

HE-SIG-B Contents

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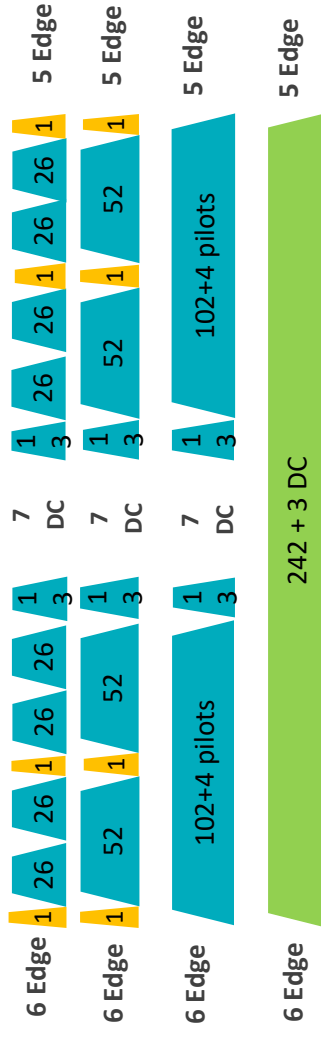
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Re-cap

- Agreement on HE-SIG-B common field [1]
 - The RU allocation signaling in the common field of HE-SIG-B signals an 8 bit per 20 MHz PPDU BW for signaling
 - The RU arrangement in frequency domain
 - Number of MU-MIMO allocations: The RUs allocated for MU-MIMO and the number of users in the MU-MIMO allocations
 - The exact mapping of the 8 bit to the arrangement and the number of MU-MIMO allocations is TBD.
 - Signaling for the center 26 unit in 80 MHz is TBD.
- Agreement on HE-SIG-B user specific field [1]
 - The user specific subfields of HE-SIG-B containing the per user dedicated information include the following fields
 - STA-ID
 - For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme) and Coding (Use of LDPC)
 - For each user in a multi-user allocation in a RU: Spatial Configuration Fields, MCS and Coding.
 - Other fields are TBD.

In this presentation

- We further discuss the details based on the agreements from the last meeting
- In HE-SIG-B common
 - Based on the tone plan and RU pattern in 20MHz [2], we design ‘the exact mapping of the 8 bit to the arrangement and the number of MU-MIMO allocations’

