IEEE P802.11
Wireless LANs

|  |
| --- |
| Proposed Spec Text for power save in congested environment |
| Date: 2016-09-01 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Laurent Cariou |  |  |  | laurent.cariou@intel.com |
| Robert Stacey | Intel | 2111 NE 25th Ave, Hillsboro OR 97124, USA | +1-503-724-893 | robert.stacey@intel.com |
| Shahrnaz Azizi |  |  |  | shahrnaz.azizi@intel.com |
| Po-Kai Huang |  |  |  | po-kai.huang@intel.com |
| Qinghua Li |  |  |  | quinghua.li@intel.com |
| Xiaogang Chen |  |  |  | xiaogang.c.chen@intel.com |
| Chitto Ghosh |  |  |  | chittabrata.ghosh@intel.com |
| Yaron Alpert |  |  |  | yaron.alpert@intel.com |
| Assaf Gurevitz |  |  |  | assaf.gurevitz@intel.com |
| Ilan Sutskover |  |  |  | ilan.sutskover@intel.com |
| Feng Jiang |  |  |  | feng1.jiang@intel.com |
| Jing Ma | NICT |  |  |  |
| Kentaro Ishizu | NICT |  |  |  |
| Fumihide Kojima | NICT |  |  |  |
| Minho Cheong | Newracom | 9008 Research Dr.Irvine, CA 92618 |  | minho.cheong@newracom.com |
| Reza Hedayat |  | reza.hedayat@newracom.com |
| Young Hoon Kwon |  | younghoon.kwon@newracom.com |
| Yongho Seok |  | yongho.seok@newracom.com |
| Daewon Lee |  | daewon.lee@newracom.com |
| Yujin Noh |  | yujin.noh@newracom.com |
| Ron Porat | Broadcom |  |  | rporat@broadcom.com |
| Sriram Venkateswaran |  |  |  |
| Matthew Fischer |  |  | mfischer@broadcom.com |
| Zhou Lan |  |  |  |
| Leo Montreuil |  |  |  |
| Andrew Blanksby |  |  |  |
| Vinko Erceg |  |  |  |
| Thomas Derham |  |  |  |
| Mingyue Ji |  |  |  |
| Robert Stacey | Intel | 2111 NE 25th Ave, Hillsboro OR 97124, USA | +1-503-724-893 | robert.stacey@intel.com |
| Shahrnaz Azizi |  | shahrnaz.azizi@intel.com |
| Po-Kai Huang |  | po-kai.huang@intel.com |
| Qinghua Li |  | quinghua.li@intel.com |
| Xiaogang Chen |  | xiaogang.c.chen@intel.com |
| Chitto Ghosh |  | chittabrata.ghosh@intel.com |
| Laurent Cariou |  | laurent.cariou@intel.com |
| Yaron Alpert |  | yaron.alpert@intel.com |
| Assaf Gurevitz |  | assaf.gurevitz@intel.com |
| Ilan Sutskover |  | ilan.sutskover@intel.com |
| Feng Jiang |  | feng1.jiang@intel.com |
| Hongyuan Zhang | Marvell | 5488 Marvell Lane,Santa Clara, CA, 95054 | 408-222-2500 | hongyuan@marvell.com |
| Lei Wang |  | Leileiw@marvell.com |
| Liwen Chu |  | liwenchu@marvell.com |
| Jinjing Jiang |  | jinjing@marvell.com |
| Yan Zhang |  | yzhang@marvell.com |
| Rui Cao |  | ruicao@marvell.com |
| Sudhir Srinivasa |  | sudhirs@marvell.com |
| Bo Yu |  | boyu@marvell.com |
| Saga Tamhane |  | sagar@marvell.com |
| Mao Yu |  | my@marvel..com |
| Xiayu Zheng |  | xzheng@marvell.com |
