Effects of Inexact Representation of Rate Information

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Abstract: Some proposals before Task Group B utilize bit rates that can not be represented exactly in the several fields that include rate information. Since the MAC was designed with the assumption that the rate information it requires would be exact, this causes problems with the MAC.

The 802.11 MAC was designed to utilize rate information provided by the PHY in both calculations and protocols. In order to operate correctly and efficiently, this rate information from the PHY must be an exact representation of the actual bit rate in use. The rate information from the PHY appears in the Supported Rates element in the association/reassociation and probe request/response protocols, in Beacons, and is used in the calculation of duration in every MAC header. The rate information is reported by the PHY in the dot11SupportedDataRatesTx and dot11SupportedDataRatesRx tables of the PHY MIB and in the RXVECTOR of every received frame. The MAC transfers its desired transmission rate to the PHY in the TXVECTOR. Each of these uses of the rate information must be examined.

The rate information in the Supported Rates element is used in the Beacon frame to announce the rates that are supported in the BSS. A station scanning for BSSs with certain capabilities may make choices of which BSS to join based on this information. For this purpose, the rate information in the Supported Rates element need not be exact. It can be considered as a *label* for the actual rate. Only the interpretation of this *label* needs to exact and identical in all stations. Similarly, the rate information in the Supported Rates element in the association/reassociation and probe request/response protocols can also be considered as a *label* and need not be exact for the same reasons.

The rate information transferred in the RXVECTOR and TXVECTOR (along with the aMPDUDurationFactor) is used to calculate the duration field in the MAC header of every frame and the NAV value for the MAC collision avoidance mechanism. This rate information must be as exact as possible in order to avoid wasting valuable bandwidth, on the one hand, or causing avoidable collisions, on the other hand.

If the rate information as represented is less than the actual rate, the duration reported in the MAC header will be longer than is required to complete the frame exchange, by nearly the percentage that the representation of the rate is in error. This causes stations to sit idle while the medium is not busy, because the NAV value will be greater than the actual duration of the frame exchange. While these stations are idle, useful bandwidth goes unused.

If the rate information as represented is greater than the actual rate, the duration in the MAC header will be shorter than is required to protect the complete frame exchange. This will cause real collisions as the NAV in stations becomes clear before the frame exchange is complete, thus allowing stations to begin transmissions while the medium is still busy. These otherwise avoidable collisions will waste a great deal of bandwidth, because the entire frame exchange must be retransmitted.

In conclusion, the MAC requires that some of the rate information provided by the PHY be represented exactly in order for an 802.11 LAN to operate correctly and efficiently.