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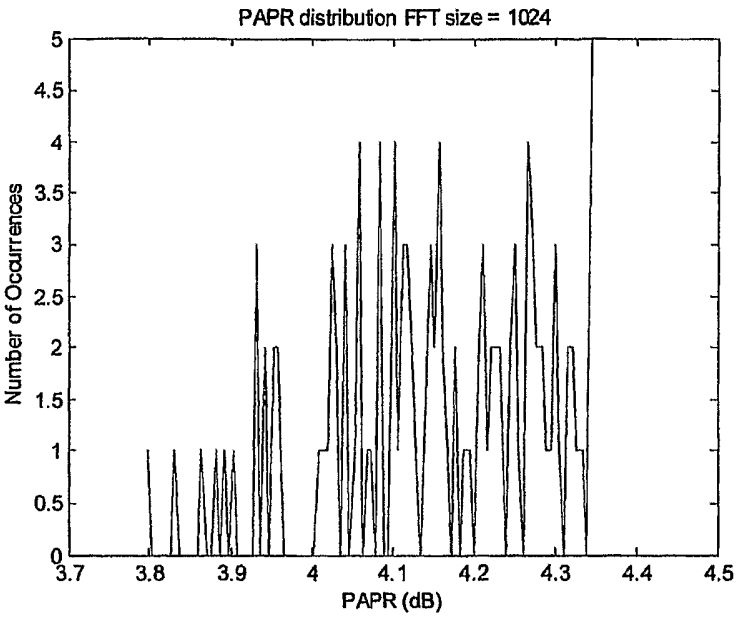
(54) Title: OFMDA PREAMBLES SYSTEM AND METHOD



(57) Abstract: A preamble code usable in Orthogonal Frequency Division Multiple Access (OFDMA) for the physical layer (PHY), selected for improved PAPR in a 1024, 512 or 128 FFT OFDMA mode. Tables 2 to 7 detail code sequences having improved PAPR performance. The disclosed codes may be used in cellular wireless.

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OFMDA Preambles system and method

The present application is related to, and claims priority from, the U.S. provisional application No. 60/582,820 filed on 28 June 2004 and entitled "Preambles design for OFDMA PHY layer, FFT sizes of 1024, 512, and 128" and from U.S. provisional application No. 60/605,497 filed on 31 August 2004 and entitled "Preambles design for OFDMA PHY layer, FFT sizes of 1024, 512, and 128" , both filed by the present applicant and inventor.

Technical Field

This invention relates to improvements in codes used in wireless communications, and more specifically to preamble codes.

Background Art

The invention relates to improvements in preamble codes used in Orthogonal Frequency Division Multiple Access (OFDMA) for the physical layer (PHY).

The invention may be used, for example, to improve the communication performance in systems within the IEEE 802.16 Standard for Broadband Wireless Access. Such improvements may better adapt the OFDMA to a mobile environment.
The improvements may be used in the OFDMA PHY/MAC layers.

An important parameter in such communications is the Peak to Average Power Ratio (PAPR). Wideband signals may exhibit high values of PAPR, which pose high demands on the linearity performance of the system. That is, a large dynamic range is required to convey the high amplitude peaks associated with such signals.

It may be highly desirable to reduce the PAPR, to allow improved performance while concurrently reducing the costs of communication systems.

It is important to achieve improved performance in short codes, of length 128, 512 and 1K, in the preamble.

The communications may use various Fast Fourier Transform (FFT) values, thus improvements preferably should be capable at operating at these values.

Disclosure of Invention

This invention describes improved preamble codes having a lower PAPR value. For example, the preambles used in the 2K OFDMA mode were devised so as to have a lower PAPR, this having many advantages. For example, a lower PAPR allows to boost the preamble to get better performance in the estimation/acquisition/cell monitoring, etc.

The present disclosure includes improvements in the 1024, 512 and 128 FFT OFDMA modes.

Tables with series to modulate, for different FFT sizes, are disclosed in the present application.

Brief Description of Drawings

Fig. 1 illustrates the PAPR distribution for FFT size 1024

Fig. 2 illustrates the Cross-correlation for FFT size 1024

Fig. 3 illustrates the PAPR distribution for FFT size 512

Fig. 4 illustrates the Cross-correlation for FFT size 512

Fig. 5 illustrates the PAPR distribution for FFT size 128

Fig. 6 illustrates the Cross-correlation for FFT size 128

Fig. 7 details a first wireless cell surrounded by a first tier and a second tier of cells.

Fig. 8 details a method for computing improved performance preamble codes.

Modes for Carrying Out the Invention

The present disclosure includes, by way of example, improvements in the 1024, 512 and 128 FFT OFDMA modes.

Tables with series to modulate, for different FFT sizes, are disclosed in the present application.
The following tables detail Pseudo Noise (PN) sequences that may be used to modulate the pilot carriers in the preamble signal. Pilot carriers are modulated every third carrier.

Table 1 describes the parameters used for each FFT size.
The series length is determined by mapping the carriers up to the last allowed carrier, then truncated if the series is too long.

The following tables illustrate series required for different FFT sizes.
The PN series are shown in hexadecimal format, wherein each digit represents values from 0 to 15 decimal (0,1,2,3...9,A,B,C,D,E,F), thus each digit may represent four bits of code.

Where required, the binary series may be lengthened by padding with zeros at the end of a sequence so the number of bits is a multiple of 4 (each hexa digit represents 4 bits) or a multiple of 8 (each byte represents 8 bits). The series may be then converted to hexa from the MSB to LSB.

Table 2 illustrates a preambles modulation series per segment and Cellid, for the 1K FFT mode.
Suggested title: Table 307b, if included in the IEEE Standard.

Table 3 illustrates a preambles modulation series per segment and Cellid, for the 512 FFT mode.
Suggested title: Table 307c, if included in the IEEE Standard.

Table 4 illustrates a preambles modulation series per segment and Cellid, for the 128 FFT mode.
Suggested title: Table 307d, if included in the IEEE Standard.

As disclosed in the U.S. provisional application No. 60/605,497 filed on 31 August 2004 by the present applicant, the present invention may also be included as an improvement in the IEEE Standard P802.18e/D3 change, by adding on page 79 the paragraph in page 556 IEEE802.16d-2004 to read:

> The PN series modulating the pilots are defined in Tables 307a-307d. The series modulated depends on the segment used and IDcell parameter. The defined series shall be mapped onto the preamble subcarriers in ascending order. Tables 307a-307d include the PN sequence in Hexadecimal format. The value of the PN may be obtained by converting the series to a binary series (Wk) and starting mapping the PN from the MSB of each symbol to the LSB. Thus, for example, 0 may be mapped to +1 and 1 to -1.
> For example, in Table 307a for the 2K mode Index= 0, segment= 0,
> Wk= 110000010010... and the mapping may be:
> -1,-1,+1,+1,+1,+1,+1,-1,+1,+1,-1,+1...

Table 5 illustrates another embodiment of a preambles modulation series per segment and Cellid, for the 1K FFT mode.
Suggested title: Table 307b, if included in the IEEE Standard.

Table 1. The parameters used for each FFT size

Parameter	1024 FFT	512 FFT	128 FFT
Starting pilot carrier	87+Segment	44+Segment	87+Segment
Carrier increment for next pilot	3	3	3
Number of carriers used for the preamble *	284/283	142	36/35
Last carrier allowed to be modulated	850	425	105

Table 2. Preambles modulation series for the 1K FFT mode

Number	CellId	Segment	Series to modulate (in Hexadecimal format)
0	0	0	A6F294537B285E1844677D133E4D53CCB1F182DE00489E 53E6B6E77065C7EE7D0ADBEAF
1	1	0	668321CBBE7F462E6C2A07E8BBDA2C7F7946D5F69E35A C8ACF7D64AB4A33C467001F3B2

2	2	0	1C75D30B2DF72CEC9117A0BD8EAF8E0502461FC07456A C906ADE03E9B5AB5E1D3F98C6E
3	3	0	5F9A2E5CA7CC69A5227104FB1CC2262809F3B10D0542B 9BDFDA4A73A7046096DF0E8D3D
4	4	0	82F8A0AB918138D84BB86224F6C342D81BC8BFE791CA9 EB54096159D672E91C6E13032F
5	5	0	EE27E59B84CCF15BB1565EF90D478CD2C49EE8A70DE3 68EED7C9420B0C6FFAF9AF035FC
6	6	0	C1DF5AE28D1CA6A8917BCDAF4E73BD93F931C44F93C3 F12F0132FB643EFD5885C8B2BCB
7	7	0	FCA36CCCF7F3E0602696DF745A68DB948C57DFA9575B EA1F05725C42155898F0A63A248
8	8	0	024B0718DE6474473A08C8B151AED124798F15D1FFCCD 0DE574C5D2C52A42EEF858DBA5
9	9	0	D4EBFCC3F5A0332BEA5B309ACB04685B8D1BB4CB49F 9251461B4ABA255897148F0FF238
10	10	0	EEA213F429EB926D1BDEC03ABB67D1DE47B4738F3E92 9854F83D18B216095E6F546DADE
11	11	0	C03036FA9F253045DF6C0889A8B83BAEFCF90EB993C2D 79BD911CA84075061AA43DA471
12	12	0	1E68EC22E5E2947FB0A29E4CC70597254B36C60331EAC F779FE752D3F55DC41ABFC7DC9
13	13	0	63A57E75A0434F035AAC4504B265081D497F10C77928B7 1797C5D6C6824DC0F23BE34EE
14	14	0	C57C4612816DE981C58FD6F8DE9DD41F2422ADBC522B 0CE31F9A6D5F2A126DC08F69FB1
15	15	0	978256AF184E7ED17789B33D324C711B36BFBCCE5446E B03687E9A0A839C7CE156104D2
16	16	0	011EC823157DD73150640CEB7DDB0A1F8F91E09599A85 1D5C7CAF687CFB752D297D82FC
17	17	0	C6DE82BEB7F57B9120E8A376D85C8F70FDC65BC660402 DAC4AE6002EA2740C4F9E5973C
18	18	0	4C74929D6F9FAB9E5BB761026038E076F6824295E0AF397 806ECEBC6DC713F03ACDC27C
19	19	0	596F18F3D454D581BBC0A414F43B595E270AD5E5AA3D4 CE6BF4860093EA13B271934344
20	20	0	13E1E85C2234D0F3418001A35F135E10C6C918C36BC659 FDA9D655D288A0BDAA8BF489D
21	21	0	FD4AF2D8F4F08F1A7DF59291C9AEE788F641B8231CFB8 13376E0BEB68DFCFCBBE552445
22	22	0	315E59049D478B0ADB32740B583DFE465F76B1F2021D0F 5829B34A09EB1D85E0531082E
23	23	0	EBBC77A493AA0C62C62F25EE5E8D0701F50386F49026F A31487C9FD5C5206CE4EB00576

