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Re:	Contribution supporting TGe WG ballot #14c
Abstract	**To enhance MIMO support for Cellular OFDMA Systems using midambles**
Purpose	Adoption of proposed changes into P802.16e-D5 ~~Crossed-out indicates deleted text,~~ underlined blue indicates new text change to the Standard, and underlined green indicates newly added text from the original contribution
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Enhanced MIMO support for Cellular OFDMA Systems using midambles

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1. Introduction

This proposal aims to improve the support for MIMO systems based on the 802.16e standard. In the current draft for 802.16e [1], the preamble is transmitted from a single antenna. The other antennas simply transmit pilots. The pilots for channel estimation for these other antennas, especially when the number of transmit antennas is 3 or 4 is not adequate. This is especially true in fast fading channels. The use of a MIMO midamble allows this without impacting the synchronization/acquisition and channel estimation performance of a SISO MSS.

Sparsely scattered pilots are available in the current standard in order to facilitate MIMO channel estimation. In slow fading channels, it is possible to combine these pilots which are spread across multiple symbols to form a single channel estimate. However, in fast fading channels (i.e. in high Doppler situations), one may not combine the pilots spread across multiple symbols to form a channel estimate since the channel changes significantly during these symbols. The pilots are more sparse when the number of antennas is 3 or 4. These pilots can be used only for tracking (under the assumption that a good channel estimate already exists). It is then important to have a good channel estimate to start with.

A midamble remedies this situation by providing a very accurate and reliable channel estimate to start with. Channel tracking can then be performed using scattered pilots or using decision directed techniques or a combination of both. The midamble also helps band AMC systems by allowing the MSS to estimate the channel quality for the entire spectrum for all the transmit antennas. Choosing the band based on the channel for single transmit antenna is suboptimal. In systems employing MIMO precoding or simple beamforming, it allows combining precoding or beamforming with band AMC.

The midamble is a single symbol consisting of only pilots, transmitted in the beginning of the MIMO zone of the DL sub-frame. For each antenna of interest, a sequence of PN (pseudo-noise) chips are mapped to certain subcarriers and transmitted. It may not be desirable the boost the midamble compared to adjacent data to avoid interference effects.

Transmission of the midamble is optional. Also it is used in the case of 2, 3 or 4 transmit antennas. In order to keep backward compatibility with IEEE 802.16d standard [2], a reserved bit in STC_Zone_IE is used to indicate the presence of this midamble.

2. Midamble structure

We propose a different midamble structure for a MIMO zone in PUSC mode, and for FUSC or optional FUSC mode.

We number the used subcarriers to start from $-N_{used}/2$. The DC carrier is also included in the numbering, but is nulled prior to transmission.

The location of the midamble within the frame need not be synchronized among the base stations. However in this case the power may not be boosted. If the location is maintained same across the network, power boosting may be used.

2.1. FUSC or Optional FUSC

In the FUSC or optional FUSC mode, the BS in a sector, uses all the subcarriers when N_t=2 or 4 and uses 3/4 of the subcarriers when N_t=3. The transmit antennas use non-overlapping subcarriers. The subcarrier to antenna mapping is different when the number of transmit antennas is 2, 3 or 4 and is described below.

Number of BS antennas is 2 : Antenna n (n = 0, 1) transmits on subcarriers, $-(N_{used}/2)+n+2k$, where k is the running index such that n+2k is always less than the number of used carriers, N_{used}. The DC carrier is nulled.

Number of BS antennas is 3 : Antenna n (n = 0, 1, 2) transmits on subcarriers, $-(N_{used}/2)+n+4k$, where k is the running index such that n+4k is always less than the number of used carriers, N_{used}. The DC carrier is nulled.

Number of BS antennas is 4 : Antenna n (n = 0, 1, 2, 3) transmits on subcarriers $-(N_{used}/2)+n+4k$ where k is the running index such that n+4k is always less than the number of used carriers, $N_{used.}$ The DC carrier is nulled.

The sequences in all cases can be chosen different like the IDcell used in the preamble.

2.2. PUSC

In the PUSC mode or zone with MIMO, the same subchannels used for data and pilots are now all used as the midamble which consists of only pilots. In other words, the data and pilot subcarriers are all replaced by the pilots of the midamble. The subcarriers within every cluster are divided among the transmit antennas as follows. Only one symbol is transmitted as the midamble.

Number of BS antennas is 2 : The even subcarriers are allotted to transmit antenna 0 and the odd subcarriers to antenna 1. Thus each antenna has 7 pilots per cluster.

Number of BS antennas is 3 : Subcarriers, n+3k are allotted to antenna n, where k is the running index.

Number of BS antennas is 4 : Subcarriers, n+4k are allotted to antenna n. Again, k is the running index.

The subcarrier allocation within a cluster is shown in figure yyyy for the case when the number of transmit antennas is 4.

The sequences in all cases can be chosen different like the IDcell used in the preamble.

3. Specific text changes

3.1. STC Zone IE format

[Modify the Table 277a in Section 8.4.5.3.4]

Table 277a -OFDMA downlink STC_ZONE IE format

Syntax	Size (bits)	Notes
STC_ZONE_IE() {		
Extended DIUC	4	STC/ZONE=0x01
Length	4	Length = 0x02
Permutation	2	00 = PUSC permutation 01 = FUSC permutation 10 = Optional FUSC permutation 11 = Optional adjacent subcarrier permutation
Use All SC indicator	1	0 = Do not use all subchannels 1 = Use all subchannels
STC	2	00 = STC using 2 antennas 01 = STC using 3 antennas 10 = STC using 4 antennas 11 = FHDC using 2 antennas
Matrix indicator	2	Antenna STC/FHDC matrix (see 8.4.8) 00 = Matrix A 01 = Matrix B 10 = Matrix C 11 = reserved
Idcell	6	
Midamble presence	1	0 = not present 1 = present at the first symbol in STC zone
Midamble boosting	1	0 = no boost 1 = Boosting (3dB)
Reserved	13	Shall be set to zero
}		

3.2. MIMO Mid-amble

[Add section 8.4.8.5]

-----------------Start text ---------------------------

8.4.8.5 The MIMO midamble

The MIMO midamble consists of one OFDM symbol which is mapped onto multiple antennas. Non-overlapping subcarriers are allotted to the transmit antennas.

