Preamble Structure in 802.11ax

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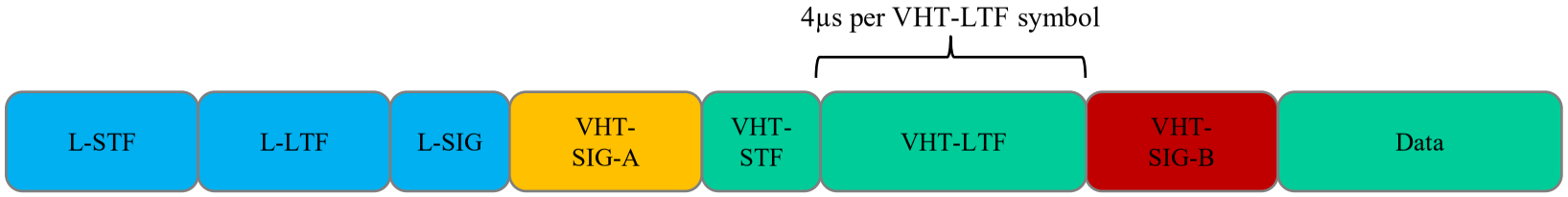
Background

- **Structure of legacy preamble and HE-SIG-A has been decided**
  - The legacy preamble (L-STF, L-LTF and L-SIG) duplicated on each 20MHz for backward compatibility and coexistence with legacy devices operating in the same band
  - HE-SIG-A duplicated as well on each 20MHz after the legacy preamble for common control information
  - Variable size of HE-SIG-B added in SFD [1]
    - 3.y.z Downlink HE MU PPDU shall include HE-SIG-B field, and the number of OFDM symbols of HE-SIG-B field is variable
      (Note: HE-SIG-B field includes information required to interpret HE MU PPDU, and detail is TBD)
- **In this contribution, several options on HE-SIG-B structure are proposed**

Preamble Structure for 11ac



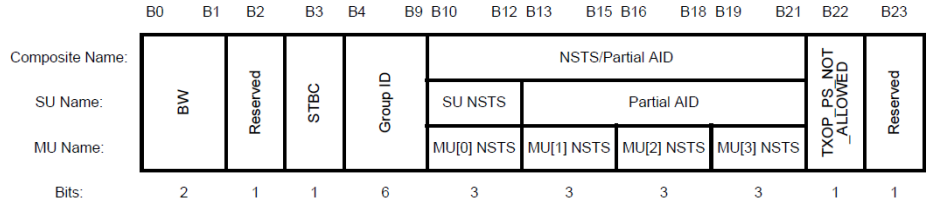


Figure 22-18—VHT-SIG-A1 structure

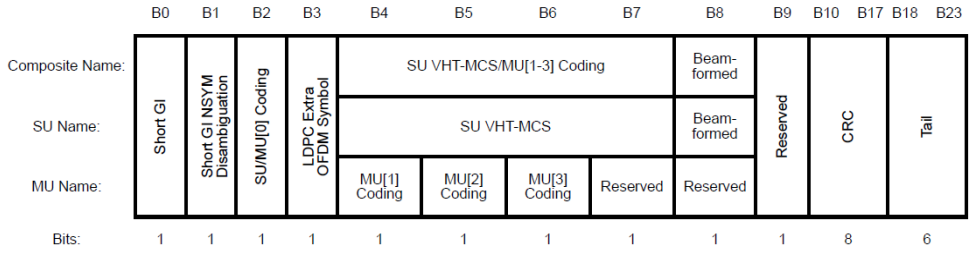


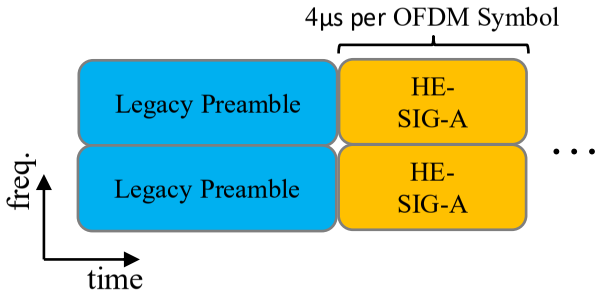
Figure 22-19—VHT-SIG-A2 structure

Field	VHT MU PPDU Allocation (bits)			VHT SU PPDU Allocation (bits)			Description
	20 MHz	40 MHz	80 MHz, 160 MHz, 80+80 MHz	20 MHz	40 MHz	80 MHz, 160 MHz, 80+80 MHz	
VHT-SIG-B Length	B0-B15 (16)	B0-B16 (17)	B0-B18 (19)	B0-B16 (17)	B0-B18 (19)	B0-B20 (21)	Length of A-MPDU pre-EOF padding in units of four octets
VHT-MCS	B16-B19 (4)	B17-B20 (4)	B19-B22 (4)	N/A	N/A	N/A	
Reserved	N/A	N/A	N/A	B17-B19 (3)	B19-B20 (2)	B21-B22 (2)	All 1s
Tail	B20-B25 (6)	B21-B26 (6)	B23-B28 (6)	B20-B25 (6)	B21-B26 (6)	B23-B28 (6)	All 0s
Total # bits	26	27	29	26	27	29	

