Wideband (WBHF) Update

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Wideband HF in 110C

- Technical discussion that follows is from final **DRAFT** MIL-STD-188-110C.
- This document has been reviewed; publication expected by end of October.
- Technical parameters unlikely to change.

Wideband HF in 110C

- Natural evolution of 110B waveform to wider channel bandwidths:
  - Up to 24 kHz
  - 3 kHz steps
- Same family of modulations and coding
- 4 interleavers from 120 ms to 10.24 s

WBHF Data Rates

Waveform Number	Modulation	Data Rate 3 kHz	6 kHz	12 kHz	18 kHz	24 kHz
0	Walsh	75	150	300	600	600
1	BPSK	150	300	600	1,200	1,200
2	BPSK	300	600	1,200	2,400	2,400
3	BPSK	600	1,200	2,400	4,800	4,800
4	BPSK	1,200	2,400	4,800	-	9,600
5	BPSK	1,600	3,200	6,400	9,600	12,800
6	QPSK	3,200	6,400	12,800	19,200	25,600
7	8PSK	4,800	9,600	19,200	28,800	38,400
8	16QAM	6,400	12,800	25,600	38,400	51,200
9	32QAM	8,000	16,000	32,000	48,000	64,000
10	64QAM	9,600	19,200	38,400	57,600	76,800
11	64QAM	12,000	24,000	48,000	72,000	96,000
12	256QAM	16,000	32,000	64,000	90,000	120,000
13	QPSK	2,400				

