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| Project | **IEEE 802.16 Broadband Wireless Access Working Group <**<http://ieee802.org/16>**>** | |
| Title | **Proposed Modifications to MIMO Support in the Consolidated SRD for IEEE 802.16q Multi-Tier Networks** | |
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| Re: | In response to the Multi-tier Networks Call for Contributions (IEEE 802.16-12-0617-00-Shet) | |
| Abstract | This contribution suggests text modifications to MIMO support in the consolidated System Requirements Document (SRD) | |
| Purpose | To discuss and adopt the proposed modifications in the System Requirements Document (SRD) for IEEE 802.16q Multi-Tier Networks | |
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# Proposed Modifications to MIMO Support in the Consolidated SRD for IEEE 802.16q Multi-Tier Networks

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# Introduction

In Session #81, MIMO support in Multi-tier Networks was suggested and has been included in the consolidated proposed text towards an initial draft System Requirements on IEEE 802.16q Multi-tier Networks [1], which provides requirements for supporting MIMO in the link between a macro BS and a small BS in multi-tier networks. It states a small BS shall support with integrated antennas, but it seems to be straightforward to employ integrated antennas when support of MIMO. In the original contribution [2], it says the 802.16q system shall support massive MIMO with highly integrated antennas in a small BS. In order to meet much higher capacity in the backhaul link than that in the cellular link, support of large-scale(or massive) MIMO with large number of antenna elements(or arrays) is a essential function. Thus, a macro BS as well as a small BS requires large number of antenna elements. In particular, it is expected that a macro BS governs a number of small BSs within its coverage, which makes backhual links point-to-multipoint. Therefore, a macro BS may require more number of antenna elements than a small BS.

The current texts include implement-specific requirements such as “Antennas in a small BS shall be integrated with low inter-antenna interferece.”, which is not functional requirements for the standard. Inter-antenna(or stream) interference would be made lower by signal processing technique for a given antenna configuration. How antennas are integrated is out of scope in the IEEE 802.16 standard. Also, antenna selection is a sort of precoding technique per IEEE 802.16.1-2012, so it is cerntainly redundant and could be removed.

It has been studied vigorously that pilot allocation and acquisition of channel state information (CSI) are challenging difficult problems to realize large-scale MIMO due to its use of extremely large number of antennas. To fully accomplish benefits of large-scale MIMO such as high spectral/energy efficiency, high reliability, reduced interference, CSI is needed both the transmit and receive sides. In the receive side, channel estimation is conducted to demodulate data tones using pilots, as increasing the number of transmit antennas, the number of pilots required also increases. To minimize pilot overhead and mitigate pilot contamination, it is desirable to typically use precoded pilot for demodulation, which requires orthogonality among streams not antenna elements. Also, with the help of channel reciprocity(despite requiring calibration between transmit and receive components in the transmit side), in TDD mode, channel sounding is an efficient way to acquisit CSI at the transmit side by receiving sounding signals from the receive side.

# References

1. IEEE 802.16-12-0615-01-000q, Consolidated proposed text towards an initial draft System Requirements on IEEE 802.16q Multi-tier Networks
2. IEEE 802.16-12-0547-00-000q, Proposal of system requirements for supporting massive MIMO in multi-tier networks
3. IEEE 802.16-12-0394-05-Gdoc, PAR and Five Criterias for P802.16q on a Multi-tier Amendment to IEEE Std 802.16, July 2012.
4. IEEE Std 802.16-2012, IEEE Standard for Air Interface for Broadband Wireless Access Systems, Aug. 2012.

# Proposed Modifiations to the texts in line 28, page 6 in the consolidated SRD for IEEE 802.16q Multi-Tier Networks

[-------------------------------------------------------Start of Text Proposal-------------------------------------------------------]

## 6.4 ~~MIMO support in Multi-tier Networks~~Support of Large-Scale Antenna Techniques for a Backhaul Link between a Macro BS and a Small BS

### This section provides requirements for supporting large-scale antenna techniques ~~MIMO in the~~for a backhaul link between a macro BS and a small BS in multi-tier networks, which employs large number of antenna elements for high spectral efficiency, high reliability, and reduced interference. [For the macro BS, minimum [TBD] number of transmit and [TBD] number of receive antennas shall be supported. For the small BS, minimum [TBD] number of transmit and [TBD] number of receive antennas shall be supported.]

### ~~MIMO support through integrated antennas in a small BS~~

### ~~The 802.16q system shall support MIMO with integrated antennas in a small BS. For the macro BS and the small BS, minimum [TBD] number of transmit and [TBD] number of receive antennas shall be supported.~~

#### ~~6.4.1.1 Antennas in a small BS shall be integrated with low inter-antenna interference.~~

#### ~~6.4.1.2 Integrated antennas shall support MIMO or beamforming/pre-coding operation.~~

#### ~~6.4.1.3 A small BS shall support antenna selection operation with low complexity.~~

#### 6.4.1 IEEE 802.16q shall support advanced antenna techniques such as MIMO and beamforming/precoding.

#### 6.4.2 IEEE 802.16q shall further support spatial division multiplexing (SDM) MIMO and spatial division multiple access (SDMA) MIMO techiniques [with upto maximum [TBD] streams].

#### 6.4.3 IEEE 802.16q shall support precoded pilots for demodulation.

#### 6.4.4 IEEE 802.16q shall support sounding mechanisms in TDD mode. To compensate imperfect channel reciprocity between DL and UL, calibration mechanisms shall be provided when sounding is used.

[--------------------------------------------------------End of Text Proposal--------------------------------------------------------]