

(12) 按照专利合作条约所公布的国际申请

(19) 世界知识产权组织
国际局



(10) 国际公布号

WO 2018/201547 A1

(43) 国际公布日

2018 年 11 月 8 日 (08.11.2018)

(51) 国际专利分类号:

H03M 13/11 (2006.01)

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(21) 国际申请号:

PCT/CN2017/087073

(22) 国际申请日:

2017 年 6 月 2 日 (02.06.2017)

(25) 申请语言:

中文

(26) 公布语言:

中文

(30) 优先权:

201710314217.3 2017年5月5日 (05.05.2017) CN

201710381396.2 2017年5月25日 (25.05.2017) CN

PCT/CN2017/086227

2017年5月26日 (26.05.2017) CN

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(81) 指定国(除另有指明, 要求每一种可提供的国家保护): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG,

(54) Title: INFORMATION PROCESSING METHOD AND COMMUNICATION APPARATUS

(54) 发明名称: 信息处理的方法、通信装置

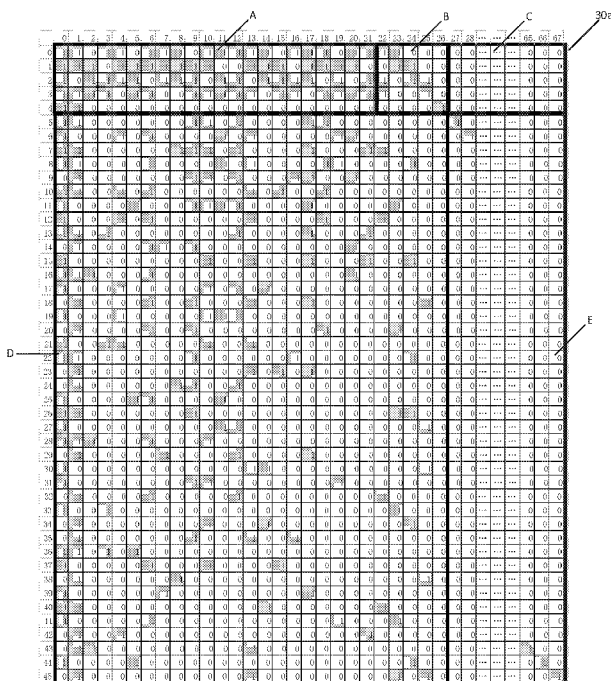


图3a

(57) Abstract: An encoding method, an apparatus, a communication device and a communication system. The method comprises: using a low-density parity-check (LDPC) matrix to encode an input bit sequence, a base graph of the LDPC matrix being expressed as a matrix of m rows and n columns, m being an integer greater than or equal to 5, n being an integer greater than or equal to 27, the base graph at least comprising a sub-matrix A and a sub-matrix B, the sub-matrix A being a matrix of 5 rows and 22 columns, the sub-matrix B being a matrix of 5 rows and 5 columns, the sub-matrix B comprising a column having a weight of 3 and a sub-matrix

BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW。

(84) 指定国 (除另有指明, 要求每一种可提供的地区保护): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), 欧亚 (AM, AZ, BY, KG, KZ, RU, TJ, TM), 欧洲 (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG)。

本国际公布:

— 包括国际检索报告 (条约第21条(3))。

B' having a dual-diagonal structure. The encoding method, the apparatus, the communication device and the communication system support encoding requirements for information bit sequences of various lengths.

(57) 摘要: 一种编码方法, 装置、通信设备和通信系统, 该方法包括: 使用低密度奇偶校验LDPC矩阵对输入比特序列进行编码; 其中, 所述LDPC矩阵的基图表示为 m 行 n 列的矩阵, m 为大于或者等于5的整数, n 为大于或者等于27的整数; 所述基图至少包括子矩阵A和子矩阵B, 其中, 所述子矩阵A为5行22列的矩阵; 所述子矩阵B为5行5列的矩阵, 其中, 所述子矩阵B包括一权重为3的列和双对角结构的子矩阵B'。上述编码方法、装置、通信设备和通信系统能够支持多种长度的信息比特序列的编码需求。