| Christian Berger |  | crberger@marvell.com |
| Niranjan Grandhe |  | ngrandhe@marvell.com |
| Hui-Ling Lou |  | hlou@marvell.com |
| Alice Chen | Qualcomm | 5775 Morehouse Dr. San Diego, CA, USA |  | alicel@qti.qualcomm.com |
| Albert Van Zelst | Straatweg 66-S Breukelen, 3621 BR Netherlands |  | allert@qti.qualcomm.com |
| Alfred Asterjadhi | 5775 Morehouse Dr. San Diego, CA, USA |  | aasterja@qti.qualcomm.com |
| Bin Tian | 5775 Morehouse Dr. San Diego, CA, USA |  | btian@qti.qualcomm.com |
| Abhishek Patil | 1700 Technology Drive San Jose, CA 95110, USA |  | appatil@qti.qualcomm.com |
| George Cherian | 5775 Morehouse Dr. San Diego, CA, USA |  | gcherian@qti.qualcomm.com |
| Gwendolyn Barriac | 5775 Morehouse Dr. San Diego, CA, USA |  | gbarriac@qti.qualcomm.com |
| Hemanth Sampath | 5775 Morehouse Dr. San Diego, CA, USA |  | hsampath@qti.qualcomm.com |
| Lin Yang | 5775 Morehouse Dr. San Diego, CA, USA |  | linyang@qti.qualcomm.com |
| Lochan Verma | 5775 Morehouse Dr. San Diego, CA USA |  | lverma@qti.qualcomm.com |
| Menzo Wentink | Straatweg 66-S Breukelen, 3621 BR Netherlands |  | mwentink@qti.qualcomm.com |
| Naveen Kakani | 2100 Lakeside BoulevardSuite 475, RichardsonTX 75082, USA |  | nkakani@qti.qualcomm.com |
| Raja Banerjea | 1060 Rincon Circle San JoseCA 95131, USA |  | rajab@qit.qualcomm.com |
| Richard Van Nee | Straatweg 66-S Breukelen, 3621 BR Netherlands |  | rvannee@qti.qualcomm.com |
| Rolf De Vegt | Qualcomm | 1700 Technology Drive San Jose, CA 95110, USA |  | rolfv@qca.qualcomm.com |
| Sameer Vermani | 5775 Morehouse Dr. San Diego, CA, USA |  | svverman@qti.qualcomm.com |
| Simone Merlin | 5775 Morehouse Dr. San Diego, CA, USA |  | smerlin@qti.qualcomm.com |
| Tevfik Yucek | 1700 Technology Drive San Jose, CA 95110, USA |  | tyucek@qca.qualcomm.com |
| VK Jones | 1700 Technology Drive San Jose, CA 95110, USA |  | vkjones@qca.qualcomm.com |
| Youhan Kim | 1700 Technology Drive San Jose, CA 95110, USA |  | youhank@qca.qualcomm.com |
| Jianhan Liu | MediatekUSA | 2860 Junction Ave, San Jose, CA 95134, USA | +1-408-526-1899 | jianhan.Liu@mediatek.com |
| Thomas Pare |  |  | thomas.pare@mediatek.com |
| ChaoChun Wang |  |  | chaochun.wang@mediatek.com |
| James Wang |  |  | james.wang@mediatek.com |
| Tianyu Wu |  |  | tianyu.wu@mediatek.com |
| Russell Huang |  |  | russell.huang@mediatek.com |
| James Yee | Mediatek | No. 1 Dusing 1st Road, Hsinchu, Taiwan | +886-3-567-0766 | james.yee@mediatek.com |
| Frank Hsu |  |  | frank.hsu@mediatek.com |
| Joonsuk Kim | Apple |  |  | joonsuk@apple.com |
| Aon Mujtaba |  |  | mujtaba@apple.com |
| Guoqing Li |  |  | guoqing\_li@apple.com |
