.16j system

3. Proposed Method

We propose to add the stability of link quality as a metric of multi-hop path selection. There are advantages considering it:

- Less frequent path changes: It can reduce the control overhead occurring by path changes.
- Less data loss: It can avoid data loss by a sudden decrease of link quality.

In order to get information regarding the stability of link quality, following methods are proposed:

- Using a fast-feedback channel (CQICH)
- Using REP-RSP messages (In case that CQICH cannot be used)

In these methods, no change of MS specification is required.

3.1. Calculating the stability of link quality using a fast-feedback channel (CQICH)

In the centralized scheduling, MMR-BS allocates CQICH to RSs and MSs (Figure 2). Allocation of CQICH for RSs is performed in the relay zone and the one for MSs in the access zone. RSs and MSs report CQI to MMR-BS, and MMR-BS maintain the history of CQI. Based on this information, it calculates the stability of link quality which is used for the multi-hop path selection. The algorithm of calculating the stability of link quality is out of this contribution.

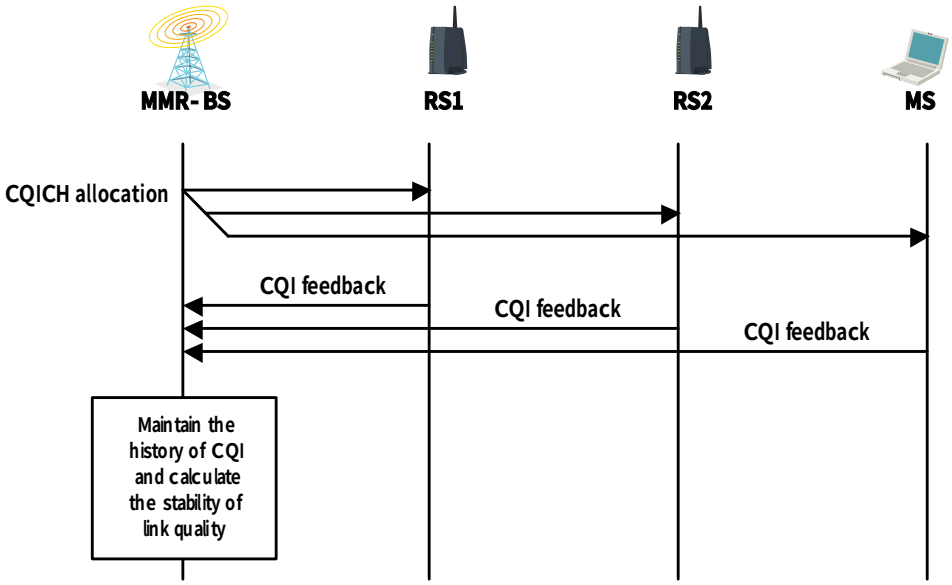

Figure 2 Using a fast-feedback channel (CQICH): Centralized scheduling

In the distributed scheduling, MMR-BS and RSs allocate CQICH to neighboring RSs and MSs (Figure 3). Allocation of CQICH for RSs is performed in the relay zone and the one for MSs in the access zone. MMR-BS and RSs collect CQI from neighboring nodes and maintain the history of CQI. Based on this information, they calculate the stability of link quality which is used for the multi-hop path selection. The algorithm of calculating the stability of link quality is out of this contribution.

