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Multirate Fix is Partially Broken

...a response to document 98/316

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Submission

Slide 1

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Overview

- Document 98/316 identifies several cases of conflicting or incomplete definition of Multirate operation in the existing 802.11 standard, and proposes ways to correct each one.
- However, one of the proposed corrections is incorrect, and several others are sub-optimal.
- This submission identifies some problems with the fixes proposed in 98/316, and suggests improved ways of resolving the Multirate issues.

Submission

Slide 2

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Multirate Issues Identified In 98/316

- Scenario 1: PHY mandatory rates are not defined
 - The problem is real. The proposed solution is correct but needs clarification.
- Scenario 2: Response may be at higher rate than initial frame
 - The problem is real. The proposed solution is appropriate.
- Scenario 3: STA only required to receive at all Basic Rates
 - The problem is real. The proposed solution is sub-optimal.
- Scenario 4: aMPDUDurationFactor is an integer
 - The problem is mis-characterized. The proposed solution is unnecessary!
- Scenario 5: No mechanism for inter-STA rate discovery
 - The problem exists only in an IBSS. There is a simpler alternative solution.

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Clarification for Scenario 1

- Summary of Scenario 1 from 98/316:
 - A BSS configured with 1, 2 and 5.5 Mb/s as rates in the BSS basic rate set.
 - On receiving a 5.5 Mb/s frame an STA is supposed to check the PHY mandatory rates.
 - PHY mandatory rates are not defined.
 - This problem can be resolved by removing the reference to PHY mandatory rates.
- Clarification
 - The proper solution is to replace the text:
“if this rate belongs to the PHY mandatory rates”
in the final paragraph of clause 9.6 with:
“if this rate is in the BSS Basic Rate Set”
to avoid creating a new ambiguity while fixing the original error.
 - The reference to the PHY mandatory rate set should be deleted in the second paragraph of clause 9.6.

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Discussion of Scenario 3

- Summary of Scenario 3 from 98/316:
 - A BSS configured with 1, 2 and 5.5 Mbit/s as rates in the BSS basic rate set.
 - On receiving a 5.5 Mbit/s frame an STA is required to respond with a 5.5 Mbit/s control frame.
 - The BSS basic rate set definition requires that STAs be able to receive at all the rates in the set and be able to transmit at (at least) one of those rates.
 - Require all STAs in a BSS be able to receive and transmit at all rates in the BSS basic rate set.
- The solution proposed in 98/316 will work, but places an unnecessary constraint on future radio PHYs and on the existing IR PHY.
- This solution requires PHYs with non-symmetric transmit and receive capability, such as the IR PHY, to omit mandatory receive rates from the BSS Basic Rate Set. This forces control responses to be sent at the lower rate, even by stations capable of transmitting at the higher rate.
 - A superior solution is to leave the definition of BSS Basic Rate Set as is; and to require control response frames to be sent “at the highest rate usable for transmission by this PHY which is in the BSS Basic Rate Set.”

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Discussion of Scenario 4

- Summary of Scenario 4 from 98/316:
 - The definition of `aMPDUDurationFactor` in clause 10.4.3.2 specifies it as an integer.
 - However, the value assigned it in clause 14.9 is 1.03125.
 - This problem can be overcome easily by normalizing the value with an integer so that the effect of discarding a fractional component will be less than 1 μ s.
- Few items have suffered worse from the Std 802.11-1997 MIB fiasco than the MPDU Duration Factor. However, the definition is correct in the published standard {if you know where to find it!} and what is needed is editorial corrections to clause 10, and possibly elsewhere.
- The proposed solution in 98/316 is undesirable, in part because “normalizing” is not what is required. However, the effect intended by the proposal in 98/316 is already present in the approved standard, and what is needed is editorial corrections to make the existing definition clear and accessible to readers of any subsequent document.

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The {Hidden} Facts About aMPDUDurationFactor

- There should be a clear distinction between the “MPDU Duration Factor” (“DF”) and the encoding of the PLME-CHARACTERISTICS.confirm parameter “aMPDUDurationFactor” that represents the actual DF.
- The DF is a fraction in the half-open interval [1.0, 2.0). The DF is multiplied by MPDU duration to calculate the PPDU duration.
- For PHYs that do not insert non-data symbols into the PPDU, DF = 1.0.
 - For PHYs that insert non-data symbols into the PPDU prior to transmission, the factor is the ratio of MPDU bits to PPDU bits. For the existing FH PHY the ratio is 33/32, so DF = 1.03125 (which is the value that appears in 14.8.2).
 - The value of aMPDUDurationFactor is related to the DF by the equation:

$$\text{aMPDUDurationFactor} = \text{INT}((\text{DF}-1) * (10e9))$$
 - This encoding was defined, along with the 0.5Mbit/s-based encoding of supported rates, at the interim meeting in Palm Bay, Florida in January, 1997.
 - This encoding appears in the published standard on page 343, in the definition of the “DurFactor” sort (and is also stated in the associated comments).
 - Clauses 10.4.3 and 14.8.2 should be updated to specify this encoding.

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Slide 7

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Discussion of Scenario 5

- Summary of Scenario 5 from 98/316:
 - There is no mechanism for an MLME on one STA to discover the receive rates supported by a remote STA.
 - Information is needed to implement the unspecified rate switching mechanism.
 - Possible Solutions
 - Use trial and error.
 - Add a service primitives to retrieve the receive capabilities of remote STAs.
- In a BSS, all frame exchanges involve the AP, so there is no problem:
 - The AP and each STA are aware of each others' supported rates from the Supported Rates elements in (Re)Association Request/Response frames.
 - There is an existing mechanism by which supported rates may be discovered in an IBSS (if this is felt to be necessary):
 - A STA could send a directed Probe Request to the target remote STA. The resulting Probe Response contains a Supported Rates element.
 - I am unaware of text in the existing standard which forbids a directed Probe Request, although all explicit uses of Probe specify a broadcast DA.

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Composite Wording Changes for 9.6

- The solutions for Scenario 1 (as clarified above), Scenario 2, and Scenario 3 (in the form shown above) all impact the last paragraph of clause 9.6. The resulting text should read:
- In order to allow the transmitting STA to calculate the contents of the Duration/ID field, the responding STA shall transmit its Control Response frame (either CTS or ACK) at the same rate as the immediately previous frame in the frame exchange sequence (as defined in 9.7), if this rate is in the BSSBasicRateSet, or else at the highest rate usable for transmission by this STA's PHY which is less than or equal to the rate at which the preceding frame was received and is also in the BSSBasicRateSet."
- The reference to the PHY mandatory rate set should be deleted in the second paragraph of clause 9.6.

Submission

Slide 9

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