信息处理的方法、通信装置

技术领域

本发明实施例涉及通信领域，尤其涉及信息处理的方法、和通信装置。

5

背景技术

低密度奇偶校验（low density parity check, LDPC）码是一类具有稀疏校验矩阵的线性分组编码，具有结构灵活，译码复杂度低的特点。由于它采用部分并行的迭代译码算法，从而比传统的Turbo码具有更高的吞吐率。LDPC码可用于通信系统的纠错码，从而提高信道传输的可靠性和功率利用率。LDPC码还可以广泛应用于空间通信、光纤通信、个人通信系统、ADSL和磁记录设备等。目前在第五代移动通信中已考虑采用LDPC码作为信道编码方式之一。

实际使用过程中，可以采用具有特殊结构化特征的 LDPC 矩阵。该具有特殊结构化特征的 LDPC 矩阵 H 可以由准循环（quasi cycle, QC）结构的 LDPC 基矩阵扩展得到。

通常情况下，待编码的信息比特序列长度从几十到上百不等，通信系统要求的码率也灵活多变。如何支持多种长度的信息比特序列的编码，符合系统的码率要求，成为一个需要解决的问题。

发明内容

本发明实施例提供了一种信息处理的方法、通信装置和系统，可以支持多种长度的信息比特序列的编码和译码，符合系统灵活的码长码率要求。

第一方面，提供了一种编码方法及编码器，所述编码器使用低密度奇偶校验LDPC矩阵对输入序列进行编码。

第二方面，提供了一种译码方法及译码器，所述译码器使用低密度奇偶校验LDPC矩阵对输入序列进行译码。

在上述第一方面或第二方面的第一种实现方式中：所述 LDPC 矩阵的基图表示为 m 行 n 列的矩阵， m 为大于或者等于 5 的整数， n 为大于或者等于 27 的整数；所述基图至少包括子矩阵 A 和子矩阵 B，其中，所述子矩阵 A 为 5 行 22 列的矩阵；所述子矩阵 B 为 5 行 5 列的矩阵，其中，所述子矩阵 B 包括权重为 3 的列和双对角结构的子矩阵 B'。

可选的，所述子矩阵 A 和所述子矩阵 B 构成的矩阵中，其中 1 行的权重满足大于或者等于 1，且小于或者等于 5，其余 4 行的权重分别满足大于或者等于 17，且小于或者等于 21。

例如，在所述子矩阵 A 和所述子矩阵 B 构成的矩阵中，其中 1 行的权重为 3，其余 4 行的权重为 19。在这种情况下，所述子矩阵 A 和所述子矩阵 B 构成的矩阵可以包括如基图 30a 中第 0 行至第 4 行以及第 0 列至第 26 列组成的 5 行矩阵块，其中行之间可以交换，列之间也能相互交换。基于上述实现方式，LDPC 矩阵的基矩阵对应所述子矩阵 A 和子矩阵 B 构成的部分可以表示为如基矩阵 30b-1、30b-2、30b-3、30b-4 和 30b-5 中任一个。

在又一种可能的实现方式中, 可以将基图 30a 中子矩阵 A 和子矩阵 B 构成的矩阵块的第 3 行和第 0 行交换, 第 2 行和第 1 行交换, 以及将第 23 列和第 25 列进行交换得到基图 80a 中的核心矩阵。

基于上述实现方式, LDPC 矩阵的基矩阵对应所述子矩阵 A 和子矩阵 B 构成的部分可以表示为如基矩阵 80b-1、80b-2、80b-3、80b-4、80b-5 和 80b-6 中任一个, 其中, 80b-4 是 30b-3 经过行列交换后的矩阵, 80b-5 是 30b-4 经过行列交换后的矩阵, 80b-6 是 30b-5 经过行列交换后的矩阵。

为了支持不同块长, LDPC 码需要不同的扩展因子 Z, 基于前述实现方式, 在一种可能的实现方式中, 基于不同的扩展因子 Z 采用与之对应的基矩阵。

例如:

若扩展因子 Z 为 {16, 18, 20, 22, 24, 26, 28, 30} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-1 所示;

若扩展因子 Z 为 {32, 36, 40, 44, 48, 52, 56, 60} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-2 所示;

若扩展因子 Z 为 {60, 64, 72, 80, 88, 96, 104, 112, 120} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-3 所示;

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-4 所示;

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-5 所示。

在又一种可能的实现方式中,

若扩展因子 Z 为 {24, 26, 28, 30} 中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-1 所示;

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-2 所示;

若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-3 所示;

若扩展因子 Z 为 {60, 64, 72, 80, 88, 96, 104, 112, 120} 中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-4 所示;

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-5 所示;