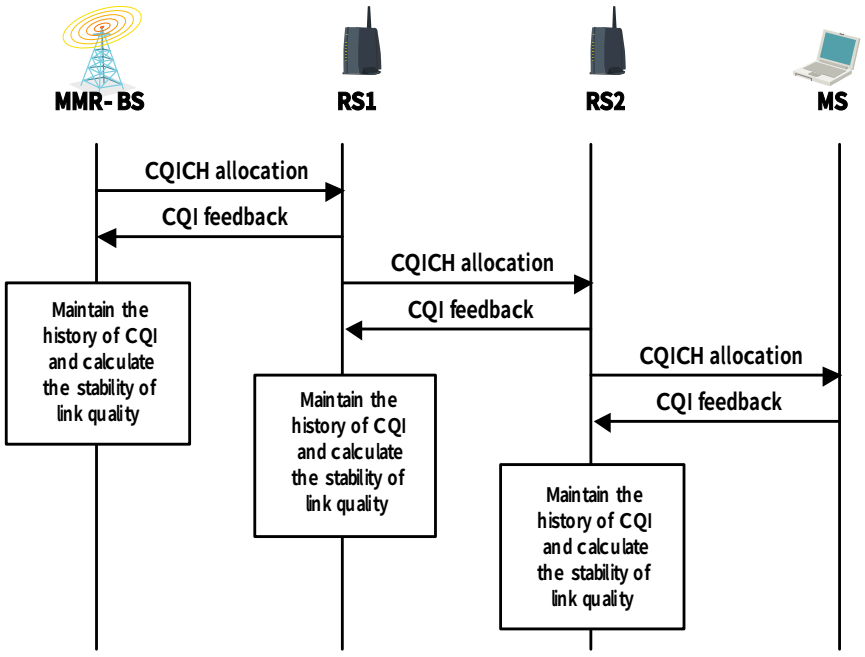

Figure 3 Using a fast-feedback channel (CQICH): Distributed scheduling

3.2. Calculating the stability of link quality using REP-RSP messages

If the fast-feedback channel (CQICH) cannot be used, REP-RSP messages may be used, alternatively. In the centralized scheduling, MMR-BS sends REP-REQ to RSs and MSs, requesting a RSSI standard deviation or a CINR standard deviation, and RSs and MSs send REP-RSP to MMR-BS (Figure 4). MMR-BS may use the value of a RSSI standard deviation or a CINR standard deviation directly as an index of the stability of link quality.

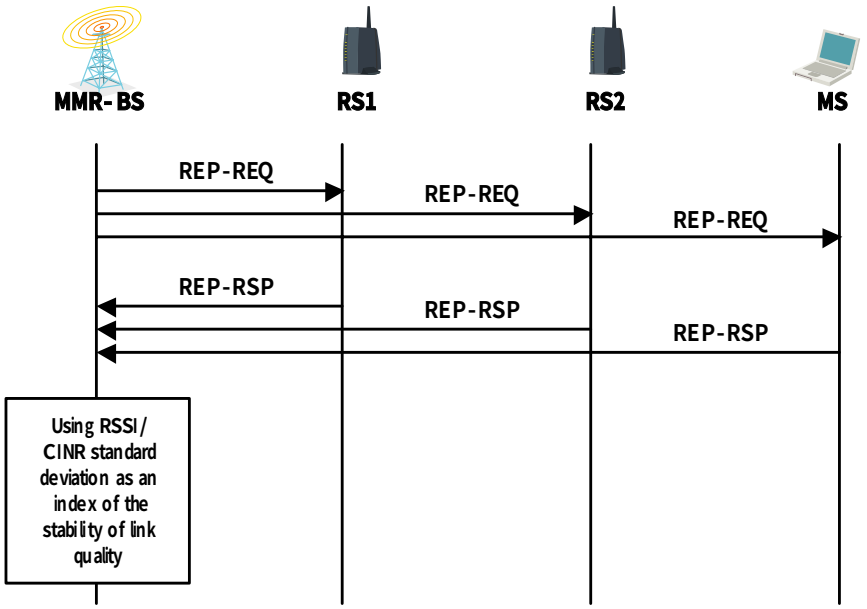

Figure 4 Using REP-RSP messages: Centralized scheduling

In the distributed scheduling, MMR-BS and RSs send REP-REQ to neighboring RSs and MSs, requesting a RSSI standard deviation or a CINR standard deviation (Figure 5). They receive REP-RSP from neighboring RSs and MSs. They may use the value of a RSSI standard deviation or a CINR standard deviation directly as an index of the stability of link quality.

