Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Preamble sequence for supporting scalable FFT**
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Re:	
Abstract	Preamble sequences for FFT size other than 2048-FFT
Purpose	Adopting of proposed method into P802.16e
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Preamble sequence for supporting scalable FFT

Problem Definition and Proposed Solutions

In IEEE 802.16e/D3, section 8.4.6.1.1 describes the preamble for scalable FFT as "For FFT size other than 2048-FFT, only the first k elements of table 307 shall used to modulate the DL preamble subcarriers, where k is the number of carriers." However, the truncated preamble sequence from that of 2048-FFT may result in high PAPR (peak to average power ratio). We propose new preamble sequences for 128-FFT, 512-FFT, and 1024-FFT in this contribution, which have low PAPRs.

Suggested change to the standard

In '8.4.6.1.1 Preamble'

[*CHANGE the sentence*]
"For FFT size other than 2048-FFT, ~~only the first k elements of table 307 shall be used to modulate the DL preamble sub-carriers, where k is the number of carriers~~ use the following preamble sequences corresponding to the FFT size"

[*ADD the following text*]
For the FFT size of 128-FFT, the preamble sequences can generated using the shift register structure in figure aaa where the initial state value are defined in table xxx. The first k elements of output sequence are used for a preamble, where k is the number of carriers.

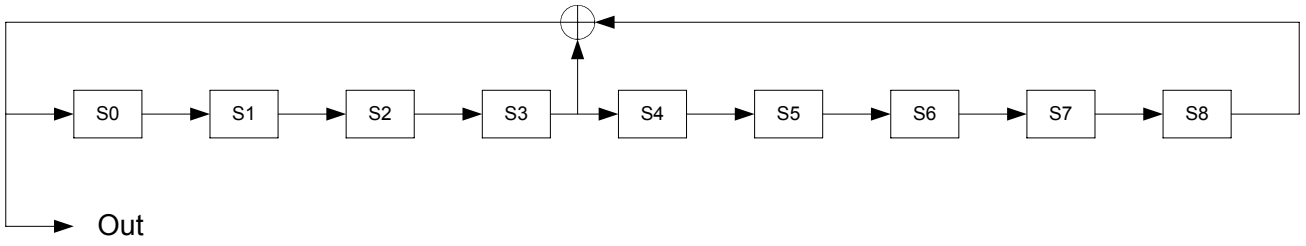

Figure aaa – Preamble sequence generator for 128-FFT

Table xxx – Initial values of preamble sequence generator for 128-FFT

Index	S0 S1 S2 S3 S4 S5 S6 S7 S8	Index	S0 S1 S2 S3 S4 S5 S6 S7 S8	Index	S0 S1 S2 S3 S4 S5 S6 S7 S8
0	1 1 1 0 1 1 0 1 0	38	1 1 0 1 0 1 0 1 1	76	1 1 0 0 0 1 1 0 1
1	0 1 1 0 0 1 0 1 1	39	1 0 1 0 1 1 0 0 1	77	1 0 1 1 1 0 1 0 1
2	1 1 0 0 1 1 0 1 1	40	1 0 1 0 0 0 0 1 1	78	1 0 1 0 0 1 0 0 1
3	0 1 0 1 1 0 0 1 0	41	1 1 0 1 0 1 1 1 1	79	0 0 0 1 1 0 0 1 1
4	0 0 0 1 0 0 1 0 0	42	1 1 1 1 1 0 1 1 0	80	0 1 0 0 0 0 1 0 1
5	1 0 0 1 1 1 0 1 0	43	0 1 1 0 1 0 1 1 1	81	0 0 1 1 0 0 1 1 1
6	1 0 1 1 0 1 0 0 0	44	0 1 1 0 1 1 0 0 1	82	1 1 0 0 0 1 0 0 0
7	0 1 1 1 0 1 1 0 1	45	0 0 1 1 0 1 1 0 0	83	1 1 1 0 0 1 0 0 0
8	0 1 0 0 1 0 1 1 0	46	1 0 1 0 0 1 1 1 0	84	0 0 1 0 1 1 0 1 1
9	1 0 0 1 1 0 1 0 0	47	0 1 1 1 0 1 0 0 1	85	0 1 1 1 1 1 1 0 0
10	0 1 0 0 0 0 0 0 1	48	1 1 1 0 0 0 0 0 1	86	0 1 0 1 0 0 1 1 1

