Revision of US Military HF Radio Standards

26 January 2012

Eric E. Johnson

New Mexico State University (USA)
Klipsch School of Electrical and Computer Engineering
and Physical Science Laboratory

eejohnson @ ieee.org

MIL-STD-188-141C

- Published 25 July 2011
- Distribution Statement A: Approved for public release; distribution unlimited.
- Website: https://assist.daps.dla.mil/quicksearch/
- Editorial touch-up (CN1) now in coordination

MIL-STD-188-110C

- Published 23 September 2011
- Distribution Statement A: Approved for public release; distribution unlimited.
- Website: https://assist.daps.dla.mil/quicksearch/
- Editorial touch-up (CN1) now in coordination

MIL-STD-188-110C

- Structure
  - Appendix A: LAN interface — New
  - Appendix B: 39-tone — (obsolete)
  - Appendix C: MDR waveforms
  - Appendix D: WBHF waveforms — New
  - Appendix E: Channel simulator specs — New
  - Appendix F: ISB

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 110 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				

WBHF Interleavers

Interleaver	Depth
Ultrashort	0.11 – 0.16 s
Short	0.45 – 0.64 s
Medium	1.81 – 2.56 s
Long	7.25 – 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	-

NM STATE UNIVERSITY

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	-					

NM STATE UNIVERSITY

WBHF Capabilities

- WBHF Block 1
  3 kHz channel only
  all waveforms
  constraint length 7 only
- WBHF Block 2
  3, 6, 9, and 12 kHz
  all waveforms
  constraint length 7 only
- WBHF Block 3
  All bandwidths up to 24 kHz
  all waveforms
  constraint length 7 and 9

Future Work

- Next revision of MIL-STD-188-141: Wideband ALE (WBALE? Wide BALE?)
  - Manage spectrum use for wideband channels
  - Link setup
  - Link maintenance
  - Cognitive radio techniques?
- New TAC project

Questions?