For FUSC and optional FUSC, the antenna to subcarrier mapping is shown in Figure xxxx. Subcarriers index starts from the first one after the left guard band. DC subcarrier is also included in the numbering but nulled prior to transmission. The midamble carrier-set is defined using the following formula:

$$\text{Midamble\_Carrier\_Set} : -(N_{used}/2) + n + 2k^* \left\lceil \frac{N_t}{2} \right\rceil$$

where:

N_t is the number of transmit antennas 2, 3 or 4

n is the antenna index 0,1,…, N_t-1 (N_t <= 4)

k is the sub-carrier running index

The subcarrier to antenna mapping is depicted in figure xxxx for the case when N_t = 4.
The midamble sequence has the identical IDcell and segment mapping as the preamble.

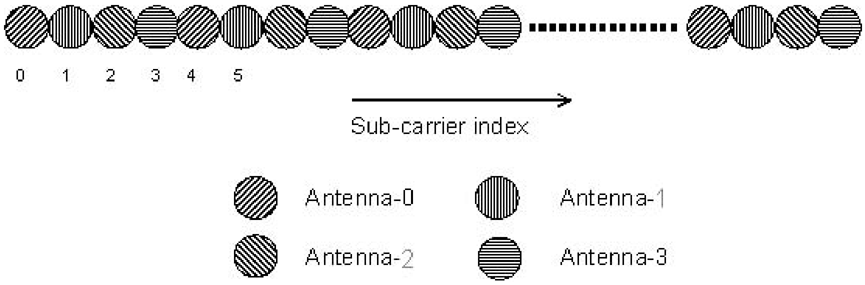

Figure xxxx Midamble FUSC structure (frequency domain)

For PUSC, the subchannel permutations and grouping remains same as for the data. Instead all the subcarriers are used as pilots. Only one symbol is used as the midamble. The midamble is allocated to the subcarriers and antennas as follows.

$$\text{Midamble\_Carrier\_Set} : -(N_{used}/2) + n + N_t k$$

where:

N_t is the number of transmit antennas

n is the antenna index 1,…, N_t-1

k is the sub-carrier running index

Figure yyyy shows the antenna to subcarrier mapping for the case when N_t = 4.

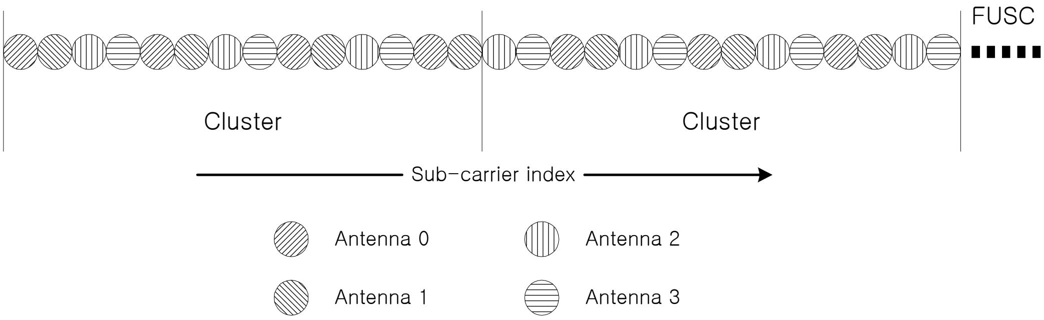

Figure yyyy Midamble PUSC structure (frequency domain)

8.4.8.5.1 Midamble Sequence for PUSC

The midamble sequence for PUSC shall be obtained from the corresponding sequence used in the FUSC or optional FUSC for the relevant FFT size and number of antennas. For PUSC, however, all the used subcarriers shall further be clustered and divided into different segments as in the data traffic region.

8.4.8.5.2 Midamble Sequence for optional FUSC

The frequency locations and corresponding values of subcarriers in a midamble are defined as in the following formula. The DC carrier is nulled.

$$P_{ID_{cell},s}\left[k_{foi}\right]=\begin{cases}1-2q_{ID_{cell}}[m], & k_{foi}=2m*\left\lceil\frac{N_t}{2}\right\rceil-\frac{N_{used}}{2}+n, m=0,1,\cdots,\frac{N_{used}}{2*\left\lceil\frac{N_t}{2}\right\rceil}-1\\ 0, & otherwise\end{cases} \quad (1)$$

$$q_{ID_{cell}}[m]=\begin{cases}R(8*\left\lfloor\frac{m}{9}\right\rfloor+m\bmod 9), & where\ \ m\ \bmod 9=0,1,\cdots,7\\ T(\left\lfloor\frac{m}{9}\right\rfloor), & where\ \ m\ \bmod 9=8\end{cases} \qquad m=0,1,\cdots,\frac{N_{used}}{2*\left\lceil\frac{N_t}{2}\right\rceil}-1 \quad (2)$$

$$ID_{cell}\in\{0,1,\cdots,126\}, n=0,1,\cdots,N_t-1, k_{foi}\in\{-N_{FFT}/2,-N_{FFT}/2+1,\cdots,N_{FFT}/2-1\}$$

The sequence $R(r)$ in (2) is either one of the following two formulas, depends on N_{FFT} and N_T. The choice of the sequence $R(r)$, and the length of sequence N_r supporting the choice are shown in table aaa.

$$R_1(r)=H_{128}(ID_{cell}+1,\ \prod\nolimits_{\left\lfloor\frac{r}{128}\right\rfloor}(r\bmod 128)),\ \ r=8*\left\lfloor\frac{m}{9}\right\rfloor+m\bmod 9=0,1,\cdots,N_r-1 \quad (3)$$

$$R_2(r)=B_{ID_{cell}+1}g_{\Pi(r)}, r=8*\left\lfloor\frac{m}{9}\right\rfloor+m\bmod 9=0,1,\cdots,N_r-1 \quad (4)$$

Tabel aaa – N_r (The length of sequence $R(r)$)