11	1 0 1 1 0 0 0 0 0	49	1 1 1 0 1 0 1 1 1	87	1 0 1 0 1 1 0 1 0
12	0 0 0 0 1 1 1 0 1	50	0 1 0 1 0 1 1 1 0	88	1 0 1 0 1 0 0 0 1
13	1 1 0 1 1 0 1 0 0	51	0 1 1 0 1 0 0 0 1	89	0 1 1 1 0 1 1 1 1
14	1 0 0 0 0 1 1 1 1	52	0 1 0 0 1 0 0 1 0	90	1 1 0 1 0 1 1 0 0
15	0 1 0 0 1 1 1 0 1	53	1 0 0 0 0 0 1 0 1	91	1 1 0 1 0 1 0 0 0
16	0 0 1 1 1 0 1 1 0	54	1 0 1 0 0 0 0 1 0	92	0 0 1 0 0 1 0 1 1
17	1 1 0 0 0 0 0 1 0	55	1 1 0 1 1 0 0 1 1	93	0 0 0 0 1 1 0 0 1
18	1 1 0 0 1 1 1 0 1	56	0 1 1 0 1 1 0 0 0	94	0 0 1 0 1 1 0 0 0
19	0 1 0 0 1 0 0 1 1	57	1 1 0 1 1 0 0 0 0	95	0 0 0 1 0 0 0 1 0
20	0 1 1 0 0 0 0 0 1	58	1 0 1 1 1 0 0 1 0	96	0 0 1 1 1 0 0 1 1
21	1 1 1 1 0 1 0 1 1	59	1 0 1 1 0 0 0 1 1	97	1 0 0 0 0 1 0 1 0
22	0 0 0 0 1 1 0 0 0	60	1 0 0 0 1 0 1 1 0	98	0 0 0 1 1 0 1 1 0
23	0 0 0 0 0 1 0 1 1	61	0 1 0 1 1 1 0 0 0	99	0 0 1 1 0 1 0 0 0
24	0 0 1 0 0 1 0 0 0	62	1 0 1 1 0 0 1 0 1	100	1 0 0 1 1 1 1 1 0
25	1 1 0 1 0 0 0 0 1	63	1 1 0 1 1 0 0 1 0	101	1 1 0 0 1 1 1 1 1
26	0 0 1 1 1 1 1 1 1	64	1 1 1 1 1 1 0 1 1	102	0 1 1 1 1 1 1 0 1
27	0 0 1 1 1 0 1 0 0	65	0 0 1 0 0 1 0 0 1	103	0 0 1 1 1 1 1 0 0
28	1 0 0 1 0 0 1 0 0	66	0 1 0 1 0 1 1 0 1	104	1 1 0 0 1 0 0 1 0
29	1 0 0 0 0 0 0 1 0	67	1 1 1 0 0 0 0 1 1	105	1 0 1 0 1 1 1 1 1
30	0 1 0 1 0 0 0 0 1	68	1 1 1 0 0 1 1 0 1	106	1 1 0 1 0 0 0 1 0
31	0 1 1 1 0 0 1 0 0	69	0 0 0 1 1 1 1 0 0	107	1 0 1 1 0 0 1 1 1
32	1 0 1 1 1 0 0 0 1	70	0 0 0 1 1 1 0 0 1	108	0 0 1 1 1 0 1 1 1
33	1 0 0 1 0 1 1 0 1	71	1 0 0 1 0 0 1 0 1	109	1 0 1 0 1 0 1 1 1
34	1 1 0 1 0 0 1 0 0	72	0 1 1 1 1 1 1 1 1	110	1 1 0 0 1 0 1 1 0
35	1 0 0 1 1 0 1 1 0	73	1 1 0 1 0 1 1 1 0	111	1 1 1 0 1 1 1 1 0
36	1 0 0 0 0 1 1 0 0	74	1 1 0 0 1 0 0 0 1	112	1 0 1 0 0 0 0 0 0
37	1 1 1 0 1 0 1 1 0	75	1 1 0 0 1 1 0 1 0	113	0 1 0 0 0 1 0 1 0

For the FFT size of 512-FFT, the preamble sequences are generated using the shift register structure in figure bbb where the initial state value are defined in table yyy. The first k elements of output sequence are used for a preamble, where k is the number of carriers.