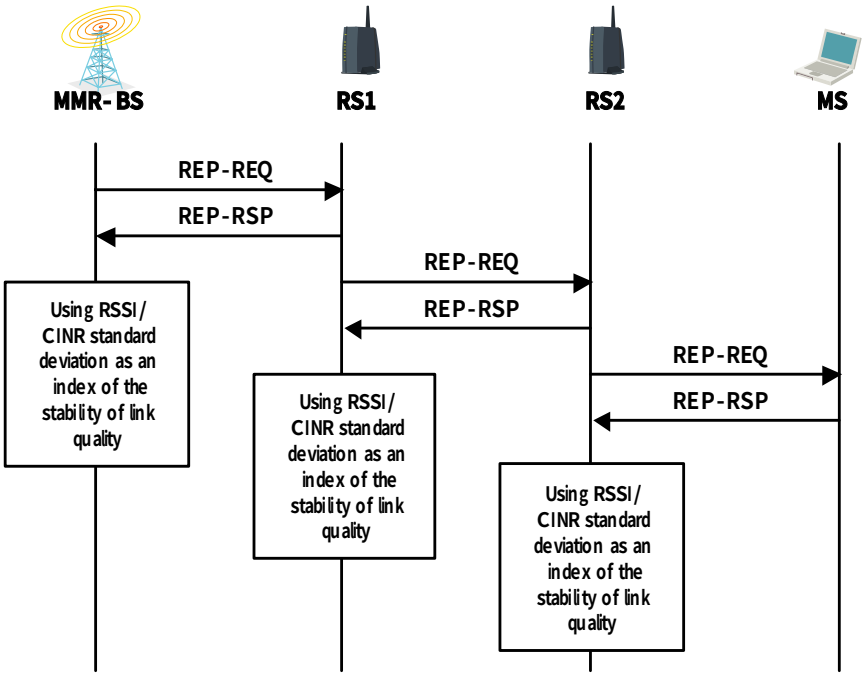

Figure 5 Using REP-RSP messages: Distributed scheduling

4. Proposed text changes

6.3.25 Relay path management and routing

[Insert the following text]

The stability of link quality shall be considered as a metric of multi-hop path selection. In order to get information regarding the stability of link quality, following methods may be used:

- Using a fast-feedback channel (CQICH)
- Using REP-RSP messages (In case that CQICH cannot be used)

In the centralized scheduling, MMR-BS may allocate CQICH to RSs and MSs. Allocation of CQICH for RSs is performed in the relay zone and the one for MSs in the access zone. RSs and MSs report CQI to MMR-BS, and MMR-BS may maintain the history of CQI. Based on this information, it calculates the stability of link quality which is used for the multi-hop path selection. The algorithm of calculating the stability of link quality is out of this standard.
In the distributed scheduling, MMR-BS and RSs may allocate CQICH to neighboring RSs and MSs. Allocation of CQICH for RSs is performed in the relay zone and the one for MSs in the access zone. MMR-

BS and RSs collect CQI from neighboring nodes and maintain the history of CQI. Based on this information, they calculate the stability of link quality which is used for the multi-hop path selection. The algorithm of calculating the stability of link quality is out of this standard.

If the fast-feedback channel (CQICH) cannot be used, REP-RSP messages may be used, alternatively.

In the centralized scheduling, MMR-BS may send REP-REQ to RSs and MSs, requesting a RSSI standard deviation or a CINR standard deviation, and RSs and MSs may send REP-RSP to MMR-BS. MMR-BS may use the value of a RSSI standard deviation or a CINR standard deviation directly as an index of the stability of link quality.

In the distributed scheduling, MMR-BS and RSs may send REP-REQ to neighboring RSs and MSs, requesting a RSSI standard deviation or a CINR standard deviation. They receive REP-RSP from neighboring RSs and MSs. They may use the value of a RSSI standard deviation or a CINR standard deviation directly as an index of the stability of link quality.

5. References

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