Table 22-14—Fields in the VHT-SIG-B field

HE-SIG-A

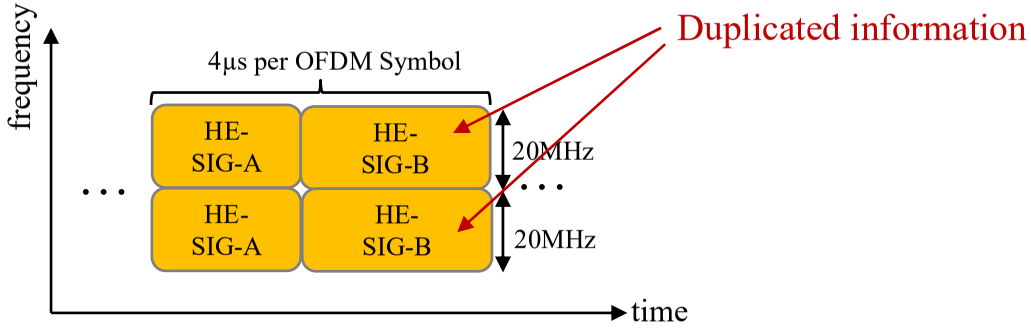
- **Preamble structure for HE-SIG-A**
  - 3.2μs DFT duration, duplicated on each 20MHz
  - Fixed number of OFDM symbols



- **Number of available bits for new features of 11ax**
  - Assumption: required control information that is common for all STAs
    - approx. 24 bits are taken away from total number of available bit in SIG-A
    - Common control information: bandwidth, GI, 2x or 4xLTF, BCC tail bits, CRC, etc
  - Approx. 24 ~ 48 bits additionally available
    - depending on the number of OFDM symbols

HE-SIG-B

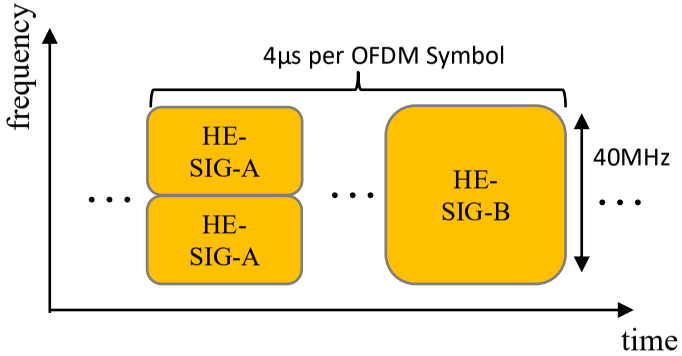
- **Option 1**
  - HE-SIG-B is defined for 20MHz and duplicated on each 20MHz



Pros	Cons
Robust to interference - Robust reception of SIG-A, and SIG-B even in case of interference/collision in non-primary channels **MRC gain** - MRC combining gain of duplicated signals is possible	**(Relatively) Larger Overhead** - Payload Size per OFDM symbol is limited to 24 bits. May require many OFDM symbols for large per-STA information.

HE-SIG-B

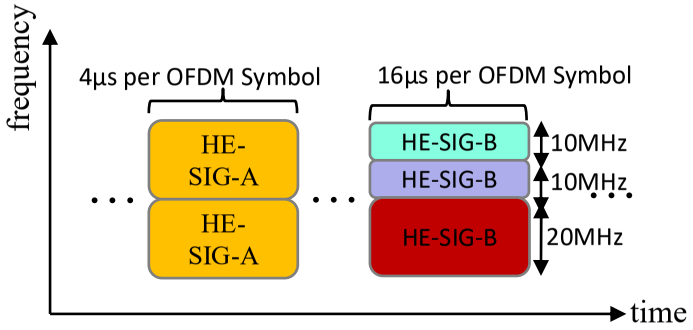
- **Option 2**
  - HE-SIG-B is jointly encoded across the entire OFDMA operation bandwidth



Pros	Cons
(Relatively) Less Overhead - More payload bits are available for wider bandwidths, where large per-STA information is more likely.	**Additional HE-STF and HE-LTF overhead** - Certain implementation/design may require additional STF/LTF symbols because channel estimation only from the primary channel exist.[*] **Additional interleaver design** - Depending on the number of tones for HE-SIG-B, new BCC interleaver may need to be defined