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图中基矩阵 80b-6 所示。

在又一种可能的实现方式中, 子矩阵 A 还可以包括 2 列内置打孔比特列。

进一步, 为了获得灵活的码率, 可以基于核心矩阵添加相应大小的子矩阵 C、子矩阵 D 和子矩阵 E, 来获得不同的码率。

其中,

所述子矩阵 C 为 5 行 m_D 列的全零矩阵;

所述子矩阵 D 为 m_D 行 27 列的矩阵;

所述子矩阵 E 为 m_D 行 m_D 列的单位矩阵;

m_D 为整数且 $0 \leq m_D \leq 41$ 。

其中，子矩阵 D 包括矩阵 F 中的 m_D 行，所述矩阵 F 为 41 行 27 列，所述矩阵 F 的各行的行重分别为 7, 7, 9, 8, 7, 7, 8, 6, 6, 5, 6, 5, 5, 6, 5, 5, 5, 5, 4, 4, 4, 5, 4, 5, 4, 4, 4, 4, 3, 4, 4, 4, 4, 3, 3, 4, 4, 3, 3, 3, 4。

在一种可能的实现方式中，矩阵 F 为基图 30a 中第 5 行至第 45 行以及第 0 列至第 26 列构成的矩阵。

在一种可能的实现方式中，矩阵 F 的偏移矩阵可以表示为如基矩阵 30c-1、30c-2、30c-3、30c-4 和 30c-5 中任一个。

在又一种可能的实现方式中，可将基图 30a 的第 17 行和第 19 行进行交换，并且将第 39 列和第 41 列进行交换得到如图 8a 所示的基图矩阵 80a。又例如，子矩阵 D 包括矩阵 F 中 m_D 行，这 m_D 行可以不进行行交换，也可以将其中一行或多行之间进行行交换，子矩阵 E 仍为对角结构，例如，子矩阵 D 包括矩阵 F 中 m_D 行，其中，矩阵 F 的第 12 行和第 14 行进行行交换，子矩阵 E 仍为对角结构，从而得到基图 80a。

为了支持不同块长，LDPC 码需要不同的扩展因子 Z，基于前述实现方式，在一种可能的实现方式中，基于不同的扩展因子 Z 采用与之对应的基矩阵。例如：

在一种可能的实现方式中，

若扩展因子 Z 为 {16, 18, 20, 22, 24, 26, 28, 30} 中的一个，基矩阵中子矩阵 D 可以包括如 30c-1 所示的偏移矩阵的 m_D 行；

若扩展因子 Z 为 {32, 36, 40, 44, 48, 52, 56, 60} 中的一个，基矩阵中子矩阵 D 可以包括如 30c-2 所示的偏移矩阵的 m_D 行；

若扩展因子 Z 为 {60, 64, 72, 80, 88, 96, 104, 112, 120} 中的一个，基矩阵中子矩阵 D 可以包括如 30c-3 所示的偏移矩阵的 m_D 行；

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个，基矩阵中子矩阵 D 可以包括如 30c-4 所示的偏移矩阵的 m_D 行；

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个，基矩阵中子矩阵 D 可以包括如 30c-5 所示的偏移矩阵的 m_D 行。

又一种可能的实现方式中，扩展因子集合可以为 {24, 26, 28, 30, 32, 36, 40, 44, 48, 52, 56, 60, 64, 72, 80, 88, 96, 104, 112, 120, 128, 144, 160, 176, 192, 208, 224, 240, 256, 288, 320, 352, 384}：

若扩展因子 Z 为 {24, 26, 28, 30} 中的一个，则矩阵 F 的偏移矩阵可以如 80c-1 所示；

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个，则矩阵 F 的偏移矩阵可以如 80c-2 所示；

若扩展因子 Z 为 {48, 52, 56, 60} 中的一个，则矩阵 F 的偏移矩阵可以如 80c-3 所示；

若扩展因子 Z 为 {60, 64, 72, 80, 88, 96, 104, 112, 120} 中的一个，则矩阵 F 的偏移矩阵可以如 80c-4 所示；

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个，则矩阵 F 的偏移矩阵可以如 80c-5 所示；

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则矩阵 F 的偏移矩阵可以如 80c-6 所示。

在上述第一方面或第二方面的第二种实现方式中,

5 所述 LDPC 矩阵的基图表示为 m 行 n 列的矩阵, m 为大于或者等于 7 的整数, n 为大于或者等于 17 的整数;

