IEEE P802.11
Wireless LANs

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| 11ba Architecture Considerations |
| Date: 2019-01-16 |
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**Abstract**

This document contains discussion of some Wake-Up Radio (11ba) architectural concepts, and proposes changes to the current 11ba draft for these concepts.

R0: Initial revision

R1: Updated to reflect recent changes in (or agreed to go into) TGba draft

R2: Further updates, based on discussion at January 2019 F2F, marked with “dot” bullets

Discussion:

Based on discussion with a subset of TGba members at recent ARC SC meeting, it has been proposed that WUR operation on both an AP and on a non-AP STA is best modelled as a mode of operation of the STA (including the STA within the AP), and not as operation of a separate sub-system/radio. This is still being investigated, through discussions at ARC SC. To further these discussions, this document pursues this direction for modelling WUR, and proposes direction (including some changes) to the 11ba amendment draft, implementing the direction.

[ Update: Recent comment resolution in TGba has confirmed this direction as a decision of the TG. This document has been updated to comment (based on the author’s understanding of) these latest changes to the 11ba draft/direction.

General approach:

The idea is to present WUR as a mode of operation on both the AP and non-AP STA.

On an AP, it is just another mode (modulation, etc.) of the PHY, and the AP will use this PHY at any time, based on the behavior description in clause 31 of the amendment. On an AP, the WUR PHY is transmit only.

[Update: this is agreed.]

A non-AP STA, similarly, WUR is another mode of the PHY. The STA can enable the PHY’s WUR receive capability at any time; it never transmits in WUR mode of operaiton. The non-AP STA can also disable all the other PHY modes (and MAC support for them), when it has negotiated the WUR power management into WUR mode with the associated AP. By disabling the other PHY modes and supporting only WUR receive, the implementation can be optimized for minimal power consumption, targeting less than 1 mW of power consumption.

[This appears to be agreed, although text that is explicit about this disabling of other PHYs is not present (yet).]

* Really should be along the lines that the AP is restricted from sending PPDUs, other than WUR PPDUs, to a non-AP STA that is in “WUR doze/awake” (as appropriate). Look for similar language in the baseline that the AP is restricted from sending any PPDU (at least BUs), and try to align the wording. Look near legacy power saving statements that the AP shall not send BUs to a sleeping non-AP STA, but shall buffer them.

Considerations of this approach:

With this model for WUR, since WUR is just a mode of a ‘regular’ PHY (and MAC), there can be no support in the amendment for a “WUR-only” STA, as either a stand-alone beaconing device (not part of an AP), or as a separate wake-up device on a non-802.11 device (separate from an 802.11 non-AP STA).

[This needs to discussed with the TG, to confirm it is an acceptable consequence.]

* Has been discussed, as part of comment resolution and updates.

Suggested changes to the amendment draft, follow. This is not intended to be a complete list, nor to provide exact wording. This is just a description of the types of changes that appear to be needed to accomplish this approach. The specific, detailed changes would need to be worked out, once this direction is discussed, assuming it is agreed.

In Definitions:

Definitions of PCR/WUR/WURx as “a radio” need to be modified – there is only one radio, so these are not a unique/separate radio, but a mode for the PHY contained within the STA. It’s not clear these terms/definitions are even needed, but that can be determined after other clauses are updated, depending on what is most clear and convenient for the wording.

[Update: This has been accomplished. The PCR and WURx terms have been deleted as a result.]

Definitions of WUR xxx channel should just reference an operating behavior, based on the PHY’s mode. (It almost is already, but could be clarified.)

[Update: This has moved in the right direction, but there is still some wording issues/confusion about the use of the concept of the “WUR non-AP STA’s state”.

WUR mode is okay nearly as-is, with appropriate wording for “the WURx” and “the PCR”, based on the above changes, so it a description of

[Update: The above comment about “WUR non-AP STA’s state” is most evident in this. It’s modified in the right direction, but needs some more wording help.]

In clause 4:

Capture the “general approach” above, instead of description like “A WUR non-AP STA includes a primary connectivity radio (PCR) component and a WURx.”

[Update: This is greatly improved in the latest language. The concepts could be fleshed out a bit more here, since this isn’t just a (strict) definition, but an explanatory clause. So, the idea that the WUR non-AP STA negotiates a desired WUR mode behaviour with a WUR AP, and then disables the other PHYs when in very low-power WUR mode sleep, could be added.]

In clause 31:

Remove all “PCR component” references (like P54.43), and replace with “non-WUR mode PHY mode”. (Need to work on wording for this.) Remove “the WURx” references, and replace with “PHY in WUR mode/operation” or something similar.

[Update: This has been accomplished, or at least a good effort and start has been done. The final result should be reviewed for completeness and accuracy, after the application of some global editing instructions.]

In clause 32:

WUR is “just” another PHY, that supports low data rates and low power requirement for operation. Like other PHY amendments, this clause should start by stating that a WUR PHY is also some subset of other (existing) 2.4 and/or 5 GHz PHYs (optionally clause 21, 19, and/or 18, and requiring clause 17.

[Update: Not aware of text changes here. The D1.1 text is close, but talks about the capability of the STA (that contains a WUR PHY) and not of the WUR PHY itself. This is potentially confusing and/or an architectural issue – how are these capabilities accomplished, if not by the WUR PHY? Is there an assumption that the STA contains another PHY (an architectural challenge to accomplish)?]

[An aside: 5 GHz is required by the requirement for clause 17 support. Should it be clause 17 and/or clause 18? And, why are DFS operating classes excluded?]

[Update: Not addressed/considered yet.]

Add (conceptually, not exact wording): When this PHY is used in a non-AP STA, that is associated with a WUR-capable AP, and with WUR negotiated, the STA may disable all PHY modes except WUR receive when in doze state. This brings power consumption expectation to less than 1 mW.

[Update: This concept does not appear to be in the draft, yet. No discussion of this has been noted, yet.]