24	24	0	134F936F9E875842587ADCA92187F2FC6D62FFC3A833D8 CDE465F9972ABAA83763AAEB7
25	25	0	3CD1DA70670BC73363D1B4A66D280FF6AA7636D07ECF 32BA26101E5EBA1594FB8A0420A
26	26	0	918296B2937C2B6F73CF98F85A81B723D1C69DBDF3E019 749C582DA22E789562729D475
27	27	0	C323981B8B2240865F48D61AE1B3B61D88522B7358952F9 49D4308CA15D1EE8FDFA683F
28	28	0	7514A6FA5FBB250C5C8CE96F791D676036C344A44B2428 4477B44CB3E758F8BCD58F05B
29	29	0	84C7FEC6E977FA1EC0C7CC9E0D067C73D8F846F82ABB 3456D2104E1448D5A58D5975152
30	30	0	A0028A7F873AF31DFF45970F51E477346CF8EDD9EFE076 94DCCDD6DAEC32694A1176D68
31	31	0	4841AFC277B86A0E067AF319422F501C87ACBFBDD66BF EA3644F879AE98BA8C5D605123
32	0	1	F35EA87318E459138A2CE69169AD5FD9F30B62DA04ED2 1320A9F59893F0D176752152FD
33	1	1	A0C5F35C5971CD3DC55D7D2B9FD27AA17A198583F580 EB0800744EE5B6B3648DEA95840
34	2	1	A6D3D33AD9B56862DBF076E3ACE6A3150510CCC8BE77 DE4E6E10EB5FE163765647D07DF
35	3	1	F335D714EDB2251A374746686EBBB485AF9A13C0F45324 AE7D73A8C2016FE1A7C24A052
36	4	1	3B841526CCF9D4E1BB79E45E83F69A523A006B02BFCAC 95594F4DDCB95705ADEBCF365F
37	5	1	52849D8F020EA6583032917F36E8B62DFD18AD4D77A7D 2D8EC2D4F20CC0C75B7D4DF708
38	6	1	8E353EC8162F5BB6947F1843C84FE4114616B8CAA45BE4 BF718899D818B5B4074FCDB4F
39	7	1	CC53A152209DEC7E61A06195E3FA633076F7AE1BAFFE8 3CE565087C0507BA596E0BD990
40	8	1	17D98A7E32CCA9B142FE32DB37B2BF726E25AA7A557F FB5C400B47A38B16CF18E1EDE63
41	9	1	5B0B7631EFE3FFE1B558E7619DB8DD71D40E6CD6E4D5 517C8FACD20B6A9B85CCBC340CB
42	10	1	2B08F06EEB736C84585AAC5BF912A249BD2109F841F441 68E0D2971841976D0E28FCDEB
43	11	1	D3AA20EF175DF3BD96D638D6797A8AA4DE51A9104464 65736E4D7953C8D50AD3D7A0096
44	12	1	A5BA8C7E2C795C9F84EBBD425992766BDE5549A7A9F7 EF7E44AFD941C6084568638FE84
45	13	1	33E57E78A5696255CA61AE36027036DA619E493A0A8F95 D9915C6E61F3006CB9706BEBA

46	14	1	09961E7309A9B7F3929C370C51910EBAB1B4F409FA976A E8679F354C84C4051F371F902
47	15	1	508A9EBAEF3C7E09CFCFC0B6F444A09B45A130EFC8C5 B22BCE87213854E7C9D329C9ADC
48	16	1	FBCD16253DF81FDC86F726AAAF4F33EE771489281A641 84F3A929BD230A2D6AE4EC9E1C
49	17	1	AACEEF9BCDC82E4AD525185B07CBABCB74861D16F7C 25CFBA917B05463AD65391AF840D
50	18	1	23060ACC5A125DAB207EEEE47B4EEE1E8466BD17DDA 2EB3CD90D2AB7A758C213E6D7FE5
51	19	1	CA55521667BDA8B6F1B205201A51B3A0C05DE9EA06BC 73268730A81A992777021F46055
52	20	1	05ADFCA2F8207DC6FF8D1A85A1DD4694D4C48A838C4F 833C532710021AC448A7B62B8DD
53	21	1	EDB5D94052CF0D9A573078FB0EEDAB142ECA77547E04 E91C6A0037B2110924BCAD8F359
54	22	1	218C951223D7B712DC98F8B5217388A830003C5F2A00F2 32DD3475D2FC78C25B8D88FF9
55	23	1	79B94D24D721121EF678B7156F8D2666DE712BBF3837C8 5A9518781903146A7B4D42A28
56	24	1	58AABEF6A6BDE4011CAC583C5104B2C6FC5A2980F856 373E5931A3C690245327581FA13
57	25	1	429492DBCFE43A1B8C8037433003543CA2CF03035D13B A70BD773C6117D92E1B0446C9D
58	26	1	427D1AD18E338E16FCE6E23B4AD6D82A2144D53048F26 65AA94577AFABD26889FCB1F9F
59	27	1	337FE0E4C15A22471AE0F6B6F91161A7DE2E1403D73587 D5C8355105D2F70642B2CE425
60	28	1	CC78DB7CAE28F42C00E9C857082C7BFA276386FDE9053 73D1E99DFC52D7C23520BECE2D
61	29	1	499FDB04EACA4BF7C9D956DC26E57A9AC636861AE955 7F39792D1D70D0034067A9F4E73
62	30	1	A3FCAA311B536AC9DB39FED9F4E996506B3181C58D6B 7E04157A3FD463F60468765BCFD
63	31	1	F484FD1F57F53A4A749B86148E0B1D0653667CE13931988 75DDB0AE9179BBBDAAD53A11
64	0	2	29F529BD5762F27ACD3A0836AC6C8953951C04C67B92F 05919F382C811D4C0EF9C01488
65	1	2	A3E9ECF1E6048562BC89DB6168E708855F0D4AD29F859 EF36C9160DF407D85426233632
66	2	2	890519376D1FFAA2894EABCD6663B0A3C2411982C17B0 1270E0FB0B289D4BC8C3B83DA9
67	3	2	54FD243CC4DAA9B8E4D47F2DE45605D6EF2C17259CD1 0EF9EBC7B92F7F7299129080C75

68	4	2	BAC53AA6F0291E10E2CE9B52D22B682637B1F5501531B 7F1EE6A649E2404196A028ED10
69	5	2	2C41D56E693B529AFC883E79ABE6B829201F132E6261A0 1973B4225CEE7116CEDADB2F2
70	6	2	09847B6187BB5F6F6728B4ED610088FAD9DADFC00748E 9DCD8A0CE320D6C991654ABE05
71	7	2	91425CEE8F1DFD79EF572F9C66CB60BD4757E0519F1336 84B5A2F4E3E266532584DBEEE
72	8	2	3285AE0A3D196313659C37BE1C94D61D20F11FD49D9FD F9D1026FF5763F02CB78AE135C
73	9	2	0069D3F34D0D455AFB45FEFDF716333B785C6BDA90DA 23F1CC68BC6A1DBC916C595DA3E
74	10	2	AA977A8BCA39381E7C35A1ACC7C4F60421C0862BFD61 06C7C025B0676EA0EF68972DD8F
75	11	2	F310745C497094ABE56E0490C0800319DBE290553E696B6 859635AF03B121F79D925D19
76	12	2	964DFD350B9C7DFDC7F6F7C43283A76F0D613E48A5520 D1DAF761C6F47E389B43A023F5
77	13	2	8102E980BC69C2C3BE45452169DCA6C45C21B2A6DF69B 12731FEF06399EA130752CF567
78	14	2	6D767B88D28A455CC3B56C942BAFD8E465A50FD2C22F E6162E03A9AAC3C1CC899800610
79	15	2	C5491C6CA3D998906EC1482F815B74B7C2E3816B682AC C6009AB7EFF34BF0E9CE59C754
80	16	2	237DB73895531253E3D7A62F485FD5D8ECAE11BE29E10 22DF659CB39A3C44120C5A0731
81	17	2	6D8EE32D30E19D93A0E5AD8226BAE9CF6FCBA17CF6E 67FDC5A15A81ECB8908BEDD77C80
82	18	2	A1A67B19CD5E80A7C1DE5780D1E594990482AA96DA82 C64AE51AB7EF3857A8F0B162888
83	19	2	98F8BFDF774C7A249418E6FF4723D6E6AB2F091CDE4DE 1CE11D3BD463B509FB716940FD
84	20	2	8E5AB6F13AAC09CA5854781ACA774F68238387806AD6C CC13EEF92B267F7FC576542AF1
85	21	2	477F8BD8905FDBF55191FC82D674094E080B539C743C19 C1064E6CA37CE692F52CB8164
86	22	2	7AFF110DBC3B44E4CA6054768146ABFAFFBB0862A196 D69A972FC318D922F620EA0F345
87	23	2	65300BAD8FFA21BC7DC2C1F79FA97A9F469CCC9E270A 61759F34D6276F57CBEB009CD21
88	24	2	F51AB5A322B4FA8C8DA65D96582C575ECDF96FCAF41D DE3A84AF8663CF4141888FEC269
89	25	2	6F36BB6D5A7DC4FB720439E91FF0DE86DD6C4B93CFC4 271F2BCC6169616E3AEAA19E360