N_T	2				3 or 4			
N_{FFT}	2048	1024	512	128	2048	1024	512	128
$R_1(r)$	768	384	192		384	192		
$R_2(r)$				48			96	24

In $R_1(r)$, $H_{128}(i,j)$ denotes the number at (i,j) of a order 128 Walsh Hadamard matrix, where $i,j=0,1,\cdots,127$. The first low vector of H_{128} is the all-one sequence and shall not be used. $\prod_{\left\lfloor\frac{m}{128}\right\rfloor}(l), l=0,1,\cdots,127$ is the l-th value of the $\left\lfloor\frac{m}{128}\right\rfloor$-th permutation out of six predefined permutations shown in Table bbb

Tabel bbb – Permutation $(l=0,1,\cdots,127)$

$\prod_0(l)$	1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 0

$\prod_1(l)$	25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 0
$\prod_2(l)$	71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 0
$\prod_3(l)$	69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 0
$\prod_4(l)$	102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 0
$\prod_5(l)$	70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 0

In $R_2(r)$, if the k, $1 \le k \le 127$ can be converted into binary as $b_6b_5b_4b_3b_2b_1b_0$, define b_6 as MSB, b_0 as LSB, B_k is a row vector to represent $B_k = [b_0b_1b_2b_3b_4b_5b_6]$. The $g_u, 0 \le u \le N_r - 1$ is u th column vector of the generator matrix G. $B_k g_u$ is an inner product of (1×7) row vector and (7×1) column vector. The generator matrix G and the permuation $\prod(l), l = 0,1,\cdots,N_r - 1$ for each N_{FFT} and N_T are shown below.
The sequence $T(k)$ is determined by IDcell and should be chosen to achieve low PAPR.

8.4.8.5.2.1 PAPR Reduction Sequence for BS with 2 Antennas

[FFT size = 2048]

Table ccc. $T(k), k = \left\lfloor \frac{m}{9} \right\rfloor = 0,1,\cdots,95$

ID cell	sequence	papr	ID cell	sequence	papr
0	E5F121DCFF4A0E63825399D3	5.92384	64	BC8C283A7CA014EC79837DD7	5.82436
1	D10BA3F1A15DDF9C4D819B45	6.28771	65	DF29647F465044A0BC7D2720	6.28397
2	13310AB0491064CE7516898C	5.88237	66	F29CCF3995F08458FA0F8908	5.89065
3	E53C10EB0B1E830D7C2302A2	5.72241	67	28F5D1FD67E98528DB28BB5D	6.08206
4	37DBDBACCEDC976D1DE87D53	6.54265	68	DC5908BB6B8E1B84ADF881A8	6.01325
5	E43B8C8299E5B2B49798FA28	6.23106	69	0AF44605329EE32ACF75481B	5.84218
6	52A78E348A46E8E84CF29D7B	6.96087	70	C7CEF13FD6FE89346FB543B2	6.33524
7	CA6B366D37E54A7EDF32A688	6.23321	71	5D2B9D0E4306F96A65BAF4EB	6.34218
8	3852A3F8B0E1E7FC41301F17	6.35304	72	0E2D2473C890413D9A9D8DB1	6.05022
9	271E4591888CBCD44B32B809	5.88167	73	7C082A7E84B366733C6E19D1	5.9351
10	1CB9181F0A47346785BC9464	6.5208	74	85C50A024C78CC1B3AEF4C94	5.84302
11	786E7023033922819D70233B	6.16551	75	298A3E89079EF4C27CC921A9	6.13354
12	D7E0A495CFE8CEC3D2AF4B5D	5.99014	76	825D06F901CE94D8168D8A46	6.00828
13	360ECD45D330B876A8F13462	6.43524	77	73DCC20AFF8C5837F539EE22	6.27564
14	C63BDDD2D536FF2416B7A424	6.01736	78	553DD23CB093EFD7C544F013	5.88433
15	10A8B5DAB83CE78B3FCFC31D	6.19619	79	5EE648A514E40CF0E7ECE2A1	5.95859
16	6152A33C894DC0B62EEA0DDA	6.13798	80	F7B98C7D1DD5CE51B6B678A3	6.54896
17	757A237D70ABD7AB1FFB04F0	5.95019	81	9B840FF5F78473E2F75B8E2D	5.87521
18	BC0D0BEA01E586B664401CFC	6.2348	82	8C99E9A614E8AC8C74566752	6.03187