| Eric Wong |  |  | ericwong@apple.com |
| Chris Hartman |  |  | chartman@apple.com |
| Jarkko Kneckt |  |  | jkneckt@apple.com |
| David X. Yang | Huawei | F1-17, Huawei Base, Bantian, Shenzhen |  | david.yangxun@huawei.com |
| Jiayin Zhang | 5B-N8, No.2222 Xinjinqiao Road, Pudong, Shanghai | +86-18601656691 | zhangjiayin@huawei.com |
| Jun Luo | 5B-N8, No.2222 Xinjinqiao Road, Pudong, Shanghai |  | jun.l@huawei.com |
| Yi Luo | F1-17, Huawei Base, Bantian, Shenzhen | +86-18665891036 | Roy.luoyi@huawei.com |
| Yingpei Lin | 5B-N8, No.2222 Xinjinqiao Road, Pudong, Shanghai |  | linyingpei@huawei.com |
| Jiyong Pang | 5B-N8, No.2222 Xinjinqiao Road, Pudong, Shanghai |  | pangjiyong@huawei.com |
| Zhigang Rong | 10180 Telesis Court, Suite 365, San Diego, CA  92121 NA |  | zhigang.rong@huawei.com |
| Jian Yu | F1-17, Huawei Base, Bantian, Shenzhen |  | ross.yujian@huawei.com |
| Ming Gan | F1-17, Huawei Base, Bantian, Shenzhen |  | ming.gan@huawei.com |
| Yuchen Guo | F1-17, Huawei Base, Bantian, Shenzhen |  | guoyuchen@huawei.com |
| Yunsong Yang | 10180 Telesis Court, Suite 365, San Diego, CA  92121 NA |  | yangyunsong@huawei.com |
| Junghoon Suh | 303 Terry Fox, Suite 400 Kanata, Ottawa, Canada |  | Junghoon.Suh@huawei.com |
| Peter Loc |  |  | peterloc@iwirelesstech.com |
| Edward Au | 303 Terry Fox, Suite 400 Kanata, Ottawa, Canada |  | edward.ks.au@huawei.com |
| Teyan Chen | F1-17, Huawei Base, Bantian, Shenzhen |  | chenteyan@huawei.com |
| Yunbo Li | F1-17, Huawei Base, Bantian, Shenzhen |  | liyunbo@huawei.com |
| David X. Yang | Huawei | F1-17, Huawei Base, Bantian, Shenzhen |  | david.yangxun@huawei.com |
| Jiayin Zhang | 5B-N8, No.2222 Xinjinqiao Road, Pudong, Shanghai | +86-18601656691 | zhangjiayin@huawei.com |
| Jun Luo | 5B-N8, No.2222 Xinjinqiao Road, Pudong, Shanghai |  | jun.l@huawei.com |
| Yi Luo | F1-17, Huawei Base, Bantian, Shenzhen | +86-18665891036 | Roy.luoyi@huawei.com |
| Yingpei Lin | 5B-N8, No.2222 Xinjinqiao Road, Pudong, Shanghai |  | linyingpei@huawei.com |
| Jiyong Pang | 5B-N8, No.2222 Xinjinqiao Road, Pudong, Shanghai |  | pangjiyong@huawei.com |
| Zhigang Rong | 10180 Telesis Court, Suite 365, San Diego, CA  92121 NA |  | zhigang.rong@huawei.com |
| Jian Yu | F1-17, Huawei Base, Bantian, Shenzhen |  | ross.yujian@huawei.com |
| Ming Gan | F1-17, Huawei Base, Bantian, Shenzhen |  | ming.gan@huawei.com |
| Yuchen Guo | F1-17, Huawei Base, Bantian, Shenzhen |  | guoyuchen@huawei.com |
| Yunsong Yang | 10180 Telesis Court, Suite 365, San Diego, CA  92121 NA |  | yangyunsong@huawei.com |