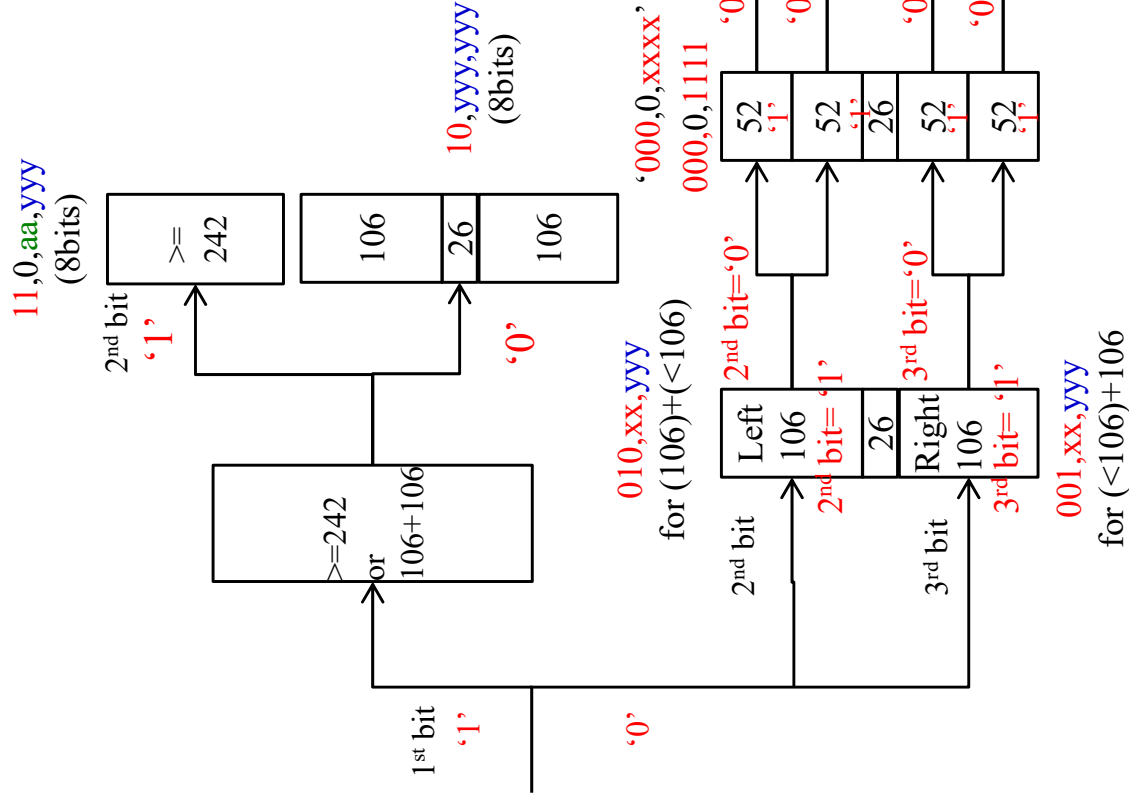


- In HE-SIG-B user specific field
 - Specify the size of STA-ID
 - Add DCM indication for data portion with reliable performance

OFDMA RU Allocation Signalling

- In case of OFDMA transmission, we design the RU allocation signaling considering the following typical cases \rightarrow 176 cases
 - All the possible combinations of 26/52/106/242-RU allocation within 20MHz
 - Also the allocation of 484/996/2*996-RU allocation larger than 20MHz
 - MU-MIMO allocation (on $RU \geq 106$) position and the number of MU-MIMO STAs
 - If $RU > 242$, distribute the MU-MIMO STA number and user-specific information on each CH within the RU.
 - The total number of MU-MIMO STAs is the summation of the number of MU-MIMO STAs per 20MHz on the $RU > 242$.
- For partial OFDMA (with unallocated RU), the indication of all the possible combination in HE-SIG-B common costs unbearable overhead.
 - There are already 2448 combination cases of partial OFDMA if $RU < 106$.
 - Whether to prioritize and indicate some special cases is TBD.

Hierarchical Indication RU allocation signaling



Summary of 8-bit RU allocation signaling:

'000,0,xxxx': 26/52 combinations;

'010,xx,yyy': 106 on the left +(26/52 combinations) on the right

'001,xx,yyy': (26/52 combinations) on the left + 106 on the right

'10,yyy,yyy': 106 on the left +106 on the right

'11,0,aa,yyy': large RU >=242, aa=00/01/10/11 to differentiate 242/484/996/2*996-RU respectively

TBD entries: '011,xxxx', '000,1,xxxx', '11,1,xxxx'