HE-SIG-B

- **Option 3**
  - HE-SIG-B is separately encoded for each assigned subband or STA



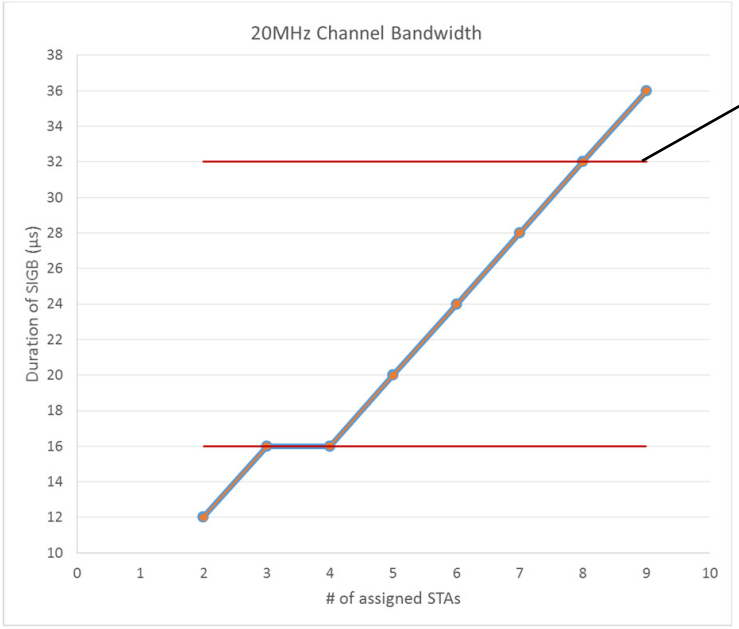
Pros	Cons
Small variation in preamble (SIG-B) length - Number of required bits per subband or STA is likely to be fixed and do not vary as a function of bandwidth or assigned number of STAs.	**Large Overhead for small number of assigned STAs** - SIG-B OFDM symbol duration is 4x time longer. And this long overhead may exist regardless of number of assigned STAs in OFDMA

HE-SIG-B (cont.)

- **DL MU overhead of HE-SIG-B for 20MHz channel bandwidth**

  Assumption : OFDMA and MU-MIMO are exclusive of each other
  : HE-SIG-B consists of user specific information (20 bits) per STA and CRC/Tail

  – Opt.1 and Opt.2 has the same overhead
  – Opt.3 has fixed duration because HE-SIG-B is separately encoded for each assigned subband or STA



2 OFDM symbols with 32 μs if there may be not enough room within 1 OFDM symbol on small subband

Opt 1 duplicated on each20MHz
Opt 2 encoded on entire band
Opt 3 encoded on assigned subband

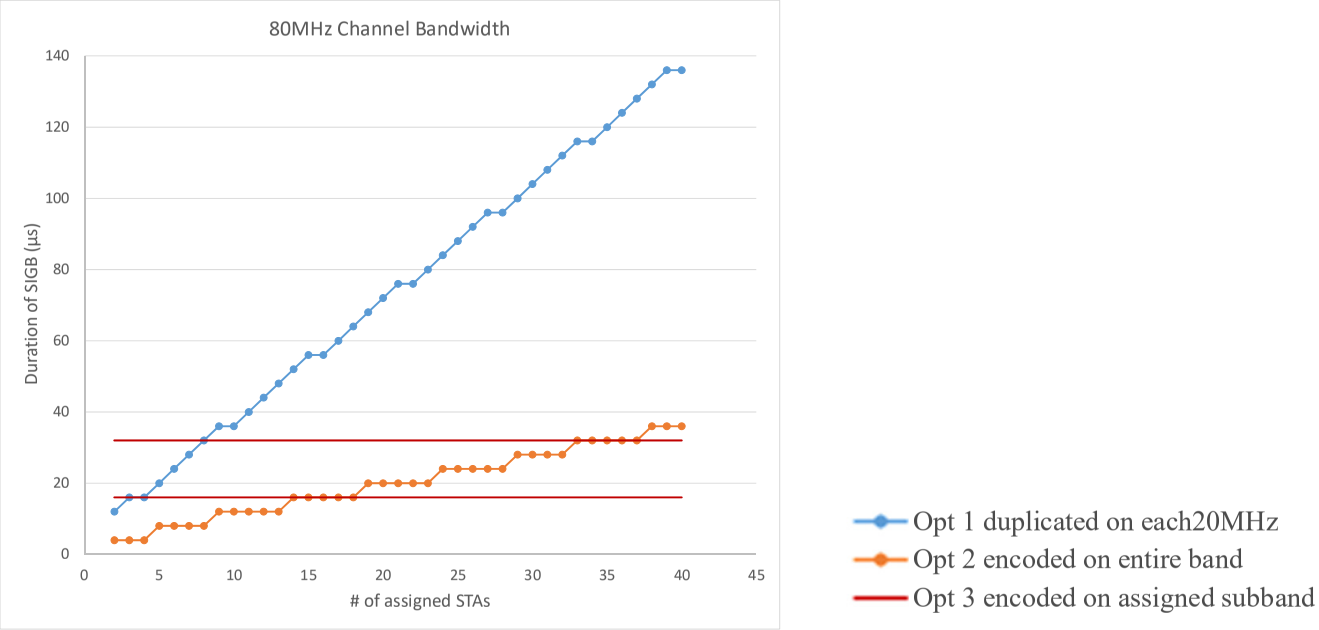
Note: the length of HE-SIG-A and HE-SIG-B can be changed depending on contents in it