所述基图至少包括子矩阵 A 和子矩阵 B , 其中,

所述子矩阵 A 为 7 行 10 列的矩阵;

10 所述子矩阵 B 为 7 行 7 列的矩阵, 所述子矩阵 B 包括一权重为 3 的列和双对角结构的子矩阵 B' 。

其中,

所述子矩阵 A 和所述子矩阵 B 构成的矩阵中, 其中 1 行的权重满足大于或者等于 1, 且小于或者等于 5, 其余 6 行的权重分别满足大于或者等于 6, 且小于或者等于 10。

15 在一种实现方式中, 所述子矩阵 A 和所述子矩阵 B 构成的矩阵中, 其中 1 行的权重为 3, 3 行的权重为 8, 其余 3 行的权重为 7。

在这种实现方式中, 所述子矩阵 A 和所述子矩阵 B 构成的矩阵可以包括如基图 40a 中第 0 行至第 6 行以及第 0 列至第 16 列组成的 7 行, 其中行之间可以交换, 列之间也能相互交换。

20 基于上述实现方式, LDPC 矩阵的基矩阵对应所述子矩阵 A 和子矩阵 B 构成的部分可以表示为如基矩阵 4b-1、4b-2、4b-3、4b-4、4b-5 和 4b-6 中任一个。

为了支持不同块长, LDPC 码需要不同的扩展因子 Z , 基于前述实现方式, 在一种可能的实现方式中, 基于不同的扩展因子 Z 采用与之对应的基矩阵。

例如:

25 若扩展因子 Z 为 {8, 9, 10, 11, 12, 13, 14, 15} 中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b 中基矩阵 4b-1 所示;

若扩展因子 Z 为 {16, 18, 20, 22, 24, 26, 28, 30} 中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b 中基矩阵 4b-2 所示;

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b 中基矩阵 4b-3 所示;

30 若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b 中基矩阵 4b-4 所示;

若扩展因子 Z 为 {64, 72, 80, 88, 96, 104, 112, 120} 中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b-5 所示。

35 若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240, 256} 中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b-6 所示。

其中, 子矩阵 A 还可以包括 2 列内置打孔比特列。

进一步, 为了获得灵活的码率, 可以基于核心矩阵添加相应大小的子矩阵 C 、子矩阵 D 和子矩阵 E , 来获得不同的码率。

其中,

40 所述子矩阵 C 为 7 行 m_D 列的全零矩阵;

所述子矩阵 D 为 m_D 行 17 列的矩阵;

所述子矩阵 E 为 m_D 行 m_D 列的单位矩阵;

m_D 为整数且 $0 \leq m_D \leq 35$ 。

其中, 子矩阵 D 包括矩阵 F 中的 m_D 行, 所述矩阵 F 为 35 行 17 列, 所述矩阵 F 的
5 各行的行重分别为 5, 4, 4, 4, 4, 4, 4, 3, 3, 3, 4, 2, 3, 3, 4, 4, 2, 3,
3, 3, 3, 3, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 2。

在一种可能的实现方式中, 矩阵 F 为基图 40a 中第 7 行至第 41 行以及第 0 列至第 16
列构成的矩阵。

在一种可能的实现方式中, 矩阵 F 的偏移矩阵可以表示为如基矩阵 4c-1、4c-2、4c-3、
10 4c-4 和 4c-5 中任一个。

为了支持不同块长, LDPC 码需要不同的扩展因子 Z, 基于前述实现方式, 在一种可
能的实现方式中, 基于不同的扩展因子 Z 采用与之对应的基矩阵。例如:

其中,

若扩展因子 Z 为 {8, 9, 10, 11, 12, 13, 14, 15} 中的一个, 基矩阵中子矩阵 D 可
15 以包括如 4c-1 所示的偏移矩阵的 m_D 行;

若扩展因子 Z 为 {16, 18, 20, 22, 24, 26, 28, 30} 中的一个, 基矩阵中子矩阵 D
可以包括如 4c-2 所示的偏移矩阵的 m_D 行;

若扩展因子 Z 为 {32, 36, 40, 44 } 中的一个, 基矩阵中子矩阵 D 可以包括如 4c-3
所示的偏移矩阵的 m_D 行;

20 若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 基矩阵中子矩阵 D 可以包括如 4c-4 所
示的偏移矩阵的 m_D 行;