19	8A5CD82D82B19593F8266E7E	5.67582	83	B7EC60A09ACD2CABB53DEDE9	5.95608
20	F44201B0903E55006BDFD5B0	6.78315	84	2900FBF0CC91DA813CDBEAD0	5.87135
21	5F252E0EC94C7965A2B347F3	6.37986	85	949EF4015122026200DF05F1	6.11214
22	6E376986A947B180015A0A9A	6.24373	86	F3AE5B267C36BF3877E4AC49	5.87287
23	3669CAF711FC2129743CFFBA	6.1472	87	A4E43FBE54A0280D65419C99	6.0007
24	C1D8E53D16322CB3B1386B0E	5.87095	88	F116946F21EF61D108AC2F42	6.94574
25	9E1F780C45570E3A475F5A77	6.11801	89	5B82DE3F0ADB20D788A045A6	6.13544
26	32F36D066051FAE51512A8F3	6.27711	90	AC639F8BDB63A8C4E4746E65	6.25857
27	464AD0462512248F26313BC4	6.50894	91	70C588D838AB0FC61F8EABDA	5.85846
28	03F93CDFCA5B9D3262FD2D25	6.12574	92	D6A8AD537E8258E745C1C476	5.82355
29	694CAFC989888FC1F358CA8F	5.86597	93	8A4F652DF088D93FC0073FD8	6.00051
30	8C9F1D8E186EAFEDF0D6F4DD	6.17035	94	450F92DF140D63380103F31B	6.48422
31	C4E95F3E65B40D938946B132	5.84552	95	EAAF05F63641E7AFED3A5A79	5.90759
32	5891E3188FA53AE34576A803	5.85053	96	5F501203D217CF94BC44A6C1	6.5396
33	409FF8A9E7FCDA58D4A5241B	6.10709	97	71F6C952D988BC8847E0BA88	6.09041
34	3C70E4E442FA01B79EE09FA5	6.20979	98	BF472D6610532AE50CDF829A	6.28286
35	36817EE5B08B5B4B9CE88CBE	5.77008	99	D15D9E8AECFE8C296D5802D6	6.22803
36	BA78FAA5BDCC40837F5205DA	6.31919	100	D5AD5575149C76589FF8784A	6.07452
37	A490E570CE08172BD82A3633	5.73775	101	7868B4788F33D2EA66C86BE2	5.83685
38	8433E275E271D4EC11019463	5.78564	102	B722E30271A97725EA79020A	5.97044
39	F83B07F42EFAE5F1EA281A78	5.68333	103	30209E7F80F14A76FCB45DBF	6.06914
40	B9B93373373FFCB301EFCD77	5.79877	104	6FA8FDC42599BDFDCEEFD828	5.99957
41	22B5A5AAC8B3756C6C4ADFE6	6.27794	105	9CAF25C12BA260391958223B	5.91873
42	C6DFADA3233FF4EE17DE5E17	5.87103	106	CD82CBA6EA27C514AA8F40A0	5.72081
43	70D09DC4F9121828C70B6064	5.76809	107	96852F4F3B879A23F97D3DFA	6.24847
44	F01F5956C24E2156253809D8	6.64621	108	236F33011BD7E277C5BC9561	5.84184
45	8E157642C21545D6AFC4C9EE	5.77721	109	9B74FD2CA98D58E7B8EDD5DB	6.1246
46	391D93EF8012E5D2F8E2C299	6.87607	110	2DC51FEED52392D7174435E8	5.80747
47	EC1D207A7BA6C4852C105E34	6.09394	111	8708EE1A78F79E3E14D30DD7	6.23013
48	55858594CBAC6A7760D72623	6.0547	112	FCCD639AD5BA5B1451CBD600	5.96117
49	FBB76DDCC08E8B0A89E8D35B	6.30027	113	652492280DC624A59D2A3F82	6.32939
50	6394D6CFC5269D0B8DFCE4D6	5.71258	114	B8D0EC8813E8453214C74501	5.99404
51	F92EDE555781CC62F5C3FA42	6.26962	115	2AC9F5941B28ED1CF89F6F0A	5.96885
52	E66B7E6E901C802D1725C31B	6.98039	116	64DB26CD230FABD4BA1A8412	6.58194
53	0BA101B2F3F78E672EFC0CC7	6.25099	117	C3E2EF9EDB75E639EDC84DEA	6.07393
54	26E1EC3E787F6092D1634683	6.54994	118	4BE5A9ADCB4B4C4758F4CEBD	5.98986
55	4767A25488E79F75E2F45FA1	6.25162	119	3C72C151C36EA2757082442D	6.02742
56	1A2FC69DC4DCAD0399DAF857	6.06972	120	B482C15B86D52FC1106E2E60	5.91514
57	53F2BFC63878B6C2C10C8A2C	5.70754	121	F26820407553EDB43C57123C	6.07394
58	C20824E0B5348061E2A4C1CE	6.05831	122	1C045E9D66325157825D6967	6.10105
59	8F1B88288316B59939D490A9	6.002	123	0E0F6D035E1AC7A1D76161A7	6.7399
60	3203E66C6406767186F8955A	6.79504	124	C1C20BF875BE9E94D1CAE3BA	5.82982
61	B335E583FD89A0A410876B81	6.17206	125	527261E102F3FC3ABCE2C13C	5.96992
62	C11D537E5E2992361F2CC44B	6.06154	126	8AFE184CD76A2756E5394350	6.76565
63	F1E074FEB2CF55427C573C6F	5.80776			

[FFT size = 1024]

Table ddd. $T(k), k = \left\lfloor \frac{m}{9} \right\rfloor = 0,1,\cdots,47$

ID cell	sequence	papr	ID cell	sequence	papr	ID cell	sequence	papr
0	C9A1F9FB33E2	5.73908	43	13CBBBDD1888	5.25927	85	B639EE82C328	5.71509
1	C615462A8D6E	5.69178	44	34B0D91482A7	5.43386	86	6414C0DB128C	6.26365
2	D8400C1E2B47	5.67259	45	0DB3ECE942B0	5.40054	87	08FEAB4846B9	5.5487
3	DBCF1478431C	5.91286	46	A4D876BF7C4E	5.45618	88	7E160C4BA0F0	5.7677
4	CC93B30C0EB9	5.55863	47	7D492A0F5B39	6.40321	89	5CCA9AF7C373	5.61368
5	C6F3D332B053	5.3082	48	C82DA6102B09	5.31582	90	21B3DF421DE7	5.43398
6	9BA4E419EBB5	5.5186	49	F68C09C7D629	5.1445	91	9323DD2F2771	5.2348
7	48FD85CD7E76	6.11686	50	4D6C3B62D026	6.44183	92	A26015CF1514	5.78478
8	E992B4493831	5.69693	51	EBD13D02E539	5.35096	93	8220CF898D60	5.43634
9	4E1401A862B5	5.92235	52	760432EDBC5B	5.42816	94	8CCEC410F8A6	5.33904
10	9D3239BF5543	5.50286	53	022040211B53	5.58372	95	4FFDECD6D0E0	5.50659