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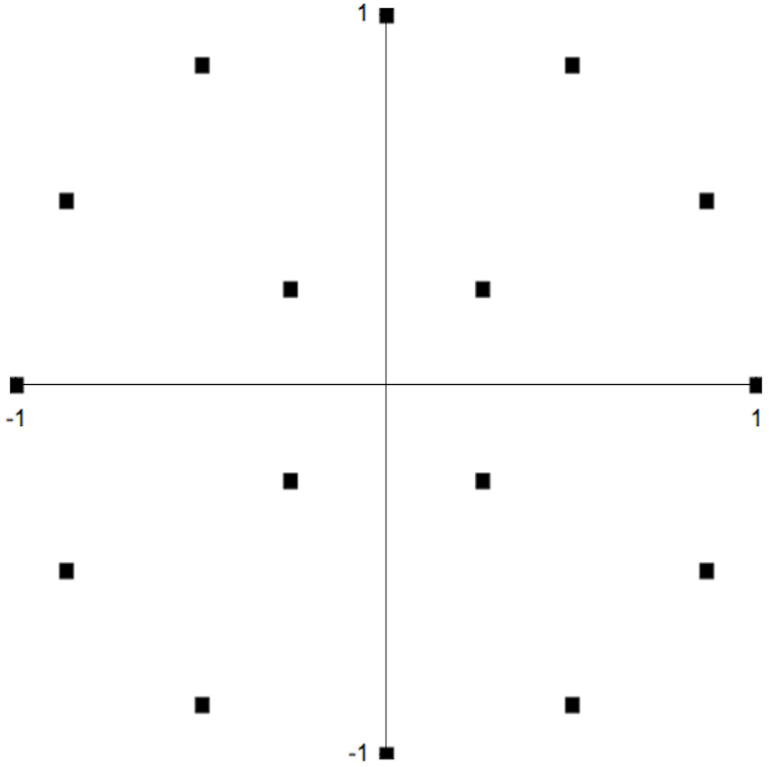
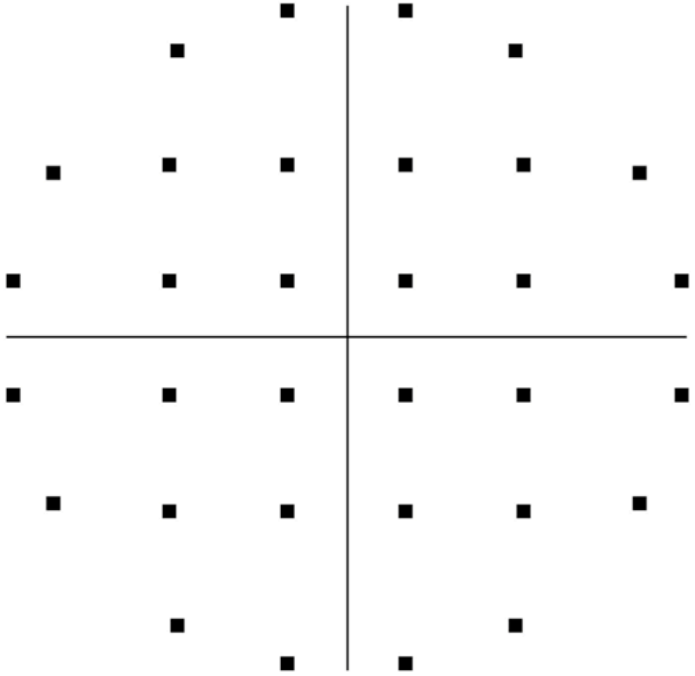
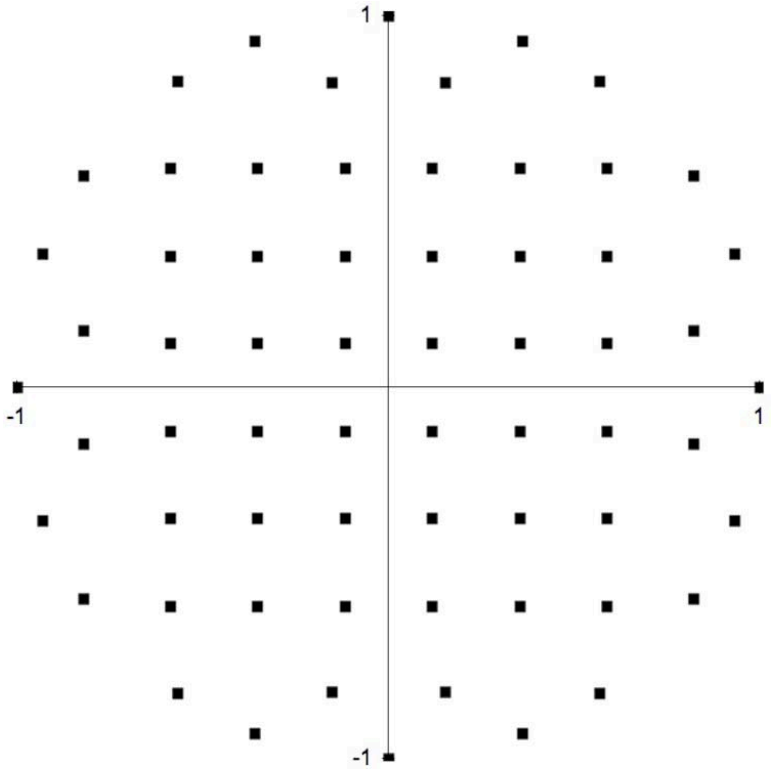
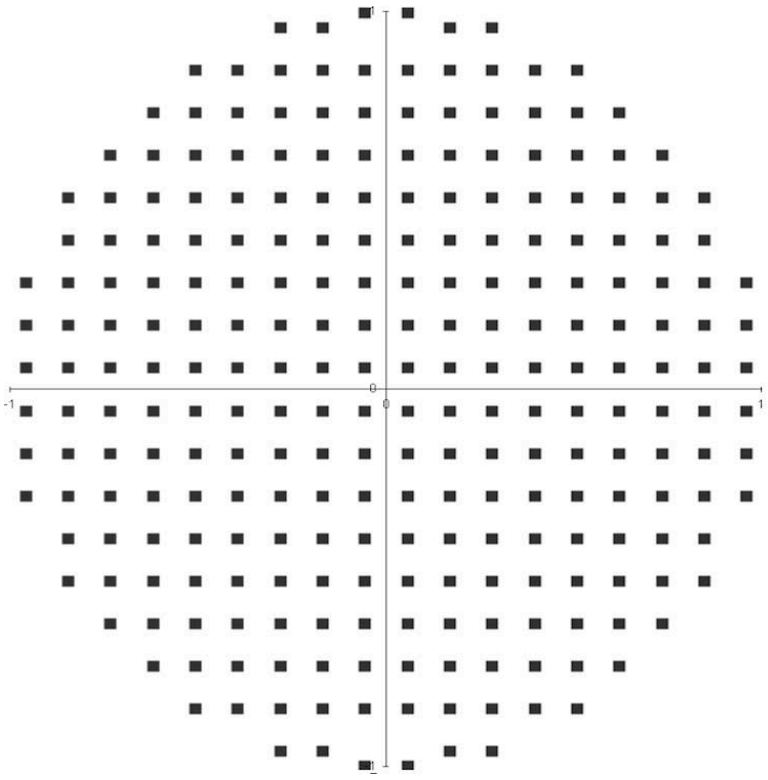
QAM Constellations