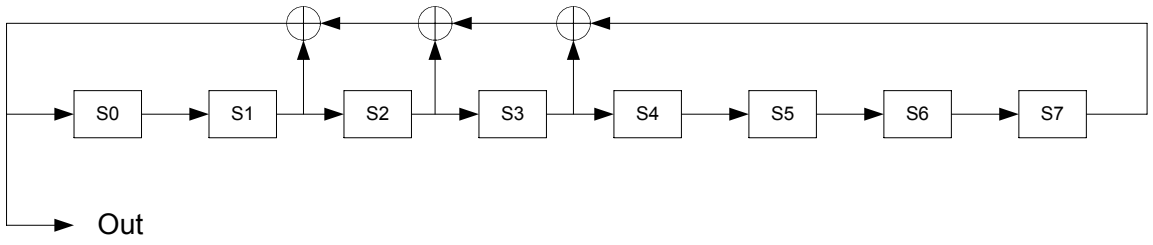

Figure bbb – Preamble sequence generator for 512-FFT

Table yyy – Initial values of preamble sequence generator for 512-FFT

Index	S0 S1 S2 S3 S4 S5 S6 S7	Index	S0 S1 S2 S3 S4 S5 S6 S7	Index	S0 S1 S2 S3 S4 S5 S6 S7
0	0 0 1 0 0 0 0 0	38	0 0 0 0 1 0 1 1	76	0 1 1 1 1 0 1 1
1	1 0 1 0 1 1 0 1	39	1 1 1 1 1 0 1 1	77	0 0 1 0 1 0 0 1
2	0 1 0 0 0 0 0 1	40	0 0 0 1 0 1 1 1	78	1 1 0 0 0 0 1 0
3	0 0 1 1 1 1 0 1	41	1 1 1 0 1 1 0 0	79	0 1 0 0 0 1 0 1
4	1 1 1 0 1 1 1 1	42	1 1 1 0 0 0 1 1	80	0 1 1 1 0 1 0 1
5	0 1 0 1 1 0 1 1	43	1 1 0 0 0 1 1 1	81	0 0 0 0 1 0 1 0

6	0 1 1 0 1 1 0 1	44	1 1 1 0 0 1 1 1	82	1 1 0 0 0 0 1 1
7	1 0 0 1 0 0 0 0	45	1 0 0 1 1 1 0 0	83	1 1 1 0 1 0 1 1
8	1 0 0 0 0 1 0 1	46	1 1 0 0 1 1 1 0	84	1 1 1 1 0 1 1 1
9	1 0 0 0 1 1 0 1	47	1 1 0 0 0 1 1 0	85	1 1 1 0 1 0 0 0
10	1 0 1 1 0 1 1 0	48	0 0 0 1 1 0 1 0	86	0 1 0 0 0 0 0 0
11	0 1 1 1 1 1 1 0	49	1 0 1 1 0 0 1 0	87	0 0 1 1 0 1 0 0
12	0 0 0 0 0 1 0 1	50	0 0 0 1 1 1 0 1	88	0 0 0 0 0 1 0 0
13	1 0 0 0 0 0 1 0	51	0 0 1 1 1 1 1 0	89	1 1 1 1 0 1 0 1
14	1 1 1 1 0 0 0 1	52	1 1 0 1 0 0 0 1	90	0 1 0 0 0 0 1 1
15	1 1 0 1 1 0 1 0	53	0 1 0 1 0 1 1 0	91	1 0 1 1 1 0 1 0
16	0 1 0 1 1 1 0 1	54	0 0 0 1 1 0 0 1	92	0 0 1 0 1 1 1 1
17	1 0 0 1 1 1 1 0	55	1 1 1 1 0 0 0 0	93	1 0 0 1 1 0 0 0
18	1 0 1 0 0 1 0 0	56	0 0 1 1 1 0 1 0	94	0 0 1 0 1 1 1 0
19	0 0 0 1 1 1 1 1	57	0 1 0 1 0 1 0 0	95	1 0 1 0 1 0 1 0
20	1 1 0 1 1 1 1 1	58	1 1 0 1 1 0 1 1	96	0 0 1 1 0 1 0 1
21	0 1 0 0 1 0 0 0	59	1 0 0 0 1 0 0 0	97	1 1 1 0 0 1 0 1
22	1 0 1 0 0 1 1 1	60	1 0 1 0 0 0 0 0	98	0 0 1 1 1 0 1 1
23	1 0 0 1 0 0 0 1	61	1 1 0 0 1 1 0 0	99	0 1 1 1 0 1 1 0
24	1 1 0 0 1 0 0 0	62	0 0 0 1 0 1 1 0	100	1 0 0 0 0 0 0 0
25	0 1 1 0 0 1 1 1	63	1 1 1 0 0 1 1 0	101	0 0 1 1 1 0 0 0
26	1 0 1 0 1 1 1 0	64	0 1 0 1 0 0 1 1	102	0 0 0 0 1 0 0 0
27	1 0 1 1 1 1 1 1	65	1 0 0 1 1 1 0 1	103	0 0 0 0 1 1 0 0
28	0 1 1 1 1 1 0 1	66	1 0 0 0 0 1 1 1	104	0 0 1 1 0 0 0 1
29	1 1 1 1 0 1 1 0	67	0 1 1 0 1 0 1 0	105	1 0 0 0 1 1 1 0
30	0 1 1 1 0 1 0 0	68	1 1 1 1 0 0 1 0	106	1 1 0 0 1 1 0 1
31	0 0 0 0 0 1 1 1	69	1 0 1 1 0 0 1 1	107	1 1 1 0 1 1 0 1
32	0 1 0 1 1 1 0 0	70	0 0 1 0 1 1 0 1	108	1 1 0 0 1 1 1 1
33	0 1 1 1 0 0 0 0	71	1 1 1 0 0 0 0 1	109	0 0 0 0 0 0 0 1
34	0 0 1 0 1 0 1 1	72	1 0 1 1 0 0 0 1	110	1 1 1 0 1 1 1 0
35	0 0 0 0 1 1 1 1	73	1 1 0 1 0 1 0 0	111	1 0 1 1 0 1 0 1
36	0 0 0 0 1 1 1 0	74	1 1 1 0 0 1 0 0	112	1 0 1 0 0 0 1 0
37	1 1 0 1 0 1 1 1	75	0 0 1 1 1 0 0 1	113	1 1 1 1 1 1 0 1