Note: 'yyy' indicate 1~8 STAs on the RU

Lookup Table for 8-bit RU allocation signaling

- 8-bit hierarchical mapping form is equivalent as a table with unique index

8 bits indices	#1	#2	#3	#4	#5	#6	#7	#8	#9	Num of entries
0000 0000	26	26	26	26	26	26	26	26	26	1
0000 0001	26	26	26	26	26	26	26	52	26	1
0000 0010	26	26	26	26	26	52	26	26	26	1
0000 0011	26	26	26	26	26	52	26	52	26	1
0000 0100	26	26	52	52	26	26	26	26	26	1
0000 0101	26	26	52	52	26	26	26	52	26	1
0000 0110	26	26	52	52	26	52	26	26	26	1
0000 0111	26	26	52	52	26	52	26	52	26	1
0000 1000	52	52	26	26	26	26	26	26	26	1
0000 1001	52	52	26	26	26	26	26	52	26	1
0000 1010	52	52	26	26	26	52	26	26	26	1
0000 1011	52	52	26	26	26	52	52	26	26	1
0000 1100	52	52	52	52	26	26	26	26	26	1
0000 1101	52	52	52	52	26	26	26	52	26	1
0000 1110	52	52	52	52	26	52	26	26	26	1
0000 1111	52	52	52	52	26	52	52	26	26	1
0001 xxxx	Definition TBD									
00100 yyy	26	26	26	26	26	26	26	106	26	8
00101 yyy	26	26	52	52	26	26	26	106	26	8
00110 yyy	52	52	26	26	26	26	26	106	26	8
00111 yyy	52	52	52	52	26	26	26	106	26	8
01000 yyy	106	106	106	106	26	26	26	26	26	8
01001 yyy	106	106	106	106	26	26	26	52	26	8
01010 yyy	106	106	106	106	26	52	26	26	26	8
01011 yyy	106	106	106	106	26	52	52	26	26	8
011 xxxxx	Definition TBD									
10 yyy yyy	106	106	106	106	26	26	26	106	26	32
11 00yyy	106	106	106	106	26	26	26	106	26	64
11 001yyy	106	106	106	106	242	26	26	106	26	8
11 010yyy	106	106	106	106	484	26	26	106	26	8
11 010yyy	106	106	106	106	996	26	26	106	26	8
11 011yyy	106	106	106	106	2*996	26	26	106	26	8
11 1 xxxxx	Definition TBD									
11 1 xxxxx	106	106	106	106	26	26	26	106	26	32
11 00yyy	106	106	106	106	242	26	26	106	26	64
11 001yyy	106	106	106	106	484	26	26	106	26	8
11 010yyy	106	106	106	106	996	26	26	106	26	8
11 011yyy	106	106	106	106	2*996	26	26	106	26	8
11 1 xxxxx	Definition TBD									
11 1 xxxxx	106	106	106	106	26	26	26	106	26	32

Note: 'yyy' = 000~111 indicates number of MU-MIMO STAs.

Definition for entries with 'x' bits are TBD.

Subn

ST Aid Options for HE-SIG-B

- ST Aid is to identify the user specific subfields for the tenced STAs.
 - Option1: MAC address (48bit)
 - unique in the whole network, no ambiguity.
 - but unbearable overhead in PHY preamble
 - Option2: AID (11bit)
 - unique within BSS,
 - already exist in MAC
 - moderate overhead, not always fully used
 - Option3: new defined ST Aid
 - assigned ST Aid to the active STA, e.g. STA with MU capability
 - Small overhead or variable overhead
 - AP require special mechanism to manage these ID to avoid ambiguity in scheduling.

STA ID Ambiguity within BSS

- Although 9-bit AID is used to generate PAID in 11ac, STAs may have same PAID when the number of STA in one BSS is large (even sleeping STA occupies AID), especially for 11ax dense scenarios.

$$(dec(AID[0:8]) + dec(BSSID[44:47] \oplus BSSID[40:43]) \times 2^5) \bmod 2^9 \quad (9-8a)$$

- The scheduler must set restriction not to schedule more than one STA with same PAID considering the complexity in STA.
- Otherwise, we have to rely on the RA in MAC header to let the STA finally identify the packet within BSS.
 - The overall overhead is not saved.
 - It is also not energy efficient for the STA with same PAID because he must decode the PSDU not for himself.

➔ Opt2 of 11-bit STAID is preferred to uniquely indicate the scheduled STA.

DCM for Data payload

- Dual Sub-carrier Modulation (DCM) modulates the same information on a pair of sub-carrier n and m separated far apart, which is beneficial for performance improvement of SIGB as well as data portion [3].
 - Extend range for outdoor scenarios by enhancing the PER performance
 - Improve robustness against narrow-band interferences under dense deployment
 - MU-MIMO detection over $RU \geq 106$ also needs robust against instantaneous narrow-band interference.
- We has passed the motion [Motion 12, September 12, 2015]
 - Move to include dual sub carrier modulation (DCM) schemes for HE-SIGB and Payload in the SFD
 - DCM schemes are optional
 - DCM schemes are only applied to BPSK, QPSK, and 16-QAM modulations

DCM Indication

- For each user's data portion, we need 1-bit DCM indication in per user dedicated info in HE-SIG-B.
 - The per user dedicated info (in SIG-B) includes the following:
 - STA_ID + the following fields
 - For allocation that includes one user – Nsts, TxBF, MCS, DCM, Coding
 - For MU-MIMO allocation – Spatial config, MCS, DCM, Coding
 - Other fields are TBD.