90	26	2	1A4186FD2DE2B2B5FFA3A96DD0AF4673026FFE4F14551754CB2FE35E634F27A4CC7931B
91	27	2	7B6FF9A8738324CBB48BBD575ABD339B581FE16742526E2A62A2D8D030B8712B2488DEF
92	28	2	D318414132A10423E99D0D952BCE250F93056CFDD86E0AC2839CFC816F195DACF581F30
93	29	2	D056262D32B6B5C75D06411B5C3AB93B94FF48DDF9523127F74104B873AE1114B60BF3E
94	30	2	D27B00C70A8AA2C036ADD4E99D047A376B363FEDC287B8FD1A7794818C5873ECD0D3D56
95	31	2	E7FDDCEED8D31B2C0752D976DE92BEA241A713CF818C274AA1C2E3862C7EB7023AF35D4
96	0	0	0D26B8D5452948E30FD29D36E8404C8456657A6CBEEFCD91BB14F91E291F2C1C8F4119F
97	1	1	2CC0EEF167D75102669A814D11A51E569D07A7433A9762A292D7E2A4FE35B9130FD67DE
98	2	2	FB5CBD0CB6FA80C8B3560B4C443BA4900BF2729B160098C2F783A7752B8BA235010A1DA
99	3	0	87BF4954022D30549DF7348477EACB97AC3565B838460CC62F242883313B15C31370335
100	4	1	076BF72542FB9FEBDEC3C316BC28CF0607BCEC5399EC9228905375D3D15F929B586D7E6
101	5	2	82DD830BEDE4F13C76E4CF9AEF5E42609F0BDDCB000A742B6372DD5225B0C3114494746
102	6	0	4E06E4CF46E1F5691938D7F40179D8F79A85216775384BD97966DB4BBF49FB6FAB8F945
103	7	1	8A842EF53464D03A34EE088E38118CB89F79035272B8ED06C8E13A16B34FBFC5BF9CDA4
104	8	2	43380948BFA0642029561E309F371E153174A4E7AC511F8861BE87D9F4D9246C93C2A92
105	9	0	32DE5121E785059F81D9A777565C51EFBB4F61B77ED08870652A4DC32DEA58A8CC6F456
106	10	1	64164534569A5E670FDB390D09C04802DD6A16B022CADC77EDD7464AFED43C773A8DC76
107	11	2	FB8769A81AA9DB607F14A6A95948401F83057CDC9C9C3996BA5821403A49F00A4E35191
108	12	0	77710D6F40B4F79CC63F678551C3EC18FA9DF2C82E6C8F415DADFD63264B7513180070E
109	13	1	3843D2B038045CB9C516B325BC0E242311ACFA807FDC40A8AD259B77F376C931A6F6AF0
110	14	2	503F196BBF93C238BFD5E735E5AE52E0DAE64F5E2F4C3B92E553F51303C4A64C4403BF3
111	15	0	CA346FCCF511822F524C043D2003F3B12DCFEA276B91BA98EB3984BBCFDF75C2A2E1B27

112	16	1	5FD4A6894566678C95B9D5A59DDE5366799045FEB03A2 BAA74094140E9068C61C2E972C
113	17	2	E68AE62D2EE51B14F9D33ED737253CDB55A6E27725405 0830F2FE409E5EE284534FC3E5

Table 3. Preambles modulation series for the 512 FFT

Number	CellId	Segment	Series to modulate (in Hexadecimal format)
0	0	0	66C9CB4D1C8F31D60F5795886EE02FFF6BE4
1	1	0	D8C30DA58B5ED71056C5D79032B80E05522C
2	2	0	8EB62664E3B2C5222DE18E9000561F25AAFC
3	3	0	3B32299087C257CD31C67E4AA5DD697B0E08
4	4	0	3B32299087C257CD31C67E4AA5DD697B0E08
5	5	0	C07E0B0C5DB44071EE6CEC40CA3135CB5DB8
6	6	0	C07E0B0C5DB44071EE6CEC40CA3135CB5DB8
7	7	0	89B08CD299A8AC757DB59107AF4E1EF1EE1C
8	8	0	1B72E8C0ECFAABF050091382B411B45A718C
9	9	0	5B33ED5A6303397EC3CCC35C8203A5A05178
10	10	0	AD1173C461254BF9181238319F93F86AF964
11	11	0	2662789A0B78BA5EDEB403CE5D62A802D50C
12	12	0	51E2005BBA69C858BCC741D84990B657271C
13	13	0	21A03B607DD96F270CBC759B2A9BD6A84A34
14	14	0	4518EC4C7AD645D24AD949B42A7881403C7C
15	15	0	F8B70C595A37315D301D378A4D2848C821D4
16	16	0	487DD10C5F24C1A9AFD9D8F442B073446480
17	17	0	F8B70C595A37315D301D378A4D2848C821D4
18	18	0	FF42582005F8382C5CC6298D757155B36B24
19	19	0	599EF40107CBB3B30AF945365494A0D60570
20	20	0	C6D6BE87F0D88458ABD22DE822B64E450738
21	21	0	5D4D86E62D6B3CA63F76C85AE79F14217408
22	22	0	E043896829F236B10A35014D9E4F26ECB95C
23	23	0	2347472A610FC084C71460393AEF36CBE928
24	24	0	5F4D880DC516DC0B3860DA948225D2BC6770
25	25	0	9EFEEA99631FAF0D9589E9640BCD56C5FF08
26	26	0	9EFEEA99631FAF0D9589E9640BCD56C5FF08
27	27	0	FE792EF83B235B3D4A6447BED27035454BC0
28	28	0	B3B1B868C121C4555A64161B654A4FE81D70
29	29	0	476EA99AF9F73D018EB649F2EE789CE0B4EC
30	30	0	B7C2D44078510ADD2447D93E8A1231AE3910
31	31	0	16A9D8F71CC1CD0EFA0008AA343A7A4ADA4C
32	0	1	2815DA9666DFBCCFAEEA82F965B70E06F42C
33	1	1	7389FDE96166E7E40F7A6778AA02944937A4

34	2	1	7389FDE96166E7E40F7A6778AA02944937A4
35	3	1	A0598A0907798B3465DD8CBD08565F0FB5B8
36	4	1	0E75B3C128085C954A25E5808FC5833A8FB0
37	5	1	BBCDA362265B4D4D2BEE80F635E638316280
38	6	1	660047B06A1B5FAE6A9F0679DBCA9B1A2DF4
39	7	1	117773F464DFB00EC570DB2C8546B534A388
40	8	1	2594AE119CB87E802D67EF7EE0EAE99474CC
41	9	1	2594AE119CB87E802D67EF7EE0EAE99474CC
42	10	1	86823FCCBA812BF28F4EF65732E938361484
43	11	1	8800AECA9BF4C9CB5B4A32D950E1B8FC8740
44	12	1	8FB3FA462D2CFAF842BB5319D9786A997C10
45	13	1	8FB3FA462D2CFAF842BB5319D9786A997C10
46	14	1	599E199B609C0C654DB053E8C94F343AAFF8
47	15	1	E0187D89220D11B5F60DAC078A5E2EED6EF0
48	16	1	E0187D89220D11B5F60DAC078A5E2EED6EF0
49	17	1	B71B524A36024F5B93F827D59DE7DF2238F8
50	18	1	304CD86DFE201256227046C3D0AE7D5F51CC
51	19	1	D2D899FBB154C422F25F218E432E483AE7A0
52	20	1	CB766885201284B65C6460F29AAE9411BF18
53	21	1	69F57E074F14A10FEC6144C26E98C4688330
54	22	1	24C5314B4FC521470F94DFE0F72AB8DB1910
55	23	1	6E4E07CC03CD3E0BDEEAB58975B4CA8E777C
56	24	1	D2C4067132528AA41BBE61A9C171A382F768
57	25	1	B027CB82594D3900700B541A99CCD5FD5870
58	26	1	24C5314B4FC521470F94DFE0F72AB8DB1910
59	27	1	76A0B07A726FB16B905A4678708759042288
60	28	1	E9B565C61F73EC6633A1F2D96EC409495B80
61	29	1	E9B565C61F73EC6633A1F2D96EC409495B80
62	30	1	EBD7E29110582C5951233AB22B03DE709698
63	31	1	0CCA91DA1B42B0B55C924F32B08B1FAE0E18
64	0	2	60F073332D4EE53CC709FFF645F545AA0348
65	1	2	928E1442069F540326E72775785C2788D3A4
66	2	2	928E1442069F540326E72775785C2788D3A4
67	3	2	5633AC03D79BE3901A79E1FFAF65B3756448
68	4	2	0F93A3C4ED837D800637B5F52FB1D73B9A68
69	5	2	F110CE0220306AD14EECEC07AC36EB28725C
70	6	2	A4213FFB85B56E27C74FC6ECBA359875438C
71	7	2	1A37F92589686CFE5E4D4BFD8E2BC63AA8CC
72	8	2	1A37F92589686CFE5E4D4BFD8E2BC63AA8CC
73	9	2	31531C7B2F7518BF59ACFB216FC74D09F2F4
74	10	2	CE026112DF00BB74E1B1F43B595112B16344
75	11	2	503494DE054AE395883AEDD8CC7801B8F124
76	12	2	503494DE054AE395883AEDD8CC7801B8F124
77	13	2	261EAF7C9AFAB5109DEC8A968A79F90F10CC

78	14	2	234AEE2720BAF6D7C7D6B9E628177243EC98
79	15	2	8447E25CA9A0EE1CFB9FADB6C42B8F565B3C
80	16	2	8447E25CA9A0EE1CFB9FADB6C42B8F565B3C
81	17	2	E571539289316AB94B6DF923124F5F91CF34
82	18	2	757C45DA8F140FB6E71024294B2439CDACFC
83	19	2	F2A59A32B51CE505E45E9B5C7C7DBE880DF4
84	20	2	06EA6FE59D24AFFF1A789F068ACE32B76A54
85	21	2	FBDD67D1E2F87744FA17E6821AD8D8D3A528
86	22	2	DCC89E78138BAFE47555B6F97128D4F394A4
87	23	2	34DFF9E83D74050A72C61908EC53E8C0CC88
88	24	2	8DFBF09479BC91E466A539E077D2B26A8B2C
89	25	2	BE4DEB5A007D6B39A0CA0611C323A7A6716C
90	26	2	38BCA168FED54EEF63E858444D0CB936C108
91	27	2	15CA281F8FC9BFBF340FAC8EE3236D3972D4
92	28	2	1C6FB87D76DB82FFA1E492166684CACEE560
93	29	2	524CF9B10D3F1AF51BAF9731980C2CF41D60
94	30	2	524CF9B10D3F1AF51BAF9731980C2CF41D60
95	31	2	E0503D5DFA4A57704C718920F3245A436624
96	0	0	A32CF584137FDF1D4CCE6A1CF40FEC1F4AE0
97	1	1	EC4D3AC52136FA468F28777078C8A82C0808
98	2	2	379C84F3A2A3EFEC4B866EB8710D209A54BC
99	3	0	30CABB208C9D6C774814A163765E4ACBC540
100	4	1	30CABB208C9D6C774814A163765E4ACBC540
101	5	2	7AED914DFCB6A06858382BC4ABC6625C44D0
102	6	0	CA3448C6716F6F8D15D7372A3A4F6E825A14
103	7	1	1C7B1FD490936A2B573037CDF699BD50F068
104	8	2	2D0FC9267E8546393BF113A1AEA2922128C0
105	9	0	ABD1526F4A510F820B689F30C1E7B88C8848
106	10	1	D9F00A909C7B9D92E7EE8477CB50D9456580
107	11	2	9AA34CA12E72C28DD0E97E5DCC4808C36700
108	12	0	36D738CD3F9F8D2D3BFB20F6AA32B31540F8
109	13	1	D54203CE6775B80D1963027DA3EB12D7C9D0
110	14	2	7AC41CAAE627C46C2FCD23D9B7DECB2E2E18
111	15	0	7AC41CAAE627C46C2FCD23D9B7DECB2E2E18
112	16	1	94E4E2AE2C4E47FD7D0A154C25BF40F759E0
113	17	2	43BFFD566D85BE162650670BE1A3CA523284