11	2B8584BFB3D8	5.19875	54	2663067DE01D	5.50621	96	42D052099826	5.68271
12	AB42706F96A0	5.44334	55	C0776A8DD057	5.29609	97	8785DFDA586A	5.2863
13	9DB123495FB7	5.63328	56	96117C9722E1	5.61786	98	68DDF31B930F	5.65759
14	A6EFBCB2865D	6.0094	57	204C31E521C4	5.27659	99	F0539BCDAACB	5.6598
15	709300E57360	5.73209	58	C8C12F23551B	5.70925	100	372C0613FE2C	5.21517
16	6E2122FC796F	5.82368	59	1217E2F687C1	5.51497	101	37402B2A80A9	6.29655
17	7F01F8B4454F	5.47779	60	DBF86CB15B3B	5.57367	102	523AE3212125	5.41681
18	CDF8525E2FF7	5.33406	61	BCC4EC437886	5.94074	103	02EDF46F9694	5.47569
19	0AC1FA2585A5	6.24242	62	AA2734F33EF9	5.71983	104	E64CC083190E	5.71759
20	46843DFB1135	5.65053	63	CBA739A84A4D	5.96463	105	65DE3871D0D1	5.80455
21	8B411A6D7235	5.524	64	E12166CA6DF5	5.64715	106	7808E3E5FE8E	5.88159
22	096A3287FE74	5.65888	65	DE42128CD418	5.16399	107	070004E13E81	5.79589
23	E26CD654FF1A	5.89291	66	F90F21A0B95F	5.52101	108	1CE29934CF8D	5.33859
24	D955EFF989FE	5.90035	67	DCC08885C1D0	5.34739	109	52B8A394BDBC	5.9872
25	882566402741	5.62867	68	152AFEFAA90D	5.34108	110	1A13C7DB3016	5.31546
26	9FCD0AB3FCF8	5.79711	69	CB30CE0D8CD2	5.89277	111	CE75430244B7	5.40294
27	8E477A39DA36	5.45249	70	849C1C0DA6A3	5.64765	112	DD89BD52F023	5.81172
28	83740061371F	5.42528	71	B8177804D737	5.78193	113	6B98276F9841	5.59191
29	179FBF270668	5.59438	72	693BE40CEE81	5.6998	114	6610C6E6E48A	5.56389
30	0B4738E24AE1	6.26907	73	632921AF950C	6.29239	115	D753E680DA0C	5.15097
31	9BD23A217294	5.83321	74	C4D296ABB9B0	5.55821	116	2C4F3846B73B	5.61595
32	E783A99153C7	5.57411	75	08DCE8EE0E46	5.61434	117	2CF0C114CDE6	5.32662
33	60690386D94B	5.56542	76	616A6B8637F3	5.29314	118	402321DA1EE8	5.54017
34	EEB11CF6A279	5.61602	77	DB69C2C67E5F	5.67251	119	9B1C5FA285FF	5.46826
35	17737FC0364B	5.46925	78	B7922C4D47E0	5.54227	120	89CCD4198A39	5.81874
36	DBA832CB29FF	5.46318	79	5A4273474A62	5.41366	121	8CCC9E1070AA	5.47071
37	841030AA2B58	5.66141	80	50082E465126	5.57391	122	A6F8618DABA3	6.12696
38	573AE8A1189A	6.49919	81	2E3844099ABD	5.27701	123	068DC6397B4C	5.86346
39	26EF1E523190	5.45727	82	F8EFB7F0CE2F	5.76264	124	860C87D27677	5.84626
40	45F27228B846	6.37869	83	64B7E857C964	5.89799	125	B28A7B2A0082	6.26524
41	D26C39A8D803	5.63232	84	5B4DDAF2A8D1	6.02566	126	1F2FB417DDEB	6.103
42	4514BB4432A6	5.74245						

[FFT size = 512]

Table eee. $T(k), k = \left\lfloor \frac{m}{9} \right\rfloor = 0,1,\cdots,23$

ID cell	sequence	papr	ID cell	sequence	papr	ID cell	sequence	papr
0	C88B5B	4.67601	43	F3D2C6	4.93286	85	B286FB	5.2203
1	4B943B	5.01945	44	0BFE87	5.03341	86	36016D	5.00459
2	26A2CA	4.9099	45	92AA64	4.93443	87	98D31F	4.85287
3	ABF43A	4.9298	46	A5D580	5.18021	88	6A87B3	4.80097
4	F653DD	5.58288	47	6D6DFD	4.94058	89	958B99	5.40979
5	686FDB	5.08845	48	6A578D	5.58274	90	8AB689	4.89558
6	0D2D4F	5.49959	49	967EE4	5.18235	91	570A5C	4.75712
7	E4BEB2	5.03402	50	CE4755	6.35302	92	47A9A6	5.42678
8	C68129	5.41883	51	2D6ECE	5.92368	93	4B2F30	5.47629
9	6C86BB	5.41345	52	6BA1CF	6.12984	94	0D6033	5.36666
10	0211D9	5.25745	53	019E02	6.09087	95	3F7DAA	4.73588
11	4A0178	4.60192	54	A06B8B	4.90168	96	E64518	5.68267
12	71E762	5.20474	55	9CBA18	5.48837	97	F94B7D	4.92173
13	3EBA79	5.1286	56	05FD60	5.16162	98	78D213	5.38737
14	8CF2B6	4.94086	57	FC2322	4.95813	99	9EDE1D	5.05499
15	F052BB	4.73214	58	F0898A	5.74311	100	8E3B36	5.76876
16	36BF3C	5.22147	59	F22469	5.32756	101	74AF80	5.10266
17	56684C	5.74529	60	57673A	6.33084	102	CC8769	4.89204
18	654D89	5.24514	61	1A38DB	5.56632	103	265829	5.3906
19	2781F3	4.89117	62	A69433	4.90576	104	7CF001	5.44668
20	46876A	4.62728	63	9B80BB	4.82736	105	B5D0CE	5.14106
21	CE53D0	4.94685	64	6B75F8	4.66086	106	43277F	5.24521
22	523974	4.87706	65	DF32CD	5.28631	107	015C21	4.93279
23	4A0453	5.02621	66	D1F692	4.86675	108	A4AB8B	5.01596

