**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | Proposed resolution to MIMO Array training feedback command in the PHY section |
| Date Submitted | 14 April, 2016 |
| Source | Ken Hiraga and Hideki ToshinagaNTT Network Innovation LaboratoriesHikarinooka 1-1, Yokosuka 239-0847 Japan | Voice: +81 46 859 3474Fax: +81 46 855 1497E-mail: hiraga.ken@lab.ntt.co.jp |
| Re: | LB114\_Consolidated\_Comments |
| Abstract | Proposes comment resolution on CID 3 and CID 4. Provides a proposed change in MIMO Array training feedback command in the MAC section, currently after 6.5.9.5. |
| Purpose | To be used by the technical editor to apply the necessary changes to the draft. |
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**List of contributors**

|  |  |
| --- | --- |
| **Name** | **Affiliation** |
| Jae Seung Lee | ETRI |
| Young-Hoon Kim | ETRI |
| Moon-Sik Lee | ETRI |
| Itaru Maekawa | Japan Radio Co., Ltd |
| Lee Doohwan | NTT Corporation |
| Ken Hiraga | NTT Corporation |
| Hideki Toshinaga | NTT Corporation |
| Keitarou Kondou | Sony Corporation |
| Hiroyuki Matsumura | Sony Corporation |
| Makoto Noda | Sony Corporation |
| Masashi Shinagawa | Sony Corporation |
| Ko Togashi | Toshiba Corporation |
| Kiyoshi Toshimitsu | Toshiba Corporation |
|  |  |

In this document we propose to insert some descriptions for the array training feedback command into the PHY section, along with the LB114 comments shown in the table below.

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| **CID** | **Page** | **Sub-clause** | **Line #** | **Comment** | **Proposed Change** | **E/T** | **Must Be Satisfied? (enter Yes or No)** | **Resolution Status** |
| 5 | 105 | 11a.2.8.3 | 1 | Figure 11a-11 does not contain Array Training Feedback command as commented above. | In the figure, insert the Array training feedback and ACK for that command after the last array training command. | T | Yes | Accepted |
| 6 | 104 | 11a.2.8.3 | 9~41 | This description does not contain the Array training feedback command. | Insert descriptions into this subclause. | T | Yes | Accepted |
| 72 | 105 | 11a.2.8.3 | 1 | Figure 11a-11 is hard to read | Large font, simple description | E | No | Accepted |

In page 105, we propose to add Array training feedback command into Figure 11a-11 as shown in the next page (CID#5). In this figure, we inserted the Array training feedback and ACK for that command after the last array training command. The revised figure employs lager font and simple descriptions (CID#72).



**Figure 11a-11 —Setup sequence for MIMO transmission**

In "subclause “11a.2.8.3 Link setup procedure for MIMO mode” on page 104, we propose to replace line#9 - line#41 with text below.

This revises descriptions on the Array training feedback command as commented with CID #6.

If value of *Nar* is more than zero, the next step for MIMO transmission is to startthe array training mode to select a set of antenna elements in the antenna array HRCP PNC, whose concept is described in 11a.2.8.4.

If *Nar* = 0, the array training mode shall be skipped because this means the HRCP PNC does not require the array training mode. At this time MIMO PHY frame exchange is started just after the Ack for Association response command is received by HRCP PNC.

In the array training mode, the DEV starts sending Array training commands after it recognizes it is not moving around on the array surface of the HRCP PNC. The method for the recognition is up to implementation, for example the NFC communication or optical camera imaging can be used, or by using timer assuming the user stabilizes the positions of DEV within a certain time (e.g. 2 sec).

All Array training commands shall be transmitted with No-ACK policy. The number of Array training commands sent is equal to *Nar*. These are transmitted from antenna element #1 to allow HRCP PNC to select antenna elements for following MIMO transmission.

Though the HRCP PNC’s antenna switching procedure in the array training mode is up to the implementation, it is recommended to ensure the reception of the first Array training command. For example, HRCP-PNC receives Array training command #1 using the same antenna element which successfully sent the Association response. If the first Array training command is not received, the DEV is disconnected.

When the first Array training command is received the Array training timer is started.

Whether the HRCP PNC can receive the Array training commands #2 ~ #*Nar* or not,

When the Array training timer ends, HRCP PNC selects, if necessary, *M* antenna elements, out of *Marray*, elements that are going to be used in the following MIMO mode.

When the HRCP PNC is ready to switch into MIMO mode, HRCP PNC sends an Array training feedback to DEV. The Array training feedback command is sent with Stk-Ack policy.

The Array training feedback command comprises information below:

* List of successfully received training commands field
* RSSI report (optional) field
* Resend all Array training commands field
* If the Array training feedback command is not received by DEV, the HRCP PNC shall retransmit Array trainingfeedback command*.*

If the Resend all Array training commands field is set to 1, the DEV shall resend all Array training commands after sending the Ack for the Array training feedback command to the HRCP PNC. This mechanism enables the HRCP PNC to do the array training until acceptable.

After that both devices switch into MIMO mode and start MIMO frame exchange with channel aggregation or channel bonding. The MIMO mode cannot be turned into SISO mode until the communication session ends.

The multiple of Array Training commands transmission is necessary for the antenna selecting procedure, which is described in the following subsection. The number of Array Training commands sent from DEV (*Nar*) and their time period (*Tar*) are notified by the beacon.

When *M < Marray*, HRCP PNC selects *M* antenna elements. For example, procedure selecting antenna is, select using reception levels and Array training commands are sent *Nar* times, hence *Nar* combinations of antennas are switched on to receive these commands. On the other hand when *M* = *Marray*, HRCP PNC does not have to select antenna element.