For the FFT size of 1024-FFT, the preamble sequences are generated using the shift register structure in figure ccc where the initial state value are defined in table zzz. The first k elements of output sequence are used for a preamble, where k is the number of carriers.

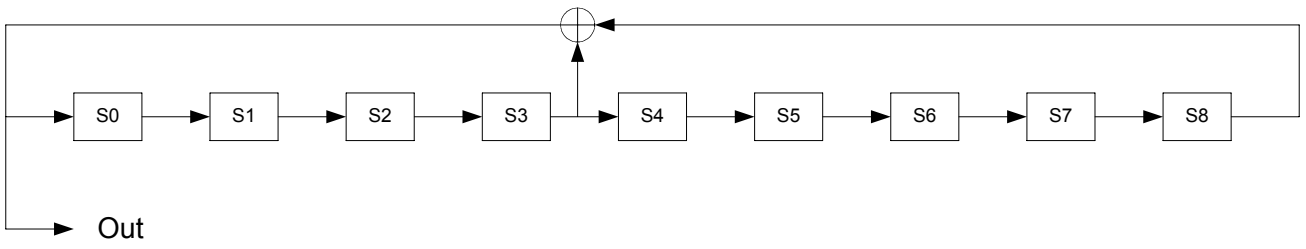

Figure ccc – Preamble sequence generator for 1024-FFT

Table zzz – Initial values of preamble sequence generator for 1024-FFT

Index	S0 S1 S2 S3 S4 S5 S6 S7 S8	Index	S0 S1 S2 S3 S4 S5 S6 S7 S8	Index	S0 S1 S2 S3 S4 S5 S6 S7 S8
0	0 1 0 1 1 1 1 1 0	38	0 1 1 1 1 0 1 1 0	76	1 0 0 1 1 1 0 1 1