24	47F9ED	5.91721	67	E6FCC8	5.65351	109	B3A938	5.15091
25	BB2C96	4.83723	68	08DF3D	4.79648	110	3333D3	4.78207
26	48B142	5.21914	69	39CFC0	4.95539	111	AFA03D	5.52105
27	FFDA6B	5.52578	70	EC8BAD	5.95318	112	88F995	5.11364
28	8F8DC4	4.95493	71	16B9AC	5.12127	113	E1668B	5.77986
29	1A1037	5.06145	72	6E6D24	5.88171	114	660486	5.54529
30	50F345	5.39428	73	B2027C	5.22276	115	950A62	5.40358
31	9C2ABE	5.15445	74	E05272	5.72503	116	8C5ADE	4.8725
32	97191F	4.88407	75	859C89	5.65769	117	E5A8B8	4.92944
33	61FCD0	5.82153	76	6624DD	4.98579	118	B829A5	6.05407
34	6F8969	6.25241	77	F2D404	5.27575	119	F307EB	5.82622
35	156F56	5.42931	78	8B81D9	5.26581	120	B17886	5.21061
36	BC8D17	5.08773	79	5C69D7	4.97194	121	D84D1D	4.76129
37	F3092A	5.05832	80	645838	5.86814	122	EF6206	5.37892
38	A41DBD	4.75378	81	8DEFA5	4.94176	123	4DBF2A	5.23858
39	6EA1E4	4.83662	82	22059A	5.76969	124	99AE0A	5.42723
40	6A29F7	5.19888	83	70A052	5.26498	125	B72333	5.34308
41	462826	4.79626	84	50E6D6	5.65313	126	39157D	5.3781
42	5FB555	4.97374						

[FFT size = 128]

$$G = [g_0 g_1 \cdots g_{47}]$$

$$= \begin{bmatrix} 010101010101010100000101011000110000000011111111 \\ 001100110011001100010001000100010000000110101010110 \\ 00001111000011110101010101010101010000010101100011 \\ 000000001111111100110011001100110001000100010001 \\ 00000011010101100000011110000111101010101010101 \\ 000001010110001100000000111111110011001100110011 \\ 00010001000100010000000110101011000000111100001111 \end{bmatrix} \quad (5)$$

Tabel fff – Permutation $(l = 0,1,\cdots,47)$

$\Pi(l)$	5,6,4,10,7,2,14,0,8,11,13,12,3,15,1,9,26,29,19,27,31,17,20,16,23,28,24,21,18,30,25,22,43,46,34,47,44,41,37,36,39,38,35,33,32,45,40,42

Table ggg. $T(k), k = \left\lfloor \frac{m}{9} \right\rfloor = 0,1,\cdots,5$

ID cell	sequence	papr	ID cell	sequence	papr	ID cell	sequence	papr
0	1 1 1 0 1 1	6.67057	43	1 0 0 1 1 0	6.50695	85	0 0 0 0 0 1	6.41868
1	0 0 1 1 0 0	5.883	44	0 0 0 0 0 1	5.58222	86	1 0 1 0 1 1	5.47231
2	1 1 1 1 1 1	4.95588	45	1 1 1 0 1 1	5.19814	87	0 1 0 1 1 1	4.27052
3	0 1 1 0 0 1	4.92942	46	1 0 0 1 1 0	5.50865	88	0 0 0 1 0 1	4.98455
4	1 0 0 1 0 0	4.84232	47	1 0 0 0 0 0	5.40503	89	0 0 0 1 0 1	4.85573
5	0 1 0 1 0 0	5.97707	48	1 0 0 1 0 0	4.48416	90	1 0 1 1 0 0	4.66224
6	0 0 0 0 1 1	5.2818	49	0 1 0 0 1 1	5.59862	91	0 1 1 0 0 1	5.59862
7	0 1 1 1 0 1	4.62935	50	0 1 0 1 0 0	4.76609	92	0 1 0 1 0 1	5.13782
8	1 1 1 1 0 1	4.80191	51	0 1 1 1 0 1	4.87033	93	1 1 0 0 0 0	5.73533
9	0 1 1 1 1 0	4.62839	52	1 1 1 0 0 1	5.60052	94	0 1 1 1 1 1	6.31115
10	1 0 0 0 0 0	4.93818	53	1 0 1 0 0 1	4.18939	95	0 1 1 1 0 1	4.76096
11	0 0 0 0 1 0	4.62239	54	1 1 1 1 0 1	5.00411	96	0 1 0 1 1 1	4.43229
12	1 1 0 0 1 1	6.23206	55	1 1 1 1 0 0	4.91284	97	1 0 0 1 1 1	4.52351
13	0 0 0 0 0 1	4.76556	56	0 0 0 0 1 0	6.92296	98	1 0 0 1 0 0	4.16266