Table 4. Preambles modulation series for the 128 FFT mode

Number	CellId	Segment	Series to modulate (in Hexadecimal format)
0	0	0	01E52A9B3
1	1	0	C96FF8AB1

2	2	0	A1F5CE648
3	3	0	1E2BF6919
4	4	0	051798B72
5	5	0	932D7FA8E
6	6	0	932D7FA8E
7	7	0	2CBD50F73
8	8	0	F86F6A451
9	9	0	2BA44F7E7
10	10	0	EEFA172C3
11	11	0	FF46C729A
12	12	0	11C1DEA49
13	13	0	E02B1D6D9
14	14	0	0362D5C61
15	15	0	27DDC7CA5
16	16	0	17EAEDAC6
17	17	0	94ACD9E03
18	18	0	F01472932
19	19	0	D345E8C40
20	20	0	1A1AC22DD
21	21	0	FD5E18DA6
22	22	0	07116DA91
23	23	0	35DEB6E0E
24	24	0	A0185E326
25	25	0	93B3F9C75
26	26	0	0FF3CDCD5
27	27	0	AAD266780
28	28	0	632481EA8
29	29	0	9B2D6A380
30	30	0	B5D3C6740
31	31	0	C1DDDF6A5
32	0	1	8BB8104A5
33	1	1	64C4215F0
34	2	1	64C4215F0
35	3	1	6B7C8AE0C
36	4	1	0CE481A55
37	5	1	AA5B9E7E6
38	6	1	87C89EF75
39	7	1	5A83EF8CC
40	8	1	207AA794C
41	9	1	FA3A6D7AC
42	10	1	6A4D1C403
43	11	1	972C3FCEE
44	12	1	44B91C10D
45	13	1	404AD1671
46	14	1	8039A8B46

47	15	1	7761B4BD7
48	16	1	78376108A
49	17	1	31ABBF06D
50	18	1	69C6E455F
51	19	1	AB3B3CFF0
52	20	1	15319240F
53	21	1	731412685
54	22	1	E1A55FF33
55	23	1	0FF3CDCD5
56	24	1	A3135C034
57	25	1	FC9DB558E
58	26	1	FECCB2B85
59	27	1	AA37BDA7C
60	28	1	90955CE1F
61	29	1	ADBC1B844
62	30	1	A04A3B197
63	31	1	015E56CB3
64	0	2	38E8240AD
65	1	2	382A846DB
66	2	2	E4D7DE350
67	3	2	E4D7DE350
68	4	2	ABCF97B09
69	5	2	249DEABE3
70	6	2	B233CA140
71	7	2	B233CA140
72	8	2	543C676DB
73	9	2	DBE7E42AE
74	10	2	DBE7E42AE
75	11	2	A7957FC4C
76	12	2	64D6F4038
77	13	2	4D0F99EF5
78	14	2	D2DD02238
79	15	2	FEA763CB2
80	16	2	3672D5700
81	17	2	64D6F4038
82	18	2	8CE0D5FB6
83	19	2	CC25D7A7E
84	20	2	CC25D7A7E
85	21	2	CC25D7A7E
86	22	2	1DCEBCBB6
87	23	2	55B6F39F8
88	24	2	01ECB468C
89	25	2	6F6C13855
90	26	2	5DA531038
91	27	2	7019D3A92

92	28	2	784CF7EAB
93	29	2	5AAC86FCF
94	30	2	E98250DC4
95	31	2	3F0C9ABBD
96	0	0	57ED9398F
97	1	1	C725A2E40
98	2	2	64F194A80
99	3	0	575A313E4
100	4	1	E4BEEBD18
101	5	2	332D6AA0F
102	6	0	FBD62ECA6
103	7	1	38665B015
104	8	2	07085DAC8
105	9	0	4CEEB5E1F
106	10	1	9E5CD5B80
107	11	2	B428BA19C
108	12	0	63A76FD05
109	13	1	517C8460C
110	14	2	A1B58A608
111	15	0	558DA7003
112	16	1	FF64761CA
113	17	2	7DF07735A

Table 5. Preambles modulation series for the 1K FFT mode

Number	CellId	Segment	Series to modulate (in Hexadecimal format)
0	0	0	A6F294537B285E1844677D133E4D53CCB1F182DE00489E53E6B6E77065C7EE7D0ADBEAF
1	1	0	668321CBBE7F462E6C2A07E8BBDA2C7F7946D5F69E35AC8ACF7D64AB4A33C467001F3B2
2	2	0	1C75D30B2DF72CEC9117A0BD8EAF8E0502461FC07456AC906ADE03E9B5AB5E1D3F98C6E
3	3	0	5F9A2E5CA7CC69A5227104FB1CC2262809F3B10D0542B9BDFDA4A73A7046096DF0E8D3D
4	4	0	82F8A0AB918138D84BB86224F6C342D81BC8BFE791CA9

			EB54096159D672E91C6E13032F
5	5	0	EE27E59B84CCF15BB1565EF90D478CD2C49EE8A70DE3 68EED7C9420B0C6FFAF9AF035FC
6	6	0	C1DF5AE28D1CA6A8917BCDAF4E73BD93F931C44F93C3 F12F0132FB643EFD5885C8B2BCB
7	7	0	FCA36CCCF7F3E0602696DF745A68DB948C57DFA9575B EA1F05725C42155898F0A63A248
8	8	0	024B0718DE6474473A08C8B151AED124798F15D1FFCCD 0DE574C5D2C52A42EEF858DBA5
9	9	0	D4EBFCC3F5A0332BEA5B309ACB04685B8D1BB4CB49F 9251461B4ABA255897148F0FF238
10	10	0	EEA213F429EB926D1BDEC03ABB67D1DE47B4738F3E92 9854F83D18B216095E6F546DADE
11	11	0	C03036FA9F253045DF6C0889A8B83BAEFCF90EB993C2D 79BD911CA84075061AA43DA471
12	12	0	1E68EC22E5E2947FB0A29E4CC70597254B36C60331EAC F779FE752D3F55DC41ABFC7DC9
13	13	0	63A57E75A0434F035AAC4504B265081D497F10C77928B7 1797C5D6C6824DC0F23BE34EE
14	14	0	C57C4612816DE981C58FD6F8DE9DD41F2422ADBC522B 0CE31F9A6D5F2A126DC08F69FB1
15	15	0	978256AF184E7ED17789B33D324C711B36BFBCCE5446E B03687E9A0A839C7CE156104D2
16	16	0	011EC823157DD73150640CEB7DDB0A1F8F91E09599A85 1D5C7CAF687CFB752D297D82FC
17	17	0	C6DE82BEB7F57B9120E8A376D85C8F70FDC65BC660402 DAC4AE6002EA2740C4F9E5973C
18	18	0	4C74929D6F9FAB9E5BB761026038E076F6824295E0AF397 806ECEBC6DC713F03ACDC27C
19	19	0	13E1E85C2234D0F3418001A35F135E10C6C918C36BC659 FDA9D655D288A0BDAA8BF489D
20	20	0	FD4AF2D8F4F08F1A7DF59291C9AEE788F641B8231CFB8 13376E0BEB68DFCFCBBE552445
21	21	0	EBBC77A493AA0C62C62F25EE5E8D0701F50386F49026F A31487C9FD5C5206CE4EB00576
22	22	0	134F936F9E875842587ADCA92187F2FC6D62FFC3A833D8 CDE465F9972ABAA83763AAEB7
23	23	0	3CD1DA70670BC73363D1B4A66D280FF6AA7636D07ECF 32BA26101E5EBA1594FB8A0420A
24	24	0	918296B2937C2B6F73CF98F85A81B723D1C69DBDF3E019 749C582DA22E789562729D475
25	25	0	C323981B8B2240865F48D61AE1B3B61D88522B7358952F9 49D4308CA15D1EE8FDFA683F
26	26	0	7514A6FA5FBB250C5C8CE96F791D676036C344A44B2428 4477B44CB3E758F8BCD58F05B

27	27	0	84C7FEC6E977FA1EC0C7CC9E0D067C73D8F846F82ABB3456D2104E1448D5A58D5975152
28	28	0	4841AFC277B86A0E067AF319422F501C87ACBFBDD66BFEA3644F879AE98BA8C5D605123
29	29	0	F35EA87318E459138A2CE69169AD5FD9F30B62DA04ED21320A9F59893F0D176752152FD
30	30	0	A0C5F35C5971CD3DC55D7D2B9FD27AA17A198583F580EB0800744EE5B6B3648DEA95840
31	31	0	A6D3D33AD9B56862DBF076E3ACE6A3150510CCC8BE77DE4E6E10EB5FE163765647D07DF
32	0	1	52849D8F020EA6583032917F36E8B62DFD18AD4D77A7D2D8EC2D4F20CC0C75B7D4DF708
33	1	1	CC53A152209DEC7E61A06195E3FA633076F7AE1BAFFE83CE565087C0507BA596E0BD990
34	2	1	17D98A7E32CCA9B142FE32DB37B2BF726E25AA7A557FFB5C400B47A38B16CF18E1EDE63
35	3	1	A5BA8C7E2C795C9F84EBBD425992766BDE5549A7A9F7EF7E44AFD941C6084568638FE84
36	4	1	33E57E78A5696255CA61AE36027036DA619E493A0A8F95D9915C6E61F3006CB9706BEBA
37	5	1	09961E7309A9B7F3929C370C51910EBAB1B4F409FA976AE8679F354C84C4051F371F902
38	6	1	508A9EBAEF3C7E09CFCFC0B6F444A09B45A130EFC8C5B22BCE87213854E7C9D329C9ADC
39	7	1	AACEEF9BCDC82E4AD525185B07CBABCB74861D16F7C25CFBA917B05463AD65391AF840D
40	8	1	23060ACC5A125DAB207EEEE47B4EEE1E8466BD17DDA2EB3CD90D2AB7A758C213E6D7FE5
41	9	1	CA55521667BDA8B6F1B205201A51B3A0C05DE9EA06BC73268730A81A992777021F46055
42	10	1	05ADFCA2F8207DC6FF8D1A85A1DD4694D4C48A838C4F833C532710021AC448A7B62B8DD
43	11	1	218C951223D7B712DC98F8B5217388A830003C5F2A00F232DD3475D2FC78C25B8D88FF9
44	12	1	79B94D24D721121EF678B7156F8D2666DE712BBF3837C85A9518781903146A7B4D42A28
45	13	1	58AABEF6A6BDE4011CAC583C5104B2C6FC5A2980F856373E5931A3C690245327581FA13
46	14	1	427D1AD18E338E16FCE6E23B4AD6D82A2144D53048F2665AA94577AFABD26889FCB1F9F
47	15	1	337FE0E4C15A22471AE0F6B6F91161A7DE2E1403D73587D5C8355105D2F70642B2CE425
48	16	1	A3FCAA311B536AC9DB39FED9F4E996506B3181C58D6B7E04157A3FD463F60468765BCFD
49	17	1	F484FD1F57F53A4A749B86148E0B1D0653667CE1393198875DDB0AE9179BBBDAAD53A11