| Junghoon Suh | 303 Terry Fox, Suite 400 Kanata, Ottawa, Canada |  | Junghoon.Suh@huawei.com |
| Peter Loc |  |  | peterloc@iwirelesstech.com |
| Edward Au | 303 Terry Fox, Suite 400 Kanata, Ottawa, Canada |  | edward.ks.au@huawei.com |
| Teyan Chen | F1-17, Huawei Base, Bantian, Shenzhen |  | chenteyan@huawei.com |
| Yunbo Li | F1-17, Huawei Base, Bantian, Shenzhen |  | liyunbo@huawei.com |
| Jinmin Kim | LG Electronics | 19, Yangjae-daero 11gil, Seocho-gu, Seoul 137-130, Korea |  | Jinmin1230.kim@lge.com |
| Kiseon Ryu |  |  | kiseon.ryu@lge.com |
| Jinyoung Chun |  |  | jiny.chun@lge.com |
| Jinsoo Choi |  |  | js.choi@lge.com |
| Jeongki Kim |  |  | jeongki.kim@lge.com |
| Dongguk Lim |  |  | dongguk.lim@lge.com |
| Suhwook Kim |  |  | suhwook.kim@lge.com |
| Eunsung Park |  |  | esung.park@lge.com |
| JayH Park |  |  | Hyunh.park@lge.com |
| HanGyu Cho |  |  | hg.cho@lge.com |
| Bo Sun | ZTE | #9 Wuxingduan, Xifeng Rd., Xi'an, China |  | sun.bo1@zte.com.cn |
| Kaiying Lv |  |  | lv.kaiying@zte.com.cn |
| Yonggang Fang |  |  | yfang@ztetx.com |
| Ke Yao |  |  | yao.ke5@zte.com.cn |
| Weimin Xing |  |  | xing.weimin@zte.com.cn |
| Brian Hart | Cisco Systems | 170 W Tasman Dr, San Jose, CA 95134 |  | brianh@cisco.com |
| Pooya Monajemi |  |  | pmonajem@cisco.com |
| Yasushi Takatori | NTT | 1-1 Hikari-no-oka, Yokosuka, Kanagawa 239-0847 Japan | +81 46 859 3135 | takatori.yasushi@lab.ntt.co.jp |
| Yasuhiko Inoue | +81 46 859 5097 | inoue.yasuhiko@lab.ntt.co.jp |
| Shoko Shinohara | +81 46 859 5107 | Shinohara.shoko@lab.ntt.co.jp |
| Yusuke Asai | +81 46 859 3494 | asai.yusuke@lab.ntt.co.jp |
| Koichi Ishihara | +81 46 859 4233 | ishihara.koichi@lab.ntt.co.jp |
| Junichi Iwatani | +81 46 859 4222 | Iwatani.junichi@lab.ntt.co.jp |
| Akira Yamada | NTT DOCOMO | 3-6, Hikarinooka, Yokosuka-shi, Kanagawa, 239-8536, Japan | +81 46 840  3759 | yamadaakira@nttdocomo.com |
| Masahito Mori | Sony Corp. |  |  | Masahito.Mori@jp.sony.com |
| Yusuke Tanaka |  |  | YusukeC.Tanaka@jp.sony.com |
| Yuichi Morioka |  |  | Yuichi.Morioka@jp.sony.com |
| Kazuyuki Sakoda |  |  | Kazuyuki.Sakoda@am.sony.com |
| William Carney |  |  | William.Carney@am.sony.com |
| Sigurd Schelstraete | Quantenna |  |  | Sigurd@quantenna.com |
| Huizhao Wang |  |  | hwang@quantenna.com |
| Narendar Madhavan | Toshiba |  |  | narendar.madhavan@toshiba.co.jp |
| Masahiro Sekiya |  |  |  |
| Toshihisa Nabetani |  |  |  |
| Tsuguhide Aoki |  |  |  |
| Tomoko Adachi |  |  |  |
| Kentaro Taniguchi |  |  |  |
| Daisuke Taki |  |  |  |
| Koji Horisaki |  |  |  |
| David Halls |  |  |  |
| Filippo Tosato |  |  |  |
| Zubeir Bocus |  |  |  |
| Fengming Cao |  |  |  |