1	1 1 1 0 1 0 1 0 1	39	1 1 0 1 0 1 1 1 0	77	1 1 0 1 1 0 1 1 0
2	1 0 1 1 0 1 0 1 1	40	0 1 0 1 1 0 0 0 1	78	1 0 0 1 0 0 1 0 1
3	1 1 1 1 0 1 0 1 0	41	0 1 1 1 0 1 0 1 0	79	0 1 0 0 0 1 0 1 1
4	0 1 1 0 1 0 1 1 1	42	0 1 0 0 1 0 1 1 1	80	1 1 1 1 0 1 0 0 1
5	1 1 1 1 1 0 1 0 1	43	1 1 1 0 0 1 0 0 0	81	0 1 0 0 0 0 1 1 0
6	0 0 0 0 1 0 1 1 0	44	0 1 0 1 1 1 0 1 0	82	0 1 0 1 1 1 1 0 0
7	0 0 0 1 0 1 1 0 1	45	0 0 1 1 1 1 1 1 0	83	0 0 0 0 0 0 1 1 1
8	1 0 1 0 1 0 1 0 1	46	1 1 0 1 0 0 1 1 0	84	1 1 1 1 0 1 0 1 1
9	1 1 0 1 0 1 0 1 0	47	0 0 0 0 0 0 1 1 0	85	0 0 1 0 0 1 1 0 1
10	1 0 1 0 1 1 1 1 1	48	1 0 0 1 1 0 0 0 0	86	1 0 0 0 0 1 0 0 0
11	0 1 1 1 1 1 0 1 0	49	0 1 0 1 1 1 0 1 1	87	1 1 0 0 0 1 0 0 0
12	0 1 1 0 1 0 0 1 1	50	1 1 1 1 1 1 0 1 0	88	0 1 1 0 1 1 0 1 1
13	0 0 1 0 1 1 0 1 0	51	0 0 1 1 0 0 0 0 0	89	0 1 1 1 0 1 1 0 1
14	1 0 1 1 1 0 1 1 1	52	0 0 1 1 1 0 1 1 0	90	1 1 1 0 0 0 0 0 0
15	1 1 0 0 0 0 0 0 0	53	0 1 1 1 1 1 1 0 0	91	1 0 0 1 1 1 1 0 1
16	1 0 0 0 0 0 0 0 1	54	1 1 0 1 1 0 0 0 0	92	1 0 1 0 0 0 1 0 1
17	0 1 0 0 1 1 0 1 1	55	0 1 1 1 0 1 1 0 0	93	0 0 0 0 0 1 0 0 1
18	1 1 1 0 1 1 0 0 0	56	0 1 1 1 0 0 1 0 0	94	0 0 1 0 1 0 0 0 0
19	1 1 1 0 1 1 1 0 0	57	0 0 0 0 0 1 1 1 0	95	1 0 1 0 0 1 0 1 1
20	1 1 1 1 1 1 1 0 1	58	0 0 1 1 0 0 0 1 0	96	0 0 0 0 1 1 1 0 1
21	1 0 1 1 1 1 1 0 1	59	1 0 0 0 0 1 1 0 0	97	0 1 0 0 1 1 1 0 1
22	1 1 0 1 0 1 1 1 1	60	0 0 1 0 0 1 0 0 0	98	0 1 1 1 1 0 1 0 0
23	1 1 1 1 1 0 1 0 0	61	0 1 1 0 1 1 1 1 1	99	0 1 0 0 1 1 1 1 0
24	1 1 1 0 1 1 0 1 1	62	1 0 1 1 1 1 1 1 1	100	1 0 1 0 1 0 1 1 0
25	1 1 0 1 1 1 1 1 1	63	0 1 0 1 0 1 0 1 0	101	1 1 1 1 1 0 1 1 1
26	0 0 0 0 0 0 0 1 1	64	1 0 0 1 0 1 1 0 0	102	1 1 0 1 0 0 0 0 0
27	0 1 0 1 1 0 1 0 1	65	0 1 1 0 0 0 0 0 1	103	1 0 1 1 0 0 0 1 1
28	1 0 1 0 1 0 1 0 0	66	0 0 0 0 0 1 0 1 1	104	0 1 1 0 0 0 0 0 0
29	1 0 1 1 1 0 1 0 1	67	1 0 1 1 0 1 1 0 0	105	0 1 0 1 0 1 0 0 0
30	1 1 0 1 0 0 0 1 0	68	0 1 0 1 0 1 1 1 1	106	1 1 0 0 1 1 0 0 0
31	1 0 1 1 0 1 1 1 0	69	0 1 0 1 0 0 0 0 0	107	1 0 0 0 0 0 1 0 1
32	1 0 1 1 0 1 0 0 1	70	0 1 0 0 1 0 1 1 0	108	1 1 1 1 1 1 0 0 1
33	0 1 0 1 0 0 0 1 0	71	1 1 0 0 0 0 0 1 0	109	0 1 1 0 1 1 0 1 0
34	1 0 1 0 0 1 1 0 1	72	0 0 1 1 1 0 1 1 1	110	0 1 0 0 1 1 0 1 0
35	0 1 1 1 0 1 1 1 0	73	1 0 0 1 0 1 1 0 1	111	0 0 1 1 0 1 1 0 1
36	1 1 0 1 0 0 1 1 1	74	0 0 0 1 1 1 0 1 1	112	1 0 1 0 0 1 1 1 0
37	1 1 1 1 0 1 0 0 0	75	1 1 1 0 0 0 1 0 1	113	1 0 1 0 1 1 1 1 0

References

[1] IEEE P802.16-REVd/D5-2004 Draft IEEE Standards for local and metropolitan area networks part 16: Air interface for fixed broadband wireless access systems.

[2] IEEE P802.16-REVe/D3-2004 Amendment for Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Band.