50	18	1	A3E9ECF1E6048562BC89DB6168E708855F0D4AD29F859EF36C9160DF407D85426233632
51	19	1	890519376D1FFAA2894EABCD6663B0A3C2411982C17B01270E0FB0B289D4BC8C3B83DA9
52	20	1	09847B6187BB5F6F6728B4ED610088FAD9DADFC00748E9DCD8A0CE320D6C991654ABE05
53	21	1	3285AE0A3D196313659C37BE1C94D61D20F11FD49D9FDF9D1026FF5763F02CB78AE135C
54	22	1	0069D3F34D0D455AFB45FEFDF716333B785C6BDA90DA23F1CC68BC6A1DBC916C595DA3E
55	23	1	AA977A8BCA39381E7C35A1ACC7C4F60421C0862BFD6106C7C025B0676EA0EF68972DD8F
56	24	1	F310745C497094ABE56E0490C0800319DBE290553E696B6859635AF03B121F79D925D19
57	25	1	964DFD350B9C7DFDC7F6F7C43283A76F0D613E48A5520D1DAF761C6F47E389B43A023F5
58	26	1	6D767B88D28A455CC3B56C942BAFD8E465A50FD2C22FE6162E03A9AAC3C1CC899800610
59	27	1	C5491C6CA3D998906EC1482F815B74B7C2E3816B682ACC6009AB7EFF34BF0E9CE59C754
60	28	1	6D8EE32D30E19D93A0E5AD8226BAE9CF6FCBA17CF6E67FDC5A15A81ECB8908BEDD77C80
61	29	1	98F8BFDF774C7A249418E6FF4723D6E6AB2F091CDE4DE1CE11D3BD463B509FB716940FD
62	30	1	65300BAD8FFA21BC7DC2C1F79FA97A9F469CCC9E270A61759F34D6276F57CBEB009CD21
63	31	1	6F36BB6D5A7DC4FB720439E91FF0DE86DD6C4B93CFC4271F2BCC6169616E3AEAA19E360
64	0	2	D27B00C70A8AA2C036ADD4E99D047A376B363FEDC287B8FD1A7794818C5873ECD0D3D56
65	1	2	E7FDDCEED8D31B2C0752D976DE92BEA241A713CF818C274AA1C2E3862C7EB7023AF35D4
66	2	2	87BF4954022D30549DF7348477EACB97AC3565B838460CC62F242883313B15C31370335
67	3	2	82DD830BEDE4F13C76E4CF9AEF5E42609F0BDDCB000A742B6372DD5225B0C3114494746
68	4	2	4E06E4CF46E1F5691938D7F40179D8F79A85216775384BD97966DB4BBF49FB6FAB8F945
69	5	2	64164534569A5E670FDB390D09C04802DD6A16B022CADC77EDD7464AFED43C773A8DC76
70	6	2	FB8769A81AA9DB607F14A6A95948401F83057CDC9C9C3996BA5821403A49F00A4E35191
71	7	2	77710D6F40B4F79CC63F678551C3EC18FA9DF2C82E6C8F415DADFD63264B7513180070E
72	8	2	503F196BBF93C238BFD5E735E5AE52E0DAE64F5E2F4C3B92E553F51303C4A64C4403BF3

73	9	2	5FD4A6894566678C95B9D5A59DDE5366799045FEB03A2 BAA74094140E9068C61C2E972C
74	10	2	95B584DC40C8B5DEAD63D48FCE65B1E61BAB4C597D9 21DB12677141E2FFE7C0AA3DA0D5
75	11	2	985763AB6CC8934DB8A0BE738A7AF1D1FA3958C1F9E2 D6A51A163E47A0A6E5FEB759FDD
76	12	2	FD8D45F00D943AD986BD353D61C6746DBF8A309B6AE1 C173B880D957B76DC031A957E8D
77	13	2	AE4323534F6EFB1A20169328417885EF304FA220389FA9C 2607E5A406F4CE4A7498A39F
78	14	2	E5205579893BE184CB9948C28E2F9AAF699D47B6E5E0B2 19CBEAFE4BEC8D561BD809E34
79	15	2	AB11D6941478D36D5695CE813070DC1E32122A39083E53 FE373660AEB125D83383FBDCA
80	16	2	188A09C46F1F11206FF9F15CFB5F6CD2F26C4BF485EE37 D3650A595064F76CE34E40EAD
81	17	2	4B1CDE25539A56CEDC45FE7F54C38CF155F4FB1AE868F 6C3952D07014BF828E810BDE2D
82	18	2	16CA8F8C6A879E865E3611EAC389D56AFA3E4E84CDBB 73567BA4A160249C4B680A7D9BC
83	19	2	39D2B08AA0E2E8781476027B41AD72F8D9838B7001AAD FD33A92D81E56ECBB2C9378D58
84	20	2	8C258BC80D4AD125F335A5151EDF9E9A463E06C5C8D04 6F82E5DC3D73EF4D2231C5D14F
85	21	2	41A029C6356C825585179C5348EDF07A3AC2022539AC28 DC4CD3C1DFADC8EE9644CD939
86	22	2	0D70A77CBE9804913BFBEC4FBF917C5CD3580F6062BB AD3F99ECEBB4A9EBB87523AB722
87	23	2	6A00A30901F9FDE44B4F1ECED44E0BCB943B29519F313 BE4496D34F39B154FC2384CB75
88	24	2	95351107A8BE6ABFC24C1292FE1A0FE677CBFD04F2E81 178CAA9D294730EF9C946F676E
89	25	2	01F21470FD9B1E0B3C6B2F7C0412A15764C277D61BA2E E3B3769DE7ADACB2BB29918FB7
90	26	2	A578ABFE155369440FA3D4DF757CCA596469B80A0E56B FE6010DD63E67CEDB86BB1EF39
91	27	2	1E1CFFAB031836777DE5D168A9246C559574C74CCC064 05EB406B8DDB7C9A6EF54A66A5
92	28	2	354149C2CA19A735F9CD04AF4922E8ECE6509B978B951 F946FD4AD36C7F9C83624205E7
93	29	2	5A27E60DEA547D0D41897A03199F28A967AC51728E3B3 8325B4FBECF1B85A7EE9B04182
94	30	2	784DA3B16B810FE3B851060AD7BD27D9D9457F6C8899A 13D311E531B855C15ECE6D3A2F
95	31	2	D7DFBC65797633A8C13D3EEC781D48952338136063B579 D69437B28B744B5A4BE18AFA9

96	0	0	61AF26BD39A9FFF52826625E04ADA299385A373FA946D837D754E6CFEBB26F5C03B87CF
97	1	1	D77D97CDB93DBEAA65CAFA146F40D72B5E80944F750E07325DC164ED60F32434BC7187D
98	2	2	4529D9CA65AF49C1C39BDC18CFAB87E03FE4DAFC0A48FF1457D46B0DF66B414A23ACDDB
99	3	0	33AC0261DAA57C1D611EBA1C730D50AFEE5BE3E849030A4E891BC8C5F4C78DCDDFEA263
100	4	1	BED48C704F02A84F03BCD299D919DA56F7B71EDF8A0F8A25E8F8496F95A44CE2B9F74C9
101	5	2	0ECCBE0902EBF4B4C29506014A3706622784B7B2D5153E10AD3112DC5E45277A32E79DE
102	6	0	7CB4937889C7DFD9AA2D37235E06F993D3D4F5D515B39CA652F62397C08457D66BC5A36
103	7	1	43F23F6CAC6C43896B3EDBF00E1CBD42E2CC75E2A996448F0FCF17F6779DD6E356FED11
104	8	2	72C8A209FBC4A568BEF03BCFE1B0D959F977B0963780B4E54E2B9A1016344ACB7EE3E3A
105	9	0	77AEB9E50DC3727849A94FBFFCDB5B9589AF50ABD8A58808B9663058E17A2EBC496DF43
106	10	1	667123C89077FE4AAAEF15C635E976C6811682D478FFC7B721A76B5A38697DF4FB7D2CE
107	11	2	CBD6C5C9BE55B0BE76AD03392E8A8AB9A86063DB31B79280B447980BB841FD7E9DC6B9B
108	12	0	C7D7DEF8B3C9C8667D8D65063B4DAD1FF69445C87CA71DA955D0CA23970E988A6EA4C83
109	13	1	FB246ABD92F9E560CB2BEC2317204C9CE22AD3BD19EA02E90F5F3B7F4F65538D8ED098E
110	14	2	29E74579472FDD8FFC2700B2BF33C649989DD8153093A7CA08B50F7A5E4BAED108A0F0D
111	15	0	A27F29D8D6CCD7EB4BBE303C3E9E95802DB98BFD5B8ED03B88304359D92E3EC108CA3C8
112	16	1	3FE70E26FA00327FE3B2BE6BC5D5014F588F09C17D222C146DD68B4824692A651888C76
113	17	2	41E91307EC58801CFF2C7E9CFEFBEB71681FAE2BEAEC72D4E4556E99345D3BA4B369B59

Table 6. Preambles modulation series for the 512 FFT mode

Number	CellId	Segment	Series to modulate (in Hexadecimal format)
0	0	0	66C9CB4D1C8F31D60F5795886EE02FFF6BE4
1	1	0	D8C30DA58B5ED71056C5D79032B80E05522C
2	2	0	8EB62664E3B2C5222DE18E9000561F25AAFC
3	3	0	3B32299087C257CD31C67E4AA5DD697B0E08