14	1 1 0 1 1 1	5.21957	57	0 0 0 0 1 0	5.39012	99	1 1 1 0 1 0	5.72573
15	0 1 1 0 0 0	6.73261	58	0 1 1 0 0 1	6.0232	100	0 1 0 1 0 0	4.34746
16	0 0 1 1 1 0	4.9981	59	1 1 0 1 0 0	6.27241	101	1 0 0 1 0 0	6.81937
17	0 1 1 0 0 0	5.23977	60	0 0 1 0 1 0	5.26582	102	0 1 0 1 1 1	5.86829
18	1 1 1 1 1 0	5.59862	61	1 0 0 0 0 1	5.47146	103	0 1 0 1 1 0	5.22038
19	0 1 1 1 0 1	6.75846	62	0 0 0 0 1 0	6.43249	104	1 0 0 0 0 0	4.8724
20	0 0 1 1 1 1	4.86729	63	1 0 0 1 1 1	4.69906	105	0 1 1 0 1 1	6.7858
21	1 1 0 0 0 0	5.57405	64	1 1 1 0 0 0	5.28969	106	1 0 0 0 1 0	5.75267
22	1 0 1 0 0 1	4.82303	65	1 0 1 0 1 1	6.66865	107	1 1 0 0 1 1	5.1796
23	0 1 0 1 0 1	4.54948	66	1 0 1 0 1 1	5.90593	108	1 1 1 0 0 0	6.00083
24	0 1 1 1 0 1	5.45765	67	0 1 1 1 0 0	6.13642	109	1 0 1 0 0 1	4.6724
25	1 1 0 0 0 1	4.91648	68	0 0 1 0 0 0	4.9337	110	1 0 0 1 0 0	4.8345
26	1 0 0 1 0 1	3.95813	69	0 1 1 0 1 0	5.13715	111	0 0 1 1 1 0	4.05646
27	1 0 0 0 0 1	6.03433	70	1 1 1 1 0 0	5.05877	112	0 0 1 1 1 1	5.6271
28	1 1 0 0 0 1	4.50629	71	1 0 0 1 0 0	5.42538	113	0 1 1 1 1 1	5.59862
29	0 1 0 0 0 1	4.80454	72	1 1 1 0 1 0	5.21428	114	1 1 0 0 1 0	4.90494
30	1 0 1 1 1 1	4.94614	73	1 0 1 1 0 1	4.27288	115	0 0 1 1 0 0	5.95286
31	1 0 1 1 0 0	4.54236	74	0 1 0 0 0 1	4.63478	116	0 1 1 0 0 1	5.99303
32	0 1 1 0 0 0	3.86311	75	1 0 1 0 0 1	5.47216	117	0 1 0 0 1 1	3.97648
33	0 1 1 0 0 0	5.18297	76	1 0 1 0 0 0	6.49514	118	0 1 0 1 0 0	5.71222
34	1 1 0 1 0 1	5.59137	77	1 1 0 0 0 0	5.35897	119	0 0 0 0 1 1	4.61398
35	1 0 0 1 0 0	5.51632	78	0 0 0 0 0 1	5.59862	120	1 1 1 1 1 0	4.67909
36	1 1 0 0 1 0	4.64969	79	0 1 0 0 0 0	5.36634	121	1 0 0 1 1 0	5.53328
37	1 1 1 0 0 0	5.59862	80	0 0 0 0 1 0	4.79522	122	0 0 0 1 1 0	5.20303
38	0 0 0 0 1 1	6.56393	81	0 0 1 1 1 0	5.03585	123	0 1 1 0 0 0	5.00679
39	1 0 1 0 0 0	6.63257	82	1 1 0 0 1 1	6.41538	124	1 0 1 1 1 0	4.57847
40	0 0 1 0 1 1	6.30837	83	0 1 1 0 0 1	5.92329	125	0 1 1 1 0 0	4.79082
41	0 0 0 1 0 1	5.76388	84	1 0 1 1 1 0	5.24541	126	1 1 0 1 0 0	4.91901
42	0 0 0 1 1 1	5.17733						

8.4.8.5.2.2 PAPR Reduction Sequence for BS with 3 or 4 Antennas

[FFT size = 2048]
The sequence $T(k)$ is the same as $N_t = 2$, $N_{FFT} = 1024$ case.

[FFT size = 1024]
The sequence $T(k)$ is the same as $N_t = 2$, $N_{FFT} = 512$ case.

[FFT size = 512]
$G = [g_0 g_1 \cdots g_{95}]$

$$= \begin{bmatrix} 010101010101010100010001000100010000010101100011000000110101011000000000111111110000111100001111 \\ 001100110011001101010101010101010001000100010001000001010110001100000011010101100000000011111111 \\ 000011110000111100110011001100110101010101010101000100010001000100000101011000110000001101010110 \\ 000000001111111100001111000011110011001100110011010101010101010100010001000100010000010101100011 \\ 000000110101011000000000111111110000111100001111001100110011001101010101010101010001000100010001 \\ 000001010110001100000011010101100000000011111111000011110000111100110011001100110101010101010101 \\ 000100010001000100000101011000110000001101010110000000001111111100001111000011110011001100110011 \end{bmatrix} \quad (6)$$

Tabel hhh – Permutation $(l = 0,1,\cdots,95)$

$\Pi(l)$	2,6,0,10,14,11,7,3,8,15,1,12,9,4,13,5,18,26,24,17,29,19,21,16,23,22,25,28,27,31,20,30,41,34, 38,44,36,43,35,32,45,47,46,39,40,33,37,42,60,56,59,61,51,62,52,49,58,48,53,50,54,57,55,63, 71,77,76,74,67,66,68,75,78,64,69,79,72,70,65,73,81,92,83,87,82,94,86,88,95,91,93,90,84,85, 80,89

Table iii. $T(k), k = \left\lfloor \frac{m}{9} \right\rfloor = 0,1,\cdots,11$

ID cell	sequence	papr	ID cell	sequence	papr	ID cell	sequence	papr
0	CB3	6.26336	43	7B6	5.20885	85	F67	4.86142
1	D47	5.27748	44	4A7	5.52378	86	4D4	6.21941
2	59D	4.9581	45	0D4	6.47369	87	810	4.25677
3	F21	5.05997	46	523	5.20757	88	201	4.47647
4	87E	6.51422	47	F29	5.0776	89	054	6.8165
5	BFA	5.33856	48	A67	5.52381	90	654	5.87238
6	4D4	7.0618	49	251	5.10732	91	F34	5.31419
7	3E0	6.41769	50	B8E	4.77121	92	4FF	6.88515
8	3E4	4.87727	51	5B0	5.38618	93	4AA	6.75475
9	6F7	4.15136	52	B6B	5.20069	94	E8D	6.10937
10	8D0	5.86359	53	DCC	6.18175	95	944	4.79898
11	33E	5.68455	54	356	5.46713	96	478	4.77121
12	CA3	5.79482	55	7FB	6.23427	97	17E	5.66118
13	119	5.29216	56	C6B	4.64117	98	696	4.93494
14	AA3	5.3423	57	956	5.81606	99	31A	5.36534
15	EC5	5.40257	58	100	5.04293	100	9D7	4.78933
16	A08	5.63148	59	DF0	6.56931	101	2A4	5.45932
17	96C	5.44285	60	663	5.4996	102	35C	6.40963
18	9D3	5.19112	61	602	5.72958	103	CBD	5.39788
19	5BC	5.41859	62	894	4.96955	104	44C	4.38835
20	4BC	5.96539	63	247	5.37554	105	416	4.38145
21	D15	6.07706	64	73E	5.29366	106	6B6	5.5007
22	A31	4.76142	65	0FE	6.62956	107	E79	5.6706
23	4B3	4.67373	66	5CB	4.88939	108	34F	5.62588
24	B0A	5.24324	67	C59	4.30678	109	DC4	5.29578
25	BB7	4.81109	68	5B5	5.54517	110	586	5.00808
26	245	4.99566	69	E2D	5.27261	111	DF3	4.48385
27	834	4.81878	70	5F6	5.03828	112	F2B	5.53794
28	A59	5.78273	71	9A9	5.25379	113	ED1	5.58523
29	807	5.59368	72	BDB	5.14859	114	686	5.71655
30	694	5.53837	73	AE7	5.39255	115	500	5.01001
31	6C6	6.42782	74	2C2	4.97124	116	8FB	5.89436
32	1F3	5.26429	75	6A3	6.20876	117	CB5	5.25553
33	573	4.94488	76	D3A	4.83271	118	99A	5.47731
34	07F	6.36319	77	741	5.5686	119	43D	5.4871
35	9A3	5.91188	78	737	5.64126	120	161	6.18899
36	C86	5.36258	79	7AC	5.17063	121	32D	5.35874
37	349	4.98064	80	79F	5.0828	122	49D	5.46312
38	C83	6.14253	81	3FA	5.22885	123	8BD	5.13605
39	EE0	5.95156	82	99C	6.01707	124	2E9	5.70272
40	4CA	5.40169	83	755	6.51422	125	0F0	6.26171
41	634	4.82317	84	A44	4.93486	126	144	5.50515
42	360	5.05168						