若扩展因子 Z 为 {64, 72, 80, 88, 96, 104, 112, 120} 中的一个, 基矩阵中子矩阵
D 可以包括如 4c-5 所示的偏移矩阵的 m_D 行;

25 若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240, 256} 中的一个, 基矩
阵中子矩阵 D 可以包括如 4c-6 所示的偏移矩阵的 m_D 行。

第一种实现方式中的 LDPC 矩阵的基图和基矩阵可以满足块长为 352 至 8448 比特的
码块的性能需求, 第二种实现方式中的 LDPC 矩阵的基图和基矩阵可以满足块长为 40 至
2560 比特的码块的性能需求。

基于上述各方面, 或者各方面任一种可能的实现方式, 在又一种可能的实现方式中,
30 还包括: 确定扩展因子 Z。例如, 根据输入序列的长度 K 来确定扩展因子 Z 的取值, 如:
若输入序列长度为 K, 可以在多个系统定义的扩展因子中确定满足 $22 \cdot Z \geq K$ 的最小值。

对于发送端的通信设备, 使用 LDPC 矩阵对所述输入序列进行编码包括:

使用扩展因子 Z 对应的 LDPC 矩阵对所述输入序列进行编码。

对于接收端的通信设备, 使用 LDPC 矩阵对输入序列进行译码包括:

35 使用扩展因子 Z 对应的 LDPC 矩阵对输入序列进行译码。

基于上述各方面, 或者各方面任一种可能的实现方式, 在又一种可能的实现方式中,
LDPC 矩阵的基矩阵可以保存在存储器中。

基于上述各方面, 或者各方面任一种可能的实现方式, 在又一种可能的实现方式中,
LDPC 矩阵的基图保存在存储器中, LDPC 矩阵的基矩阵中非零元素的偏移值可以保存在
40 存储器中。

基于上述各可能的实现方式，在一种可能的设计中，用于 LDPC 编码或者译码的基图和基矩阵中至少一个是上述 LDPC 矩阵的基图和基矩阵中至少一个经过行交换、或者列交换、或者行交换和列交换后得到的。

5 第三方面，提供一种通信装置可以包含用于执行上述方法设计中第一方面任一种可能的实现方式相对应的模块。所述模块可以是软件和/或是硬件。

在一个可能的设计中，第三方面提供的通信装置，包括如上述第一方面所述的编码器、确定单元以及处理单元。所述确定单元用于确定对输入序列编码所需的扩展因子 Z 。所述处理单元，用于使用所述扩展因子 Z 对应的 LDPC 矩阵对所述输入序列进行编码。

10 可选地，所述通信装置还包括收发器，所述收发器用于发送对应于所编码后的信息数据的信号。

第四方面，提供一种通信装置可以包含用于执行上述方法设计中第二方面任一种可能的实现方式相对应的模块。所述模块可以是软件和/或是硬件。

15 在一种可能的设计中，第四方面提供的通信装置，包括如上述第二方面所述的译码器，获取单元以及处理单元。所述获取单元用于获取 LDPC 码的软值和扩展因子 Z 。所述处理单元，用于基于扩展因子 Z 对应的基矩阵 H_B 对 LDPC 码的软值译码得到信息比特序列。

所述通信装置还包括收发器，所述收发器用于接收包含基于 LDPC 编码的信号。

第五方面，提供了一种通信装置，包括一个或多个处理器。

20 在一种可能的设计中，一个或多个所述处理器可实现第一方面所述编码器的功能，在另一种可能的设计中，第一方面所述编码器可以是所述处理器的一部分，处理器除了实现第一方面所述编码器的功能，还可以实现其他功能。

