Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [DF00 Beamforming Related Comment Resolutions: Part I]
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Source: [Junyi Wang, Zhou Lan, Chang woo Pyo, Chin-Sean Sum, Tuncer Baykas, Azizur Rahman, Ryuhei Funada, Fumihide Kojima, Hiroshi Harada, Shuzo Kato, Su-Khiong Yong*, Huai Rong Shao*, Jisung Oh*, Ismail Lakkis+,]
Company [National Institute of Information and Communications Technology (NICT), Tensorcom, Samsung]
Address[1][3-4 Hikari-no-oka, Yokosuka-shi, Kanagawa 239-0847, Japan;
416 Maetan-3Dong Yeongtong-Gu Suwon-shi Kyunggi-Do 443-742, Korea*;
10875 Rancho Bernardo Rd, #108, San Diego, CA 92127+]
Voice[1]:[+81-46-847-5074] , FAX[1]: [+81-46-847-5440]
E-Mail[junyi.wang@nict.go.jp]
Re: []
Abstract: [Comment Resolutions related to Beamforming in DF00]

Purpose: [To be considered in TG3C baseline document.]

DF00 Beamforming Related Comment Resolutions: Part I

Summary

- There are totally 31 comments on DF00 beamforming listed as follows
  - 1 comment in General:
    - #551
  - 13 comments for beamforming IE
    - 38 (492), 39, 40, 41(107), 43, 44, 45, 116, 385(493, 579)
  - 3 comments for codebook/Reference model/clustering
    - 108, 431, 432
  - 5 comments for training/tracking/switching procedure
    - 501, 300, 476, 482, 542
  - 5 comments for directional Beacon/CAP/Extended beacon
    - 35, 47, 51, 438, 443
  - 3 comments for adopting beamforming proposal in AV-OFDM
    - 109, 148, 433
  - 1 comments for beamforming performance
    - 150
- This document provides the resolutions for 17 in BLUE out of total 31 comments.

Comments for Beamforming IE

- Comment 39: BST Clustering.
- Suggestion from the owner : what is this field and how is it used. Couldn't find further usage of this in the draft.
- (subclause 7.4.28, Figure 48e, p35)

- Resolution:
  - Insert following sentence in L28, p35.
    1. "BST clustering IE is used for AAS sector and beam level training as defined in 13.4.1.1.1 and 13.4.1.2.1, respectively. It is also used for SAS sector and beam level training, as defined in 13.4.1.1.2 and 13.4.1.2.2, respectively."

- Comment 40: PET Clustering. what is this field and how is it used. Couldn't find further usage of this in the draft.
- Suggestion from the owner : what is this field and how is it used. Couldn't find further usage of this in the draft.
- (subclause 7.4.30, L31, p36)

- Resolution:
  - Insert following sentence in L3, p36.
    1. "PET clustering IE is used for AAS sector and beam level training as defined in 13.4.1.1.1 and 13.4.1.2.1, respectively. It is also used for SAS sector and beam level training, as defined in 13.4.1.1.2 and 13.4.1.2.2, respectively."

- Comment 41, 107: Figure 48u: reference to x-axis and z-axis.
- Suggestion from the owner : The definition of x and y axis is relative to what? How are we to interpret these as absolute coordinates? Same comment on figure 48w.
- (subclause 7.4.31, L6, p37, and subclause 13.1.3, L1, p162)

- Resolution: Following sentences will be added in L12, p37
  - "The x-axis and z-axis are only applied here as an example to define antenna pattern for linear 2-D antenna array, as describe in 13.1.3. The reference to x-axis and z-axis are changeable according to the implementation requirement "

- Comment 43: line says "field shall be omitted
- Suggestion from the owner : Do you mean "field shall be ignored"?
- (subclause 7.4.32, L37, p37)

- Resolution:
  - Replace the following sentence in L35-37, p37
    - “For the SAS case, the PET HRS Configuration fields for RX and TX are the same, so the PET HRS Configuration (RX) field shall be omitted. ”
  - by
    - “For the SAS case, the PET HRS Configuration fields for RX and TX are the same, so the PET HRS Configuration (RX) field shall be ignored. ”

- Comment 45: Naming inconsistency.
- Suggestion from the owner : Figure 50 calls it "Response TX Sector" and line 44 calls it "Response TX Vector". Is this the same parameter? If so fix the name to be consistent.
- (subclause 7.5.11, L44, p40)
- Resolution:
  - Replace the following sentence in L44-45, p40
    - “If the PNC uses AAS, as determined from the received beacon, the DEV may set the Response TX vector field to the index of the beacon that was initially heard by the DEV. It shall be set to zero otherwise.”
  - by
    - “If the PNC uses AAS, as determined from the received beacon, the DEV may set the Response TX sector field to the index of the beacon that was initially heard by the DEV. It shall be set to zero otherwise.”