[FFT size = 128]

$$G = [g_0 g_1 \cdots g_{23}] = \begin{bmatrix} 010101010101010101010101 \\ 001100110011001100110011 \\ 000011110000111100001111 \\ 111111110000000011111111 \\ 000000001111111111111111 \\ 111111001010000010010000 \\ 111110100000011000001100 \end{bmatrix} \quad (7)$$

Tabel jjj – Permutation $(l = 0,1,\cdots,23)$

$\prod(l)$	11,6,4,9,7,8,0,10,5,1,2,3,17,20,21,14,18,16,23,15,19,22,12,13

Table kkk $T(k), k = \left\lfloor \frac{m}{9} \right\rfloor = 0,1,\cdots,2$

ID cell	sequence	papr	ID cell	sequence	papr	ID cell	sequence	papr
0	0 1 0	5.35724	43	1 1 1	5.22032	85	1 0 1	5.38087
1	0 0 0	5.17414	44	0 0 0	6.51422	86	1 1 0	4.70313
2	1 1 1	6.51422	45	1 1 1	4.98055	87	0 0 0	3.79899
3	0 0 0	3.82903	46	0 0 1	3.50075	88	1 0 0	5.31434
4	1 1 0	5.5707	47	0 0 0	5.08034	89	1 1 0	6.41534
5	1 1 1	4.51562	48	0 1 0	5.41647	90	0 0 1	4.11983
6	1 0 1	4.99659	49	1 1 0	4.02914	91	1 1 0	4.18856
7	1 0 0	4.507	50	0 1 0	3.77237	92	0 1 0	4.81524
8	0 0 0	2.77148	51	1 1 1	3.99062	93	0 1 0	5.0717
9	0 1 1	4.52863	52	0 1 1	4.62794	94	0 1 0	5.05024
10	0 0 1	4.77121	53	1 0 0	4.81314	95	0 0 0	4.77121
11	1 0 0	4.59416	54	0 0 0	4.20522	96	1 0 0	4.18255
12	0 1 0	3.78955	55	1 0 0	5.39106	97	1 1 0	3.49527
13	1 0 0	4.60896	56	0 1 1	5.58402	98	0 1 0	4.47417
14	1 0 0	4.5935	57	1 1 1	4.58125	99	0 1 1	6.09081
15	1 0 0	4.22853	58	0 0 0	4.72378	100	1 0 1	4.2738
16	1 0 1	4.53933	59	0 0 0	4.16781	101	0 0 1	3.77032
17	1 0 0	4.22832	60	0 0 1	6.57249	102	0 0 0	4.79531
18	0 1 1	4.53739	61	1 0 0	3.98784	103	1 1 0	3.80557
19	0 0 1	4.84545	62	0 0 1	5.95339	104	0 0 1	3.67728
20	1 0 0	5.1608	63	1 1 0	5.27337	105	1 0 0	5.55408
21	1 1 0	6.19203	64	0 1 1	3.52173	106	1 1 1	4.96913
22	0 0 1	4.58568	65	0 0 0	5.01602	107	0 1 1	4.52983
23	0 1 1	5.684	66	0 0 1	6.01058	108	0 1 1	5.0537
24	0 1 0	4.76503	67	0 1 0	4.70152	109	0 1 1	4.67829
25	0 0 0	4.77579	68	0 0 0	3.37021	110	1 0 1	6.11194
26	0 1 0	4.73628	69	0 0 1	5.18544	111	1 1 0	3.53966
27	1 0 0	4.98055	70	1 0 1	5.59372	112	1 0 0	4.49668
28	0 1 1	4.77121	71	1 1 0	4.64525	113	0 0 0	4.44827
29	1 0 0	4.44124	72	0 0 0	4.54804	114	1 1 1	5.4278
30	0 0 0	5.17708	73	1 0 1	6.18314	115	1 0 0	6.33804
31	0 0 0	4.2966	74	0 1 0	4.32808	116	0 1 0	5.31678
32	1 0 1	4.61762	75	0 0 1	4.56337	117	1 1 0	4.77121
33	1 0 1	3.5604	76	0 0 0	5.36844	118	0 0 1	4.9246
34	0 1 0	5.96329	77	0 1 1	4.98055	119	0 1 0	4.46379
35	0 0 0	6.00008	78	0 0 0	4.43788	120	0 1 1	4.32577
36	0 1 1	5.2032	79	1 0 0	6.51422	121	1 1 1	5.88992
37	0 1 1	5.5032	80	1 1 1	4.21693	122	0 0 0	5.02873

38	1 1 1	4.63273	81	0 0 1	4.73888	123	1 0 1	5.70347
39	0 0 0	4.79863	82	1 1 1	5.31912	124	1 1 0	6.14544
40	1 1 1	6.68743	83	0 0 1	6.51422	125	0 0 1	4.75797
41	1 0 1	4.93428	84	0 0 1	6.01936	126	1 1 0	4.66479
42	1 1 0	5.43501						

-----------------End text ----------------------------