在一种可能的设计中，一个或多个所述处理器可实现第二方面所述译码器的功能，在另一种可能的设计中，第二方面所述译码器可以是所述处理器的一部分。

25 可选地，所述通信装置还可以包括收发器以及天线。

可选的，所述通信装置还可以包括用于产生传输块 CRC 的器件、用于码块分割和 CRC 校验的器件、用于交织的交织器、或者用于调制处理的调制器等。

可选的，所述通信装置还可以包括，用于解调操作的解调器、用于解交织的解交织器、或者用于解速率匹配的器件等等。可以通过一个或多个处理器实现这些器件的功能。

30 在一种可能的设计中，可以通过一个或多个处理器实现这些器件的功能。

第六方面，本发明实施例提供了一种通信系统，该系统包括上述第三方面所述的通信装置和上述第四方面所述的通信装置。

35 第七方面，本发明实施例提供了一种通信系统，该系统包括一个或多个第五方面所述的通信装置。

再一方面，本发明实施例提供了一种计算机存储介质，其上存储有程序，当其运行时，使得计算机执行上述方面所述的方法。

本申请的又一方面提供了一种包含指令的计算机程序产品，当其在计算机上运行时，

使得计算机执行上述各方面所述的方法。

本发明实施例的信息处理的方法、装置、通信设备和通信系统，在编码性能和错误平层上能够适应系统灵活多变的码长码率需要。

5

附图说明

图 1 为一 LDPC 码的基图、基矩阵及其循环置换矩阵的示意图；

图 2 为一 LDPC 码的基图的结构示意图；

图 3a 为本发明一实施例提供的 LDPC 码基图的示意图；

10 图 3b 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

图 3c 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

图 4a 为本发明另一实施例提供的 LDPC 码基图的示意图；

图 4b 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

图 4c 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

15 图 5a 为本发明另一实施例提供的性能示意图；

图 5b 为本发明另一实施例提供的性能示意图；

图 5c 为本发明另一实施例提供的性能示意图；

图 6 为本发明另一实施例提供的信息处理装置的结构示意图；

图 7 为本发明另一实施例提供的通信系统的示意图；

20 图 8a 为本发明另一实施例提供的 LDPC 码基图的示意图；

图 8b 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

图 8c 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

图 9a 为本发明另一实施例提供的 LDPC 码基图的示意图；

图 9b 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

25 图 10a 为本发明另一实施例提供的 LDPC 码基图的示意图；

图 10b 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

图 11a 为本发明另一实施例提供的 LDPC 码基图的示意图；

图 11b 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

图 12a 为本发明另一实施例提供的 LDPC 码基图的示意图；

30 图 12b 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

图 13a 为本发明另一实施例提供的 LDPC 码基图的示意图；

图 13b 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图；

图 14a 为本发明另一实施例提供的 LDPC 码基图的示意图；

图 14b 为本发明另一实施例提供的 LDPC 码的基矩阵的示意图。

35 具体实施方式

为便于理解下面对本申请中涉及到的一些名词做些说明。

本申请中，名词“网络”和“系统”经常交替使用，“装置”和“设备”也经常交

替使用，但本领域的技术人员可以理解其含义。“通信装置”可以是芯片（如基带芯片，或者数据信号处理芯片，或者通用芯片等等），终端，基站，或者其他网络设备。终端是一种具有通信功能的设备，可以包括具有无线通信功能的手持设备、车载设备、可穿戴设备、计算设备或连接到无线调制解调器的其它处理设备等。在不同的网络中终端可以叫做不同的名称，例如：用户设备，移动台，用户单元，站台，蜂窝电话，个人数字助理，无线调制解调器，无线通信设备，手持设备，膝上型电脑，无绳电话，无线本地环路台等。为描述方便，本申请中简称为终端。基站（base station， BS），也可称为基站设备，是一种部署在无线接入网用以提供无线通信功能的设备。在不同的无线接入系统中基站的叫法可能有所不同，例如在而在通用移动通讯系统（Universal Mobile Telecommunications System， UMTS）网络中基站称为节点 B(NodeB)，而在 LTE 网络中的基站称为演进的节点 B（evolved NodeB， eNB 或者 eNodeB），在新空口（new radio， NR）网络中的基站称为收发点（transmission reception point， TRP）或者下一代节点 B（generation nodeB， gNB），或者其他各种演进网络中的基站也可能采用其他叫法。本发明并不限于此。

下面将结合本发明实施例中的附图，对本发明实施例中的技术方案进行描述。

LDPC码通常可以用奇偶校验矩阵H来表示。LDPC码的奇偶校验矩阵H可以通过基图（base graph）和偏移（shift）值得到。基图通常可以包括 $m \times n$ 个矩阵元素（entry），可以用 m 行 n 列的矩阵形式表示，矩阵元素的值为0或1，其中值为0的元素，有时候也称为零元素，表示该元素可以被 $Z \times Z$ 的全零矩阵（zero matrix）替换，值为1的元素，有时候也称为非零元素，表示该元素可以被 $Z \times Z$ 的循环置换矩阵（circulant permutation matrix）替换。也就是说，每个矩阵元素代表的是一个全零矩阵或者一个循环置换矩阵。如图1中10a所示为一个示例性的 $m=4$ ， $n=20$ 具有QC结构的LDPC码的基图中的各元素。需要说明的是，在本文中，基图和矩阵的行号和列号均是从0开始编号的，仅仅是为了方便理解。可以理解的是，行号和列号也可以从1开始编号，则相应的行号和列号在本文所示的行号和列号基础上加1。