Abstract

This document provides proposals for text spec related to power save section.

1. **Introduction**

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. The introduction and the explanation of the proposed changes are not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGax Editor: Editing instructions preceded by “TGax Editor” are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.***

1. **Proposed changes**

***TGax editor: Modify section 9.4.2.6 TIM element as follows***

* TIM element

The TIM element contains four fields: DTIM Count, DTIM Period, Bitmap Control, and Partial Virtual Bit-map. See Figure 9-127 (TIM element format).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | DTIM Count | DTIM Period | Bitmap Control | Partial Virtual Bitmap |
| Octets: | 1 | 1 | 1 | 1 | 1 | 1–251 |
| * TIM element format
 |

The Element ID and Length fields are defined in 9.4.2.1 (General).(#139)

The Length field for this element(#139) is constrained as described below.

The DTIM Count field indicates how many Beacon frames (including the current frame) appear before the next DTIM. A DTIM count(#5291) of 0 indicates that the current TIM is a DTIM. The DTIM Count field(#5291) is a single octet. When a TIM element is included in a TIM frame, the DTIM Count field is reserved.(#308)

The DTIM Period field indicates the number of beacon intervals between successive DTIMs. If all TIMs are DTIMs, the DTIM Period field has the value 1. The DTIM Period value 0 is reserved. The DTIM period field is a single octet.

The Bitmap Control field is a single octet. Bit 0 of the field contains the traffic indication virtual bitmap(#234) bit associated with AID 0. This bit is set to 1 in TIM elements with a value of 0 in the DTIM Count field when one or more group addressed MSDUs/MMPDUs are buffered at the AP or the mesh STA. The remaining 7 bits of the field form the Bitmap Offset.

The (#2060)traffic indication virtual bitmap, maintained by the AP or the mesh STA that generates a TIM, consists of 2008 bits, and is organized into 251 octets such that bit number *N* (0  *N*  2007) in the bitmap corresponds to bit number (*N* mod 8) in octet number *N* / 8 where the low-order bit of each octet is bit number 0, and the high order bit is bit number 7.

When included in TIM frames and FILS discovery frames at the beginning of a broadcast TWT SP by an HE AP:

* The DTIM count field is reserved
* The DTIM period is reserved
* The partial virtual bitmap is computed as follows:
	+ bit N in the traffic indication virtual bitmap that corresponds to an HE non-AP STA with AID N is determined as follows:
		- Bit number *N* in the traffic indication virtual bitmap is 0 if the AP does not intend to transmit to the STA or to trigger the STA for an UL MU transmission during the TWT SP and before the next TWT SP.
		- Otherwise, bit number *N* in the traffic indication virtual bitmap is 1.

***TGax editor: Modify table 9-257l1 (Table 9-257l1— TWT Flow Identifier field for a broadcast TWT element) as follows***

|  |
| --- |
| * TWT Flow Identifier field for a broadcast TWT element
 |
| TWT Flow Identifier field value | Description when transmitted in a broadcast TWT element |
| 0 | No constraints on the frames transmitted during a broadcast TWT SP. |
| 1 | Frames transmitted during a broadcast TWT SP by a TWT scheduled STA are recommended to be limited to:* Frames with reduced payload sizes that deliver control feedback:
* PS-Poll and QoS Null frames
* Feedback can be contained is the QoS Control field or in the HE variant HT Control field of the frame, whichever is present (see 25.5.1 (HE DL MU operation), 25.5.2 (UL MU operation), 25.8 (Operating mode indication), 25.14 (Link adaptation using the HE variant HT Control field), etc.)
* Frames that are sent as part of a sounding feedback exchange (see 25.6 (HE sounding protocol))
* Management frames
* Action, or Action No Ack frames