4	4	0	C07E0B0C5DB44071EE6CEC40CA3135CB5DB8
5	5	0	89B08CD299A8AC757DB59107AF4E1EF1EE1C
6	6	0	1B72E8C0ECFAABF050091382B411B45A718C
7	7	0	5B33ED5A6303397EC3CCC35C8203A5A05178
8	8	0	AD1173C461254BF9181238319F93F86AF964
9	9	0	51E2005BBA69C858BCC741D84990B657271C
10	10	0	21A03B607DD96F270CBC759B2A9BD6A84A34
11	11	0	4518EC4C7AD645D24AD949B42A7881403C7C
12	12	0	F8B70C595A37315D301D378A4D2848C821D4
13	13	0	FF42582005F8382C5CC6298D757155B36B24
14	14	0	599EF40107CBB3B30AF945365494A0D60570
15	15	0	C6D6BE87F0D88458ABD22DE822B64E450738
16	16	0	E043896829F236B10A35014D9E4F26ECB95C
17	17	0	2347472A610FC084C71460393AEF36CBE928
18	18	0	5F4D880DC516DC0B3860DA948225D2BC6770
19	19	0	9EFEEA99631FAF0D9589E9640BCD56C5FF08
20	20	0	FE792EF83B235B3D4A6447BED27035454BC0
21	21	0	B3B1B868C121C4555A64161B654A4FE81D70
22	22	0	B7C2D44078510ADD2447D93E8A1231AE3910
23	23	0	16A9D8F71CC1CD0EFA0008AA343A7A4ADA4C
24	24	0	7389FDE96166E7E40F7A6778AA02944937A4
25	25	0	A0598A0907798B3465DD8CBD08565F0FB5B8
26	26	0	0E75B3C128085C954A25E5808FC5833A8FB0
27	27	0	BBCDA362265B4D4D2BEE80F635E638316280
28	28	0	660047B06A1B5FAE6A9F0679DBCA9B1A2DF4
29	29	0	2594AE119CB87E802D67EF7EE0EAE99474CC
30	30	0	8FB3FA462D2CFAF842BB5319D9786A997C10
31	31	0	599E199B609C0C654DB053E8C94F343AAFF8
32	0	1	E0187D89220D11B5F60DAC078A5E2EED6EF0
33	1	1	69F57E074F14A10FEC6144C26E98C4688330
34	2	1	D2C4067132528AA41BBE61A9C171A382F768
35	3	1	B027CB82594D3900700B541A99CCD5FD5870
36	4	1	E9B565C61F73EC6633A1F2D96EC409495B80
37	5	1	EBD7E29110582C5951233AB22B03DE709698
38	6	1	0CCA91DA1B42B0B55C924F32B08B1FAE0E18
39	7	1	A4213FFB85B56E27C74FC6ECBA359875438C
40	8	1	1A37F92589686CFE5E4D4BFD8E2BC63AA8CC
41	9	1	31531C7B2F7518BF59ACFB216FC74D09F2F4
42	10	1	CE026112DF00BB74E1B1F43B595112B16344
43	11	1	503494DE054AE395883AEDD8CC7801B8F124
44	12	1	8447E25CA9A0EE1CFB9FADB6C42B8F565B3C
45	13	1	757C45DA8F140FB6E71024294B2439CDACFC
46	14	1	F2A59A32B51CE505E45E9B5C7C7DBE880DF4
47	15	1	8DFBF09479BC91E466A539E077D2B26A8B2C

48	16	1	1C6FB87D76DB82FFA1E492166684CACEE560
49	17	1	A32CF584137FDF1D4CCE6A1CF40FEC1F4AE0
50	18	1	EC4D3AC52136FA468F28777078C8A82C0808
51	19	1	30CABB208C9D6C774814A163765E4ACBC540
52	20	1	CA3448C6716F6F8D15D7372A3A4F6E825A14
53	21	1	ABD1526F4A510F820B689F30C1E7B88C8848
54	22	1	94E4E2AE2C4E47FD7D0A154C25BF40F759E0
55	23	1	43BFFD566D85BE162650670BE1A3CA523284
56	24	1	D7644475A2E5EDAD1AD184242E3C841A03E0
57	25	1	A61DDBA416D1D14358647C4ACEF2503001E4
58	26	1	1F9047A8651D4D4A7C582469DC8C41B68E08
59	27	1	E0EAC02D975263F36D4BEF70669CBDEE658C
60	28	1	DFAE7334BD2B8FF1D2C7CB5922823B03F744
61	29	1	D44B2AD5842F1EEA1A39DBC64EC064FCCFB C
62	30	1	08AD296C8D17ABD021E02E20DACC247673EC
63	31	1	2FE66830D806B3F8DD38D5FE1CF12DEB9774
64	0	2	C6325F42597BD48A8914944C7DB973D83E64
65	1	2	E04B98E9254434D3F765A621752C0F1FEC54
66	2	2	A74B60D84CCB156B1B8AE015B8CE980868EC
67	3	2	78E7405DCFDA1DFCDA6E54B3794B49A0F8B0
68	4	2	F32F4CA1A154E746FE1C2D1E4A1251779804
69	5	2	5A2905A1CF5D06444C880ADC07EB3889E71C
70	6	2	74290661C664DEB829569B7C4E6C32B2BE00
71	7	2	EBB53241F5D9CD87A612C0774ED2FED4679C
72	8	2	E33B89ABA4ED020D558B833AF74072922164
73	9	2	3B7D2DEEF829E230718AA7996CD814A4DD88
74	10	2	373861E8993FC22E176F6DA6A46A10158EF4
75	11	2	2BEA329B65DE1CD26ECDD382915AC40B1D0 C
76	12	2	7A8B131BD5D1270C30003DA472DD81D9A434
77	13	2	9D6A237940057479D30BE19AD719F8F9B47C
78	14	2	C1FB9C3811B349E9F793A14C8AE8425A6218
79	15	2	DFFDE03D8C717A346B4B1D3C02693330A9B4
80	16	2	76254DEF89683CD7210898069E2CDA0EE144
81	17	2	09B9B69C132C4E2DC16A1438828147D65F94
82	18	2	B1CCE0D47DF246E9059CBC970168518206AC
83	19	2	1017669D7990F3AB4378924C69E442F2BAD0
84	20	2	772407B19C5FA41D542C8A2DC9ADD2C2943C
85	21	2	7A38C2889EB10D93F23EC75B212D327D18A8
86	22	2	D25A195D899BF6F531F5ECC228BE0678A438
87	23	2	A83FD1C33F4C6CAA5A0E8B062937AC310034
88	24	2	AA6DDD1A05ADF49F615BE9F9EBCA6630E44 0
89	25	2	B14990574937763EEBD71A12FEB0C673F878

90	26	2	DDF013D74BDDE5FBB621A32B54DE24AA1D60
91	27	2	D814295D387D2EE33F90C07CA493062B3054
92	28	2	89B93046231A786C3D74ABAEC6AFF42D037C
93	29	2	5680E918BA19199E841B4D6A7D1DD1420E78
94	30	2	639CC821373B332F975817C0A1AC16A48150
95	31	2	06711D78BD8978D82DA58B7E494DDF77E994
96	0	0	C882DD8DBD23C796A1389DA4EAA9A4138640
97	1	1	038086D70895496BCABC404B1EC999F67AC0
98	2	2	8203073A335DB9E57B0CA2F07D5958176B50
99	3	0	3FF1CD3638EE6469A4A482AF834EF56A2340
100	4	1	69EA7871159D5099F900C6133C07DABF56F0
101	5	2	4D88ABB17FF855393EDBC070CF0439D5E94C
102	6	0	01EFD43C87362B00E376A728BC597BEED978
103	7	1	7AE20D16F3CC6F947413518FDF6E1FCCCDE8
104	8	2	BB852F9A90B0DE260BB67F45491B31DE3A74
105	9	0	088627544BDF971C1AC4F86F05A212EE9634
106	10	1	0C8A08A37C2B9D3C1812E9C116B4E6A6285C
107	11	2	E74775CADDDDF0D2D808FE7FC1C177489284
108	12	0	E81ECC6AC393294E9B549A8B2BADE7FFF904
109	13	1	1C5FAE8CACE7A2CD13CAF4A34A440E909BF8
110	14	2	6EE7E42A292BDACC5C79B81CA6598274C940
111	15	0	407547BC0C961D9E9ADDE010F4990724E8DC
112	16	1	46CE626ACD894F9650E6B7C3F9E3BFAE5B08
113	17	2	C59B894FBF170F44F4816750280AB8CB4E48

Table 7. Preambles modulation series for the 128 FFT mode

Number	CellId	Segment	Series to modulate (in Hexadecimal format)
0	0	0	01E52A9B3
1	1	0	C96FF8AB1
2	2	0	A1F5CE648
3	3	0	1E2BF6919
4	4	0	051798B72
5	5	0	932D7FA8E
6	6	0	2CBD50F73
7	7	0	F86F6A451
8	8	0	2BA44F7E7
9	9	0	EEFA172C3
10	10	0	FF46C729A
11	11	0	0362D5C61
12	12	0	27DDC7CA5
13	13	0	17EAEDAC6

14	14	0	94ACD9E03
15	15	0	1A1AC22DD
16	16	0	FD5E18DA6
17	17	0	35DEB6E0E
18	18	0	A0185E326
19	19	0	93B3F9C75
20	20	0	632481EA8
21	21	0	8BB8104A5
22	22	0	87C89EF75
23	23	0	207AA794C
24	24	0	6A4D1C403
25	25	0	7761B4BD7
26	26	0	31ABBF06D
27	27	0	69C6E455F
28	28	0	AB3B3CFF0
29	29	0	731412685
30	30	0	A3135C034
31	31	0	FECCB2B85
32	0	1	AA37BDA7C
33	1	1	90955CE1F
34	2	1	ADBC1B844
35	3	1	A04A3B197
36	4	1	015E56CB3
37	5	1	64D6F4038
38	6	1	D2DD02238
39	7	1	FEA763CB2
40	8	1	8CE0D5FB6
41	9	1	CC25D7A7E
42	10	1	7019D3A92
43	11	1	784CF7EAB
44	12	1	07085DAC8
45	13	1	4CEEB5E1F
46	14	1	9E5CD5B80
47	15	1	63A76FD05
48	16	1	AA276F96F
49	17	1	3370F5082
50	18	1	35A644170
51	19	1	16FD73B8B
52	20	1	EEE990E94
53	21	1	28A3120FC
54	22	1	C2FBC2993
55	23	1	880BCACD3
56	24	1	AFA4DB918
57	25	1	AE1E49884
58	26	1	F7945E264

