IEEE P802.11  
Wireless LANs

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| RTS/CTS | | | | |
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| Author(s): | | | | |
| Name | Affiliation | Address | Phone | Email |
| Simone Merlin | Qualcomm Inc | 5775 Morehouse Dr  San Diego, CA 92109 | 8588451243 | smerlin@qualcomm.com |
| Menzo Wentink | Qualcomm | Straatweg 66-s, Breukelen, The Netherlands | +31 65 183 6231 | mwentink@qualcomm.com |

Abstract

This document provides resolution for the comments listed below

Comments are from: 11-12-0223-03-00ac-lb187-comment-tgac-d2-0.xlsx

Comments refer to: Draft P802.11ac\_D2.0.pdf

**Comments**

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| 4366 | 93.35 | 9.3.2.6 | So using VHT RTS lack the same featureset as non-HT frames - not a good design | 1) Add a Static/Dynamic indication to an RTS carried in a HT/VHT frame (using the non-HT mechanism or some other), then 2) make HT/VHT RTS frames behave the same as non-HT RTSs | COEX |

Proposed resolution: REJECT

The non-HT dynamic/static BW mechanism is sufficient for achieving the scope for which it was designed. The additional benefit of duplicating the mechanism for VHT RTS/CTS is not justified.

The usefulness of a dynamic BW mechanism implicitly assumes there are interfering STAs operating on channels other than the primary 20Mhz channel. In this case, using VHT RTS/CTS frames is inappropriate as it does not allow distribution of the NAV to interfering STAs.

Moreover, in general sending RTS/CTS in VHT format does not allow protection against non-VHT STAs, hence defeating the main purpose of RTS/CTS so it is not going to be widely used.

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| 4573 | Haiguang Wang | 112.38 | 9.3.2.5a | 11ac has introduced MU-MIMO feature. An AP can transmit to multiple STAs simulataneously on donwlinks (eg. description in 9.19.2.2a).  However, the TXOP for MU-MIMO is not sufficiently protected and subject to  severe collision, especially when there are overlapped APs and/or legacy STAs. A collision avoidance mechansims shall be put in place to protect multiple transmission. | A amendment to VHT-RTS/CTS procedure for protection in MU-MIMO transmission could serve the purpose, e.g., using single RTS multiple CTS to protect the MU-MIMO downlink when transmission duration is very long and the coverage of BSs are overlap to each other. | COEX |
| 4636 | Joseph Teo | 112.38 | 9.3.2.5a | For the MU-MIMO feature in 11ac (description in 9.19.2.2a), the TXOP for MU-MIMO is not sufficiently protected and subject to  severe collision when there are overlapped APs and/or legacy STAs. A collision avoidance mechanism shall be put in place to protect multiple transmission. | An amendment to VHT-RTS/CTS procedure in order to protect MU-MIMO transmission could serve the purpose, e.g., using single RTS, multiple CTS to protect the MU-MIMO downlink when the coverage of BSs are overlap to each other. | COEX |
| 5490 | Zhongding Lei | 112.38 | 9.3.2.5a | 11ac has introduced MU-MIMO feature where an AP can transmit to up to four STAs with a single PPDU in each DL MU-MIMO transmission (eg. description in 9.19.2.2a).  However, the TXOP for MU-MIMO is not sufficiently protected and subject to  severe collision, especially when there are overlapped APs and/or legacy STAs. A collision avoidance mechansims shall be put in place to protect multiple transmission. | A amendment to VHT-RTS/CTS procedure for protection in MU-MIMO transmission could serve the purpose, e.g., using single RTS multiple CTS to protect the MU-MIMO downlink when the coverage of BSs are overlap to each other. | COEX |

Proposed resolution: REJECT

The comments propose to introduce a new RTS/CTS mechanism for MU-MIMO, where an RTS solicits CTSs from multiple STAs.

Comments requesting the introduction of a similar mechanism were addressed in previous letter ballots and rejected (e.g. CID 2114 in LB 178) after detailed discussion; no benefits of such a mechanism were ever shown; below discussion points out limitations and issues that would be associated with such a protocol.

CID 2114 in LB 178

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| *Comment:*    *In order to protect against all hidden nodes, CTS must be sent by all STAs that are receivers of VHT frames. To minimize overhead, a VHT RTS frame should be defined that requests all receiveing STAs to sequentially send CTSs.* | *Proposed resolution*  *As specified in 11-11-0898-00-00ac.* |

Approved resolution to CID 2114 in LB 178

*DISAGREE (COEX: 2011-09-14 05:55:27Z)*

*The issue of RTS/CTS for DL MU-MIMO has been considered and debated at length in TGac. Below is a summary of the discussions on this subject.*

*Regarding the proposed solutions based on multiple sequential CTS frames in response to a single RTS (or modified multiple-RTS), the possibility that RTS might not be responded by CTS by one of the intended clients causes a gap in the sequence of CTSs that might indicate availability of the medium to other clients, hence they might attempt to claim the medium by starting a frame transmission. Error cases such as this questions the resilience of multiple sequential CTSs.*

*On the other hand, the current rules allow AP to send multiple RTSs one by one to whatever subset of the clients in the MU group and expect CTS for each of the RTSs. For instance, AP can send RTS to the primary client and after receiving CTS, AP can send RTS to one of the secondary clients and expect CTS in response (see 9.3.2.6a VHT RTS procedure , 9.3.2.7 CTS procedure and 9.19.2.2 EDCA TXOPs), etc. If the second or subsequent CTS is not sent then the AP can perform a PIFS recovery and for example not include that client in the MU PPDU (see 9.19.2.4 Multiple frame transmission in an EDCA TXOP).*

Moreover, note that 802.11n rules allow to start a TXOP with RTS/CTS and transmit multiple frames during the TXOP; the multiple frames can be addressed to different STAs and those STAs may send immediate reply frames; that is no different than a TXOP including a MU-MIMO transmission. In fact, in MU-MIMO transmission the PPDU is addressed to multiple STAs, one STA might reply immediately, and then AP may send BAR to a different STA, which replies with a BA, etc…

The new proposed protocol would imply additional overhead and complexity with no proven benefit for MU-MIMO.