1-bit DCM bit indicates the modulation of payload

DCM bit per-user specific field of HE-SIG-B	Modulation Schemes of Payload
1	MCS x with DCM
0	MCS x

Conclusion

- In HE-SIG-B common, we design ‘the exact mapping of the 8 bit to the arrangement and the number of MU-MIMO allocations’ per 20MHz.
- The 8-bit lookup table is summarized in slide 14.
- In HE-SIG-B user specific field, we propose
 - STAID size is 11bits to uniquely indicate the tenced STA.
 - For SU/MU-MIMO allocation, 1-bit DCM indication is added for data portion with reliable performance.

References

- [1] 11-15-1066-00-00ax-he-sig-b-contents
- [2] 11-15-0330-05-00ax-ofdma-numerology-and-structure
- [3] 11-15-1068-01-00ax-reliable-transmission-schemes-for-he-sig-b-and-data

SP#1

- Do you agree to modify the text in IEEE 802.11ax SFD(r9) as follows
 - Change “The exact mapping of the 8 bit to the arrangement and the number of MU-MIMO allocations is TBD.” to “The mapping of the 8 bits to the arrangement and the number of MU-MIMO allocations is defined in the following lookup table.”

8 bits indices	#1	#2	#3	#4	#5	#6	#7	#8	#9	Num of entries
000 0 0000	26	26	26	26	26	26	26	26	26	1
000 0 0001	26	26	26	26	26	26	26	52	26	1
000 0 0010	26	26	26	26	26	52	26	26	26	1
000 0 0011	26	26	26	26	26	52	26	52	26	1
000 0 0100	26	26	52	26	26	26	26	26	26	1
000 0 0101	26	26	52	52	26	26	26	52	26	1
000 0 0110	26	26	52	52	26	52	26	26	26	1
000 0 0111	26	26	52	52	26	52	26	52	26	1
000 0 1000	52	26	26	26	26	26	26	26	26	1
000 0 1001	52	26	26	26	26	26	26	52	26	1
000 0 1010	52	26	26	26	26	52	26	26	26	1
000 0 1011	52	26	26	26	26	52	26	52	26	1
000 0 1100	52	52	52	26	26	26	26	26	26	1
000 0 1101	52	52	52	26	26	26	26	52	26	1
000 0 1110	52	52	52	52	26	52	26	26	26	1
000 0 1111	52	52	52	52	26	52	26	52	26	1
000 1 xxxx	Definition TBD									
00100 yyy	26	26	26	26	26	26	106	106	106	8
00101 yyy	26	26	52	26	26	26	106	106	106	8
00110 yyy	52	26	26	26	26	26	106	106	106	8
00111 yyy	52	52	52	26	26	26	106	106	106	8
01000 yyy	106	106	106	26	26	26	26	26	26	8
01001 yyy	106	106	106	26	26	26	26	52	26	8
01010 yyy	106	106	106	26	26	52	26	26	26	8
01011 yyy	106	106	106	26	26	52	26	52	26	8
011 xxxx	Definition TBD									
10 yyy yyy	106	106	106	26	26	26	106	106	106	32
11 0 00yyy	242	242	242	242	242	242	242	242	242	64
11 0 01yyy	484	484	484	484	484	484	484	484	484	8
11 0 10yyy	996	996	996	996	996	996	996	996	996	8
11 0 11yyy	2*996	2*996	2*996	2*996	2*996	2*996	2*996	2*996	2*996	8
11 1 xxxxx	Definition TBD									
11 1 xxxxx	32	32	32	32	32	32	32	32	32	32

Note: ‘yy’ = 000~111 indicates number of MU-MIMO STAs.

Definition for entries with ‘x’ bits are TBD.

SP#2

- Do you agree to add the ST AID size in the user specific subfields of HE-SIGB is 11bits?

- **Y**
- **N**
- **A**

SP#3

- Do you agree to add a DCM subfield (1-bit) to the user-specific subfields of HE-SIG-B in IEEE 802.11ax SFD(r9) (as shown in red)
 - For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme), **DCM (Dual Sub-Carrier Modulation)** and Coding (Use of LDPC)
 - For each user in a multi-user allocation in a RU: Spatial Configuration Fields, MCS, **DCM** and Coding

- **Y**
- **N**
- **A**