59	27	1	38374CA42
60	28	1	5AAE39B00
61	29	1	138069E54
62	30	1	966707005
63	31	1	A5037759E
64	0	2	3FE158D96
65	1	2	AED3B839F
66	2	2	F5AE23268
67	3	2	1895E68BE
68	4	2	1443C94EC
69	5	2	929547307
70	6	2	A17D3230C
71	7	2	D54FC0C33
72	8	2	AB77F079C
73	9	2	C3CA00A66
74	10	2	025519879
75	11	2	6CF39F815
76	12	2	F69E451B1
77	13	2	91BC72EBF
78	14	2	F964A5447
79	15	2	F8CD36F4A
80	16	2	726A3C802
81	17	2	118D1B682
82	18	2	DED9E703A
83	19	2	3E8929773
84	20	2	2C64AA7F9
85	21	2	2249CEA0F
86	22	2	01363A94E
87	23	2	69D77721F
88	24	2	AE103C9B9
89	25	2	89E2A6940
90	26	2	A7BC42645
91	27	2	BBB6B9C0F
92	28	2	5BF7598F8
93	29	2	4AE4C79FE
94	30	2	1FDC748C9
95	31	2	877D5E6E4
96	0	0	0FE322452
97	1	1	4DC778B5F
98	2	2	ADD9E3F88
99	3	0	2C1C857DC
100	4	1	CFB4B5503
101	5	2	CD8505E21
102	6	0	82892F4CE
103	7	1	3979FD176

104	8	2	5FA49C311
105	9	0	BA7857B19
106	10	1	BC030C4CA
107	11	2	517F3CBD6
108	12	0	7E545BE73
109	13	1	DDCA69C3F
110	14	2	A01A2C8C7
111	15	0	1C0B64435
112	16	1	330282DF2
113	17	2	147FCCF4B

Table 6 illustrates another embodiment of a preambles modulation series per segment and Cellid, for the 512 FFT mode.
Suggested title: Table 307c, if included in the IEEE Standard.

Table 7 illustrates another embodiment of a preambles modulation series per segment and Cellid, for the 128 FFT mode.
Suggested title: Table 307d, if included in the IEEE Standard.

Preamble properties: the preambles were chosen using a computer search which minimizes the PAPR and cross-correlation properties (or a coherent/slow or differential/fast cell search).

The graphs in Figs. 1 to 6 illustrate these properties.

The following method may be used to compute codes such as those presented in this disclosure, see Fig. 8.

To evaluate the performance of each code, a cellular model was used, see Fig. 7, which includes a first cell 11 surrounded by a first tier 12 of 6 cells and a second tier 13 of 12 cells, 19 cells in total.

Each cell may have three sectors separated in frequency, groups F1, F2 and F3; in another embodiment, the cells may have six sectors each.
F1, F2, F3 each may refer to an orthogonal set of subcarriers.

For a group of 19 cells with 6 segments each, the total number is
19 x 6 = 144

We are looking for a randomizer that will achieve best performance from the aspects of Crest Factor/ PAPR and/or Cross-correlation, for the above possible scenarios.

The various codes generated as detailed below have been evaluated with reference to the above model, see also Fig. 7.

Method for codes generation

1. For each of the FFT modes: 128, 512, 1024, performing the following steps (2 - 4) [21]:

2. Generating various codes, pseudo-random simulation [22]

3. Codes evaluation in a predefined model, including a wireless cell, a first tier including 6 cells and a second tier including 12 cells, 19 cells in total [23].
Compute Crest Factor, PAPR
Compute Cross-correlation among codes

4. Selecting the highest performance codes according to predefined criteria in PAPR and/or Cross-correlation [24]

End of Method.

Industrial Applicability

The present invention refers to improvements in wireless communications. It describes improved preamble codes having a lower PAPR value. A lower PAPR allows to boost the preamble to get better performance in the estimation/acquisition/cell monitoring, etc.

The present disclosure includes improvements in the 1024, 512 and 128 FFT OFDMA modes.

Tables with series to modulate, for different FFT sizes, are disclosed in the present application.

It will be recognized that the foregoing is but one example of an apparatus and method within the scope of the present invention and that various modifications will occur to those skilled in the art upon reading the disclosure set forth hereinbefore.

Claims

1. A preamble code usable in Orthogonal Frequency Division Multiple Access (OFDMA) for the physical layer (PHY), selected for improved PAPR in a 1024, 512 or 128 FFT OFDMA mode.

2. The preamble code according to claim 1, and as detailed in Table 2 in the disclosure.

3. The preamble code according to claim 1, and as detailed in Table 3 in the disclosure.

4. The preamble code according to claim 1, and as detailed in Table 4 in the disclosure.

5. The preamble code according to claim 1, and as detailed in Table 5 in the disclosure.

6. The preamble code according to claim 1, and as detailed in Table 6 in the disclosure.

7. The preamble code according to claim 1, and as detailed in Table 7 in the disclosure.

8. A cellular system using the preamble codes according to claim 1, 2, 3, 4, 5, 6 or 7.

9. A method for cellular communications using the preamble codes according to claim 1, 2, 3, 4, 5, 6 or 7.

10. A Method for preamble codes generation, comprising:
    a. For each of the FFT modes: 128, 512, 1024, performing the following steps (b - d);
    b. Generating various codes;
    c. Codes evaluation in a predefined model including a wireless cell surrounded by other cells;
    d. Selecting the highest performance codes according to predefined criteria.

11. The Method for preamble codes generation according to claim 10, wherein the selection criteria include minimizing PAPR.

12. The Method for preamble codes generation according to claim 10, wherein the selection criteria include minimizing cross-correlation.

13. The Method for preamble codes generation according to claim 10, wherein the selection criteria include minimizing cross-correlation and PAPR.

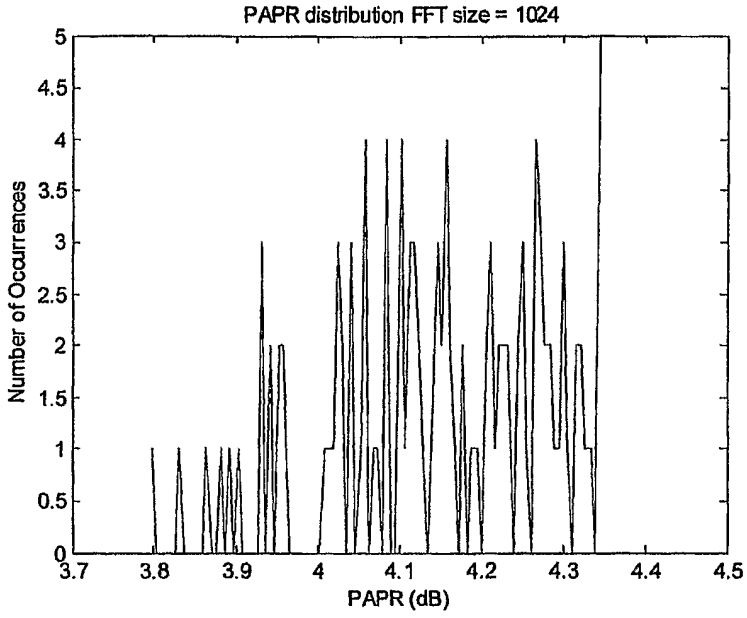
PAPR distribution FFT size = 1024
Number of Occurrences
PAPR (dB)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
3.7
3.8
3.9
4
4.1
4.2
4.3
4.4
4.5

Fig. 1

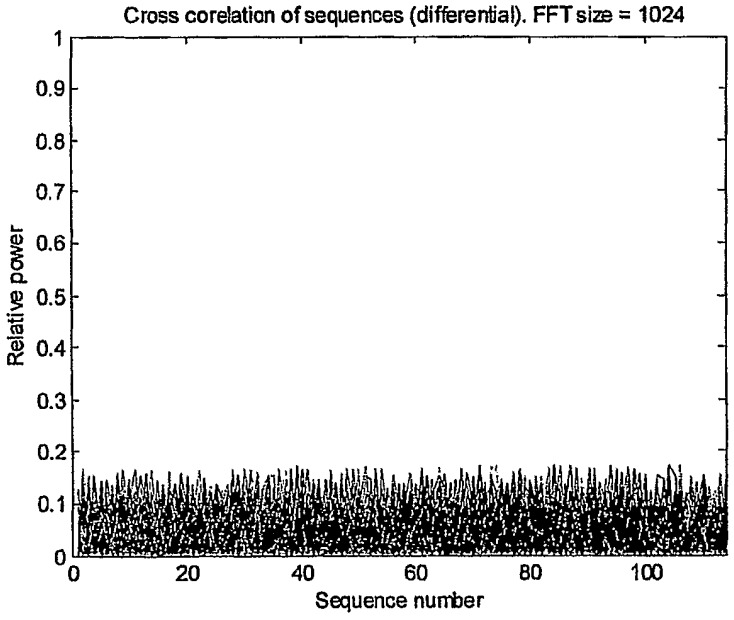
Cross corelation of sequences (differential). FFT size = 1024
Relative power
Sequence number
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100

Fig. 2

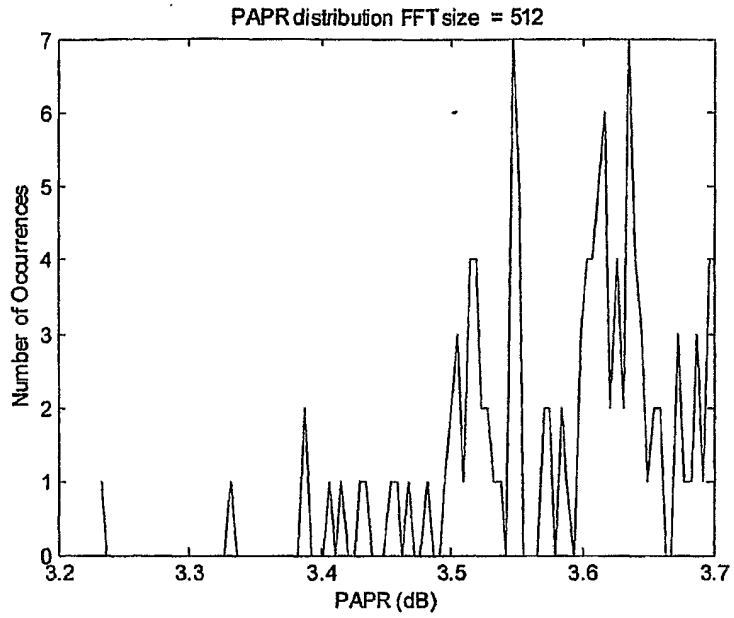
PAPR distribution FFT size = 512
Number of Occurrences
PAPR (dB)
0
1
2
3
4
5
6
7
3.2
3.3
3.4
3.5
3.6
3.7