HE-SIG-B (cont.)

- **DL MU overhead of HE-SIG-B for 80MHz channel bandwidth**

  Assumption : OFDMA and MU-MIMO are exclusive of each other
  : HE-SIG-B consists of user specific information (20bits) and CRC/Tail

  – Opt.2 is good if 11ax optimizes for small number of STAs
  – Opt.3 is good if 11ax optimizes for large number of STAs



Note: the length of HE-SIG-A and HE-SIG-B can be changed depending on contents in it

SP 1

- **Do you agree to add the following sentence to the TG SFD:**
  - 3.y.x. HE-SIG-A field in HE PPDU shall be fixed number of OFDM symbols, the number of OFDM symbols is TBD.

  - YES
  - NO
  - ABS

SP 2

- **Do you agree to add the following sentence to the TG SFD:**
  - 3.y.x. HE-SIG-B field in DL HE PPDU is a single encoded information mapped to the entire bandwidth.

  - YES
  - NO
  - ABS

SP 3

- **Do you agree to add the following sentence to the TG SFD:**
  - 3.y.x. HE shall support only two types of HE-SIG, such as HE-SIG-A and HE-SIG-B.

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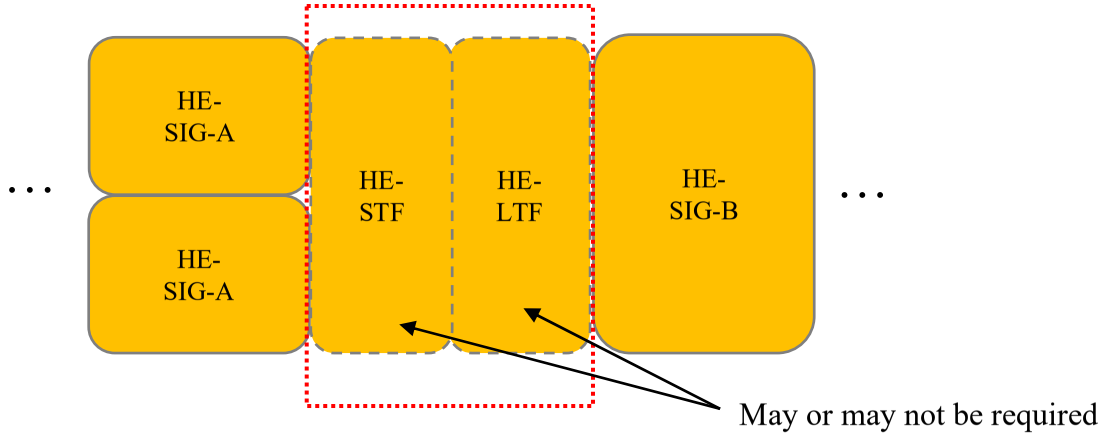
  - YES
  - NO
  - ABS

References

[1] Robert Stacey, Specification Framework for Tgax, 11-15/0132r4, Mar 2015

Appendix – Additional STF/LTF for Option 2

- **Depending on the implementation or design, additional STF/LTF before SIG-B may be needed**
  - Some implementation may choose to only buffer samples in the primary 20 MHz channel, and adapt its receiver once bandwidth information is available (typically in first OFDM symbol of SIG-A).
    - May require additional STF, if receive bandwidth is also changed during the process
  - SIG-B may have more subcarriers than L-LTF subcarriers, in which case channel estimation for the additional subcarriers requires additional LTF.



HE-SIG-B (cont.)

- **More Example for DL MU overhead of HE-SIG-B**

  Assumption : OFDMA and MU-MIMO are exclusive of each other
  : HE-SIG-B consists of user specific information (10 bits) per STA and CRC/Tail

  – Similar trends are shown