- Comment 116: Problem with locating indicated field
- Suggestion from the owner : I looked in the PNC Capabilities IE and I couldn't find a field called PNC number of sectors. Please clarify … is the field missing???
- (subclause 13.6, L30, p178)

- Resolution:
  - Replace the following sentence in L30, p178
    - "The PNC number of sectors is specified in the Capabilities IE for the PNC."
  - by
    - "The PNC number of sectors is specified in the beamforming capabilities field of Capabilities IE as described in Figure 39."

- Comment 385, 393, 575: In Figure 42a, bit fields b17-b22 are undefined.
- Suggestion from the owner : Please define the bits or indicate that they are reserved!
- (subclause 7.4.22, Figure 42a, p31)

- Resolution:
  - Insert the following sentence in L38, p31
    - "b17-b23 are reserved bits to leave for covering some other missing fields."

Comments for codebook/Reference model/clustering

- Comment 108: Cluster
- Suggestion from the owner : I don't understand what is verbally being described nor do I understand the Figure of 217. What do the little circles indicate? Beam patterns viewed from some particular viewing angle? If so then why assume the beam patterns are perfectly circular? More explanation needs to be provided.
- (subclause 13.1.4, L162, p10)

- Resolution:
  - Insert following sentence in L12, p162
    - "The circle in Figure 217 shows hypothetic beams"

- Comment 432: The beam forming reference model is too restrictive because it doesn't have switched antenna options.
- Suggestion from the owner : Redefine beamforming reference model to cover more general antenna architectures.
- (subclause 13.3, L45, p164)

- Resolution:
  - Replace the sentence in L52-53, p162
    - "The codebook for a sectored antenna array and switched antenna array of *M* elements is given by the identity matrix."
  - by
    - "The codebook for a sectored antenna array and swithced antenna array of *M* elements is a spectial case of beamforming antenna given by the *M* by *M* identity matrix."
  - Ismail will furthermore provide some formulas

Comments for training/tracking/switching procedure

- Comment 501: Notation for HRS beams shall be B not H as HRS is just additional beams with size same as the beams and to make it consistent with Figure 215(d)
- Suggestion from the owner : Fix it
- (subclause 13.1, L22, p160)

- Resolution: No change required. Keep the original notations to make the statement to be easily understood. But Add a sentence to clarify HRS beams are just additional set of fine beams.
  - Add sentence in L19, P160
    - "HRS beams are just additional set of fine beams."

- Comment 482: When blocking happens during the communication between source and destation device, the beam forming functionality doesn't seem to be enough to recover the connection. Even though there are lots of multipaths, the path loss attenuation would be too severe because of the characteristics of 60 GHz frequency band. Moreover, the performance pretty much depends on the environment such as the material reflecting signals and etc. So, we need the alternatives for this beam forming problem.
- Suggestion from the owner : The relay can be one alternative to solve or complement the beam forming problem. The presentation will be provided.
- (subclause 13, p159)

- Resolution: Reject the comments. We have already proposed the tracking phase to improve the connectivity, and therefore partially solved the blocking problem. Presented relay proposal still can not solve all the problems

- Comment 542: It is not clear why to choose the best beam, best cluster and second best cluster is enough for beam track.
- Suggestion from the owner : Clarification and more discussion needed
- (subclause 13.4.2, L33, p176)

- Resolution: Beamtracking is to provide backups for the best beam in case the best beam is blocked. We do not have to guarantee backups are available for all time.
  - Add following sentences in L23, p176 to show above fact.
    - “To improve connectivity, beam tracking phase is provided ”

Comments for directional Beacon/CAP/Extended beacon

- Comment 51: Sequence specified twice
- Suggestion: In line 4 the QT sequence is specified. But it was previously specified on page 45, line 44. This is bad form for a standard. Also, on page 45 the specification of the QT sequence (line 44) and the ST sequence (line 50) is rather causal … perhaps it should be somewhat more formalized by providing explicit clause numbers.
- (subclause 8.6.6.4, L4, p48)

- Resolution:
  - Delete the sentence in L4, p48
    - "~~The QT sentence shall be identical to the long preamble.~~".
  - Add reference in L2, p45
    - During each cycle, the DEV shall send $I^{(1,r)}$ repetitions of a quasi-omni training (QT) sequence, as defined in 8.6.6.1, in the same direction.

- Comment 443: This section defines an optional method for devices without any omnidirectional modes to connect to a PNC. If this is left optional it creates interoperability problems for people who purchases only directional devices.
- Suggestion from the owner : Remove the optional requirement.
- (L47, p44)

- Resolution: Reject comments, Keep directional antenna as an option. We will create beacon and CM to be able to communicate in between different DEVs.