Fig. 3

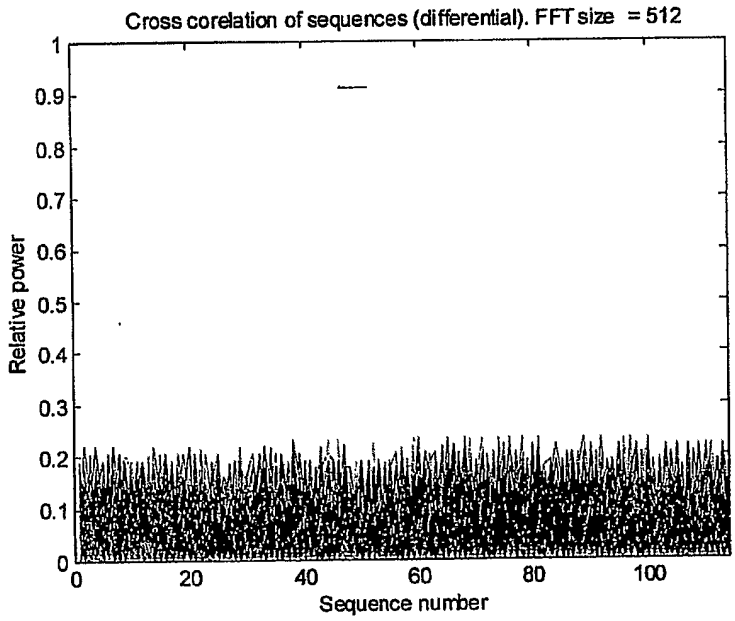
Cross corelation of sequences (differential). FFT size = 512
Relative power
Sequence number
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100

Fig. 4

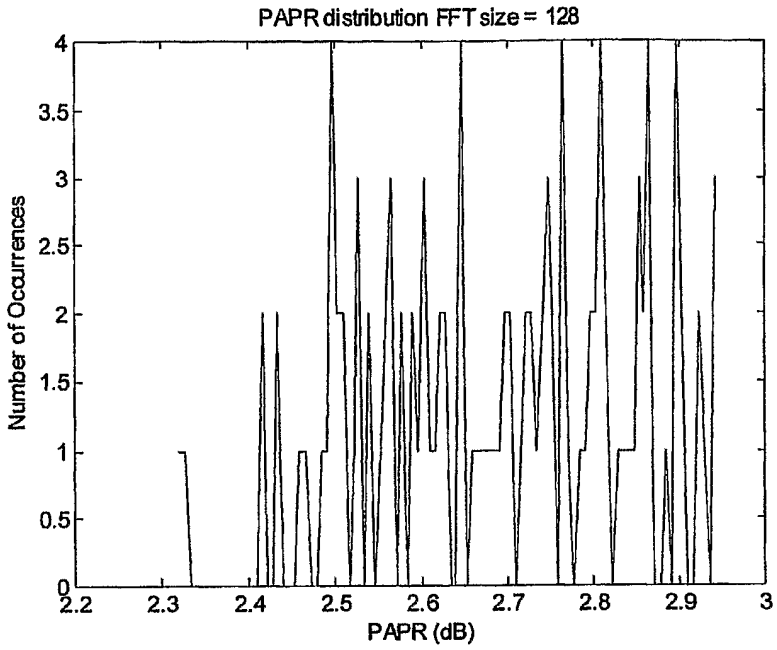
PAPR distribution FFT size = 128
Number of Occurrences
PAPR (dB)
0
0.5
1
1.5
2
2.5
3
3.5
4
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3

Fig. 5

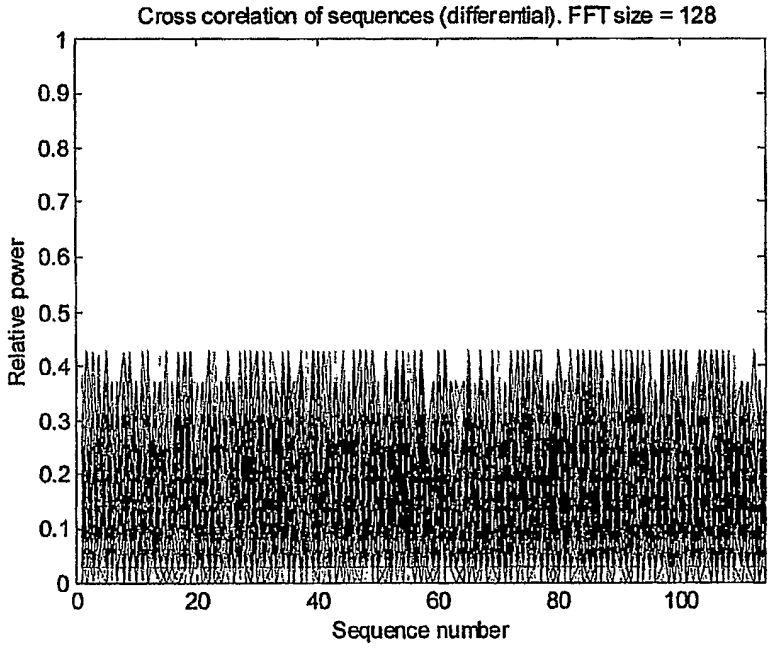
Cross corelation of sequences (differential). FFT size = 128
Relative power
Sequence number
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100

Fig. 6

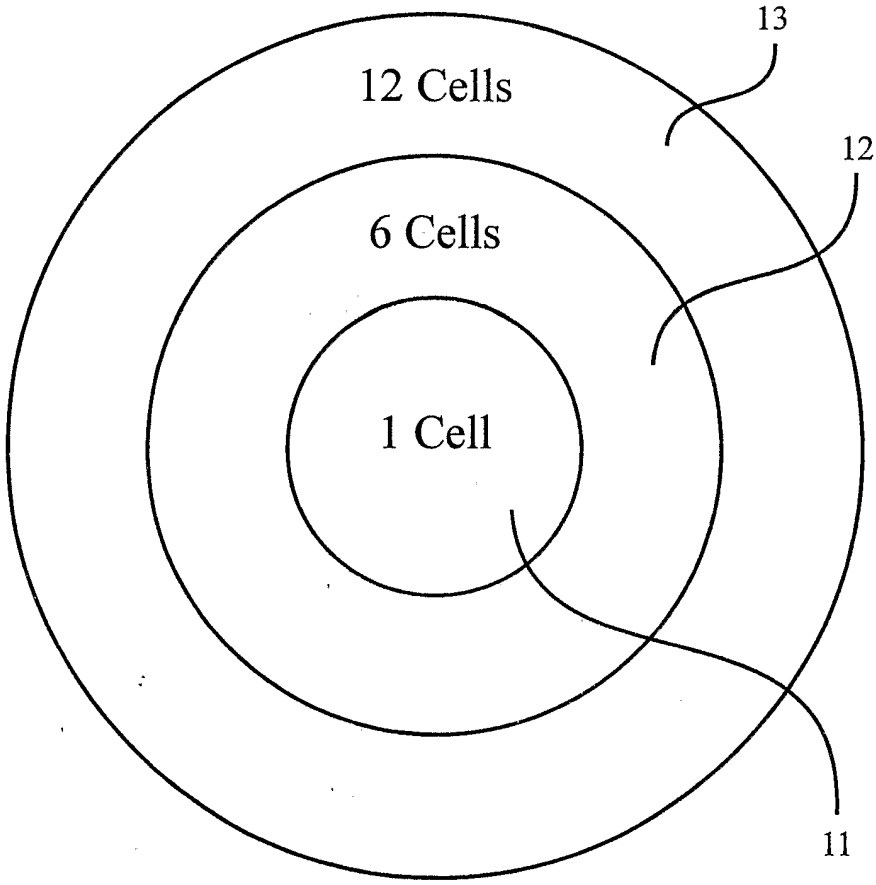

Fig. 7

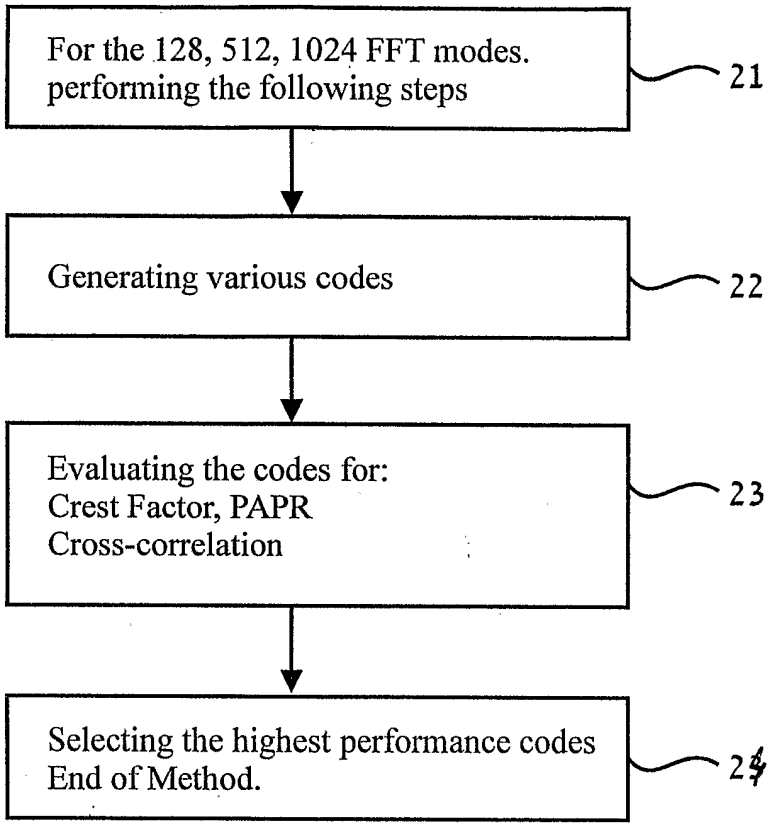
For the 128, 512, 1024 FFT modes. performing the following steps
21
Generating various codes
22
Evaluating the codes for:
Crest Factor, PAPR
Cross-correlation
23
Selecting the highest performance codes
End of Method.
24

Fig. 8