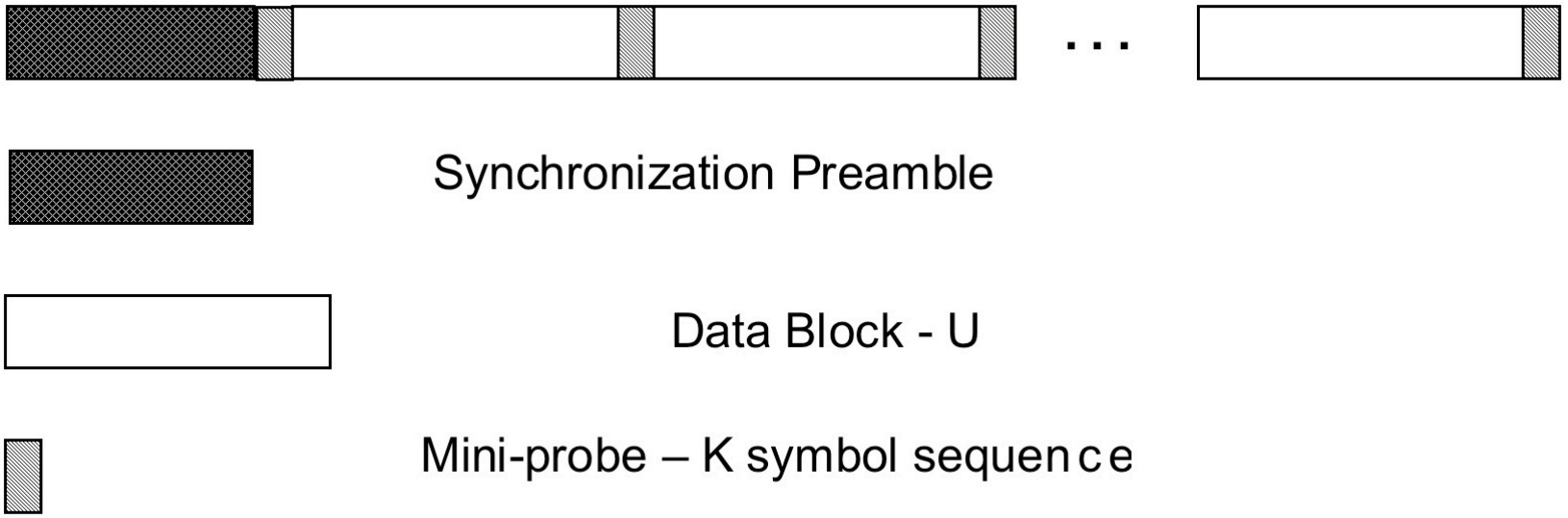


QAM Constellations



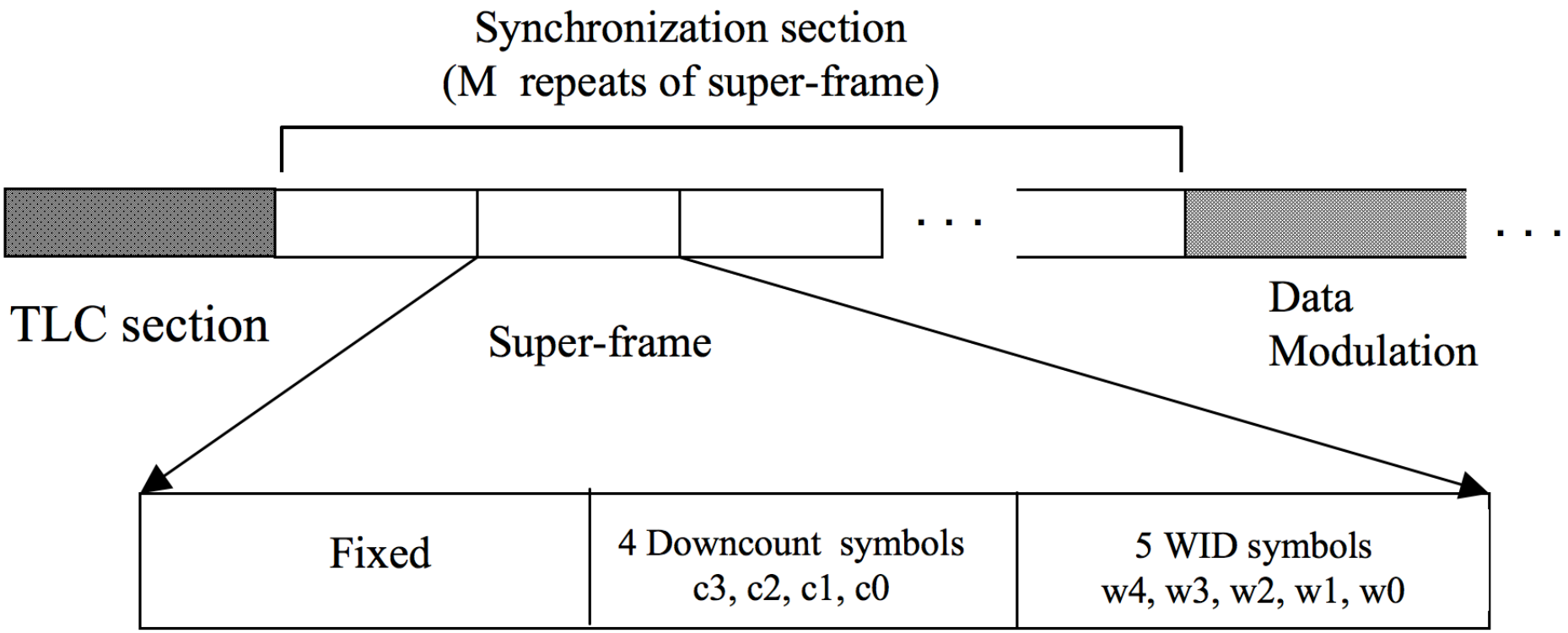


WBHF Frame Structure



- No reinserted preambles

WBHF Sync Preamble



* Downcount: 5 count bits plus 3 for parity

Waveform ID Symbols

- w4, w3 identify the waveform
- w2 specifies interleaver
  - Ultrashort, short, medium, long
- w1 (msb) identifies constraint length (7 or 9)
- w1 (lsb) & w0: 3 parity check bits

WBHF Mini-Probes

- Inserted following preamble and each data block in non-Walsh waveforms
- 14 different mini-probe sequences
- Cyclically-rotated version sent after penultimate block of long interleaver frame (independent of interleaver in use)

WBHF Interleavers

Interleaver	Depth
Ultra-short	0.16 s
Short	0 6.4 s
Medium	2.56 s
Long	10.24 s

WBHF Coding

Waveform Number	Modulation	Data Rate 12 kHz	Code Rate	Probes	SNR (dB) for BER ≤ 1.0E-5 AWGN	Poor
0	Walsh	300	1/2		-6	-1
1	BPSK	600	1/8	1/2	-3	3
2	BPSK	1,200	1/4	1/2	0	5
3	BPSK	2,400	1/3	1/4	3	7
4	BPSK	4,800	2/3	1/4	5	10
5	BPSK	6,400	3/4	1/9	6	11
6	QPSK	12,800	3/4	1/9	9	14
7	8PSK	19,200	3/4	1/9	13	19
8	16QAM	25,600	3/4	1/9	16	23
9	32QAM	32,000	3/4	1/9	19	27
10	64QAM	38,400	3/4	1/9	21	31
11	64QAM	48,000	8/9	1/16	24	-
12	256QAM	64,000	8/9	1/16	30	-