若基图中第 i 行第 j 列的元素值为1，其偏移值为 $P_{i,j}$ ， $P_{i,j}$ 为大于或者等于0的整数，则表示第 i 行第 j 列的值为1的元素可以被 $P_{i,j}$ 对应的 $Z \times Z$ 的循环置换矩阵替换，该循环置换矩阵可通过将 $Z \times Z$ 的单位矩阵进行 $P_{i,j}$ 次向右循环移位得到。可见，将基图中每个值为0的元素用 $Z \times Z$ 的全零矩阵替换，每个值为1的元素采用其偏移值对应的 $Z \times Z$ 的循环置换矩阵进行替换，则可以得到LDPC码的奇偶校验矩阵。 Z 为正整数，也可以称之为扩展（lifting）因子，可以根据系统支持的码块大小和信息数据的大小确定的。可见奇偶校验矩阵H的大小为 $(m \times Z) \times (n \times Z)$ 。例如，扩展因子 $Z=4$ ，则每个零元素被一个 4×4 大小的全0矩阵11a替换，若 $P_{2,3}=2$ ，则第2行第3列的非0元素被 4×4 的循环置换矩阵11d替换，该矩阵是由 4×4 的单位矩阵11b经过2次向右循环移位得到的，若 $P_{2,4}=0$ ，则第2行第4列的非0元素被单位矩阵11b替换。需要说明的是，此处仅仅只是举例说明，并不以此为限制。

由于 $P_{i,j}$ 可以是基于扩展因子 Z 得到的，对于同一个位置上值为1的元素，采用不同的扩展因子 Z 可能存在不同的 $P_{i,j}$ 。为了简化实现，通常系统也会定义一个 $m \times n$ 的基矩阵（base matrix），在基矩阵中每个元素和基图中每个元素的位置一一对应，基图中的零元素在基

矩阵中位置不变,采用-1表示,基图中第*i*行第*j*列值为1的非零元素在基矩阵中位置不变,可表示为 $P_{i,j}$, $P_{i,j}$ 为大于或者等于0的正整数。在本申请实施例中,有时也将基矩阵称为基图矩阵的偏移矩阵。

如图1中10b所示为基图10a对应的一个基矩阵。

- 5 通常LDPC码的基图或基矩阵中还可以包括*p*列内置打孔(built-in puncture)比特列,*p*可以为0~2的整数,这些列参与编码,但是其编码对应的系统比特不被发送,则LDPC码

基矩阵的码率满足 $R = \frac{(n-m)}{(n-p)}$ 。对于一个4行20列(4*20)的基矩阵来讲,如果有2列内置打孔比特列,则码率为(20-4)/(20-2)=8/9。

- 10 无线通信系统中采用的LDPC码,其基图的矩阵大小为*m***n*,可以包括5个子矩阵A、B、C、D和E,其中,矩阵的权重是由非零元素的个数决定的,行的权重(行重)是指一行中包括的非零元素的个数,列的权重(列重)是指一列中包括的非零元素的个数。如图2中200所示,其中:

子矩阵A为 m_A 行 n_A 列的矩阵,其大小可以为 $m_A \times n_A$,其中每列对应LDPC码中的*Z*个系统比特,系统比特有时候也称为信息比特。

- 15 子矩阵B为 m_A 行 m_A 列的方阵,其大小可以为 $m_A \times m_A$,每列对应于LDPC码中的*Z*个校验比特。子矩阵B包括双对角结构的子矩阵B'和一系列权重为3的矩阵列(简称为3列重列),其中列重为3的矩阵列位于子矩阵B'之前,如图2中20a所示;子矩阵B还可以包括一系列权重为1的矩阵列(简称为单列重列),单列重列可以位于子矩阵B的首列或者最后一列,并且其中的非零元素在子矩阵B的最后一行,使得子矩阵B的最后一行的行重为1,如图2中20b或20c所示。