There are no restrictions on the frames transmitted by the scheduling STA of the broadcast TWT SP.Trigger frames transmitted by the AP during the broadcast TWT SP will not contain RUs for random access (see 25.7.3.2 (Rules for TWT scheduling STA)).(#114) |
| 2 | Frames transmitted during a broadcast TWT SP by a TWT scheduled STAT are recommended to be limited to:* Frames with reduced payload sizes that deliver control feedback:
* PS-Poll and QoS Null frames
* Feedback can be contained is the QoS Control field or in the HE variant HT Control field of the frame, whichever is present (see 25.5.1 (HE DL MU operation), 25.5.2 (UL MU operation), 25.8 (Operating mode indication), 25.14 (Link adaptation using the HE variant HT Control field), etc.)
* Frames that are sent as part of a sounding feedback exchange (see 25.6 (HE sounding protocol))
* Management frames
* Action, Action No Ack frames or (Re-)Association Request frames

There are no restrictions on the frames transmitted by the scheduling STA of the broadcast TWT SP.Trigger frames transmitted by the AP during the broadcast TWT SP will contain at least one RU for random access (see 25.7.3.2 (Rules for TWT scheduling STA)).(#114) |
| 3 | No constraints on the frames transmitted during a broadcast TWT SP.The AP transmits a TIM frame or a FILS discovery frame including a TIM element at the beginning of the TWT SP. |
| 4-7 | Reserved |

***TGax editor: Modify table 8-309a—FILS Discovery frame format as follows***

* + - 1. FILS Discovery frame format

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| 1 | Category |  |
| 2 | Public Action |  |
| 3 | FILS Discovery Information field |  |
| 4 | Reduced Neighbor Report element | The Reduced Neighbor Report element is optionally pres- ent. |
| 5 | FILS Indication element | The FILS Indication element is optionally present. |
| 6 | Roaming Consortium element | The roaming Consortium element is optionally present |
|  |  |  |
| 7 | TIM element | The TIM element is optionally present when dot11TWToptionActivated and dot11HEOptionImplemented are true, otherwise it’s not present. |

 Table 8-309a—FILS Discovery frame format

***TGax editor: Add the following to the section 8.6.8.36 FILS discovery frame format***

The FILS discovery frame may include a TIM element, which is defined in 9.4.2.6 (TIM element), for operation as defined in 25.15.3 (Opportunistic power save in congested environment).

***TGax editor: Add section 25.15.3*** ***Opportunistic power save in congested environment***

***25.15.3*** ***Opportunistic power save in congested environment***

25.15.3.1 AP operation for opportunistic power save

Opportunistic power save mechanism has the objective for an AP to split a beacon interval into several periodic broadcast TWT SPs and to provide, at the beginning of each SP, the scheduling information to all non-AP STAs. Based on this information, the non-AP STAs may opportunistically go to doze state until the next TWT SP.

If it wants to enable opportunistic power save, an AP shall include a TWT element in beacons to set a periodic Broadcast TWT SP with the TWT flow identifier field set to 3.

At the beginning of these periodic TWT SPs, the AP shall transmit a TIM frame or a FILS discovery frame that includes a TIM element that is defined as described in 9.4.2.6. The AP should transmit a FILS discovery frame instead of a TIM frame if the TWT start time aligns with the transmission time of a FILS discovery frame.

For any HE non-AP STA for which their associated AP set their corresponding bit in the traffic indication virtual bitmap field of the TIM element to 0, the AP shall neither send unicast or multicast frames to those STAs, nor trigger those STAs for UL MU transmissions during the TWT SP and, unless otherwise specified, until the next TWT SP.

For an HE non-AP STA for which their associated AP set their corresponding bit in the traffic indication virtual bitmap field of the TIM element to 1, if the STA was not served before the next TWT SP then the AP shall set its corresponding bit in the traffic indication virtual bitmap field of the TIM element to 1 in the subsequent TWT SP.

25.15.3.2 STA operation for opportunistic power save

When receiving a TIM element in TIM frame or FILS discovery frame at the beginning of a broadcast TWT SP, an HE non-AP STA with AID *N* may enter the doze state during the TWT SP and until the next TWT SP, if the bit N in the traffic indication virtual bitmap field of the current TIM element is set to 0.