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3 kHz WBHF *vs* 110B

3 kHz Data Rate	WBHF Waveform					110B Waveform				
				SNR (dB) for BER≤1E-5					SNR (dB) for BER≤1E-5	
	Modulation	Code Rate	Probes	AWGN	Poor	Modulation	Code Rate	Probes	AWGN	Poor
75	Walsh	1/2	-	-6	-1	Walsh	1/2	-		2*
150	BPSK	1/8	1/2	-3	3	BPSK	1/8	1/2		5*
300	BPSK	1/4	1/2	0	5	BPSK	1/4	1/2		7*
600	BPSK	1/3	1/4	3	7	BPSK	1/2	1/2		7
1,200	BPSK	2/3	1/4	5	10	QPSK	1/2	1/2		11
1,600	BPSK	3/4	1/9	6	11					
2,400	QPSK	9/16	1/9	6	11	8PSK	1/2	1/3	10	18
3,200	QPSK	3/4	1/9	9	14	QPSK	3/4	1/9	9	14
4,800	8PSK	3/4	1/9	13	19	8PSK	3/4	1/9	13	19
6,400	16QAM	3/4	1/9	16	23	16QAM	3/4	1/9	16	23
8,000	32QAM	3/4	1/9	19	27	32QAM	3/4	1/9	19	27
9,600	64QAM	3/4	1/9	21	31	64QAM	3/4	1/9	21	31
12,000	64QAM	8/9	1/16	24	-					
16,000	256QAM	8/9	1/16	30	-					

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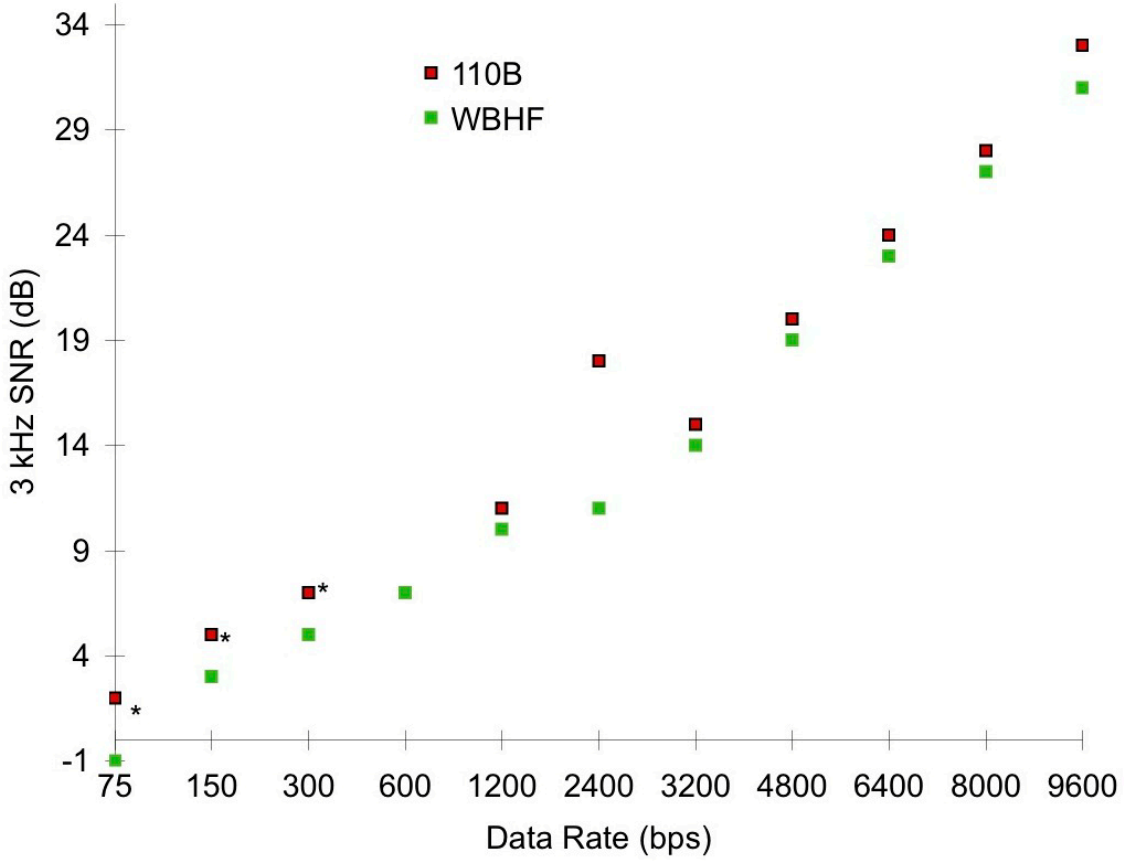
3 kHz WBHF *vs* 110B



Questions?