通常基于子矩阵A和B生成的矩阵为核心矩阵,可以用来支持高码率的编码。

子矩阵C为零矩阵,其大小为 $m_A \times (n - (m_A + n_A))$ 。

子矩阵E为单位矩阵,其大小为 $(m - m_A) \times (m - m_A)$ 。

子矩阵D大小为 $(m - m_A) \times (n_A + m_A)$,通常可用来生成低码率的校验位。

- 25 由于子矩阵B、C和E的结构相对确定,子矩阵A和D两部分的结构是LDPC码的编译码性能的影响因素之一。

- 30 通常LDPC码可基于基图和基矩阵获得,对基图或者基矩阵采用密度进化的方法可以确定出LDPC码的性能上限,并且根据基矩阵中的偏移值确定出LDPC码的错误平层。改善编译码性能和降低错误平层是确定基图和基矩阵的目标之一。无线通信系统中码长灵活多变,既可以是如40比特,1280比特这样的小块长码块,也可以是如5000比特8448比特这样的大块长码块。图3a、3b以及3c分别是根据密度进化方法获得的一个LDPC码的基图和基矩阵示例,可满足块长为352至8448比特的码块的性能需求,图4a、4b以及4c分别是根据密度进化方法获得的另一个LDPC码及其核心矩阵的基图和基矩阵示例,可满足块长为40至2560比特的码块的性能需求。为方便说明及理解,附图中3a、3b、3c、4a、4b以及4c中在最上侧以及最左侧,分别示出了列号和行号图5a和图5b分别给出了图3a~3c所示的LDPC码在两种不同码率时的性能示意图,图5c给出了图4a~4c所示的LDPC码的性能示意图。

图3a所示为一个LDPC码的基图30a示例,其中,图中最上面一行0~67表示列编

号, 最左面一列 0~45 表示行编号, 也就是基图的矩阵大小为 46 行 68 列。

子矩阵 A 对应系统比特, 大小为 5 行 22 列, 在基图 30a 中由第 0 行至第 4 行以及第 0 列至第 21 列的元素构成;

子矩阵 B 对应校验比特, 大小为 5 行 5 列, 在基图 30a 中由第 0 行至第 4 行以及第 22 列至第 26 列的元素构成;

子矩阵 A 和子矩阵 B 构成了 LDPC 码基图的核心矩阵部分, 也即构成了一个 5 行 27 列的矩阵, 可用于高码率编码。

其中, 子矩阵 A 中可以包括 2 列内置打孔比特列, 则打孔后, 核心矩阵可以支持的码率为 $22/(27-2) = 0.88$ 。

其中, 子矩阵 B 中最后 1 行 (第 4 行) 的行重和最后一列 (子矩阵 B 的第 4 列, 核心矩阵的第 26 列) 的列重均为 1, 矩阵 B 包括 1 列 3 列重列, 即子矩阵 B 的第 0 列 (核心矩阵的第 22 列) 列重为 3, 子矩阵 B 的第 1 至 3 列 (核心矩阵的第 23 至 25 列), 第 0 至 3 行为双对角结构。

基图 30a 的核心矩阵中, 包括了 4 行权重为 19 的行, 和 1 行权重为 3 的行。也就是, 子矩阵 A 和子矩阵 B 构成的核心矩阵中各行的权值分别为 19, 19, 19, 19 和 3。需要说明的是, 核心矩阵中各行的顺序是可以交换的, 例如第 0 行和第 2 行交换, 第 1 行和第 3 行交换等等。权重为 3 的行可以如基图 30a 的核心矩阵中第 4 行, 第 0 至第 26 列所示; 权重为 19 的行可以分别为基图 30a 的核心矩阵中第 0 至第 3 行, 第 0 至第 26 列所示的各行之一。这些行顺序可以交换, 各列的顺序也可以交换。例如, 可以将核心矩阵的第 3 行和第 0 行交换, 第 2 行和第 1 行交换, 为了保持子矩阵 B 中的双对角结构, 还可以在此基础上将第 23 列和第 25 列进行交换得到如图 8a 所示的基图 80a 的核心矩阵部分, 也即 80a 中第 0 行至第 5 行, 第 0 列至第 26 列构成的矩阵部分。由于子矩阵 C 是全零矩阵, 经过行交换和列交换后的基图 80a 的各行的权重没有改变。

通常对于一个 LDPC 码给定的基图或者基矩阵而言, 对矩阵元素的少量修改对性能影响是可接受的。例如, 在一种实现方式中, 可以基于基图 30a 的核心矩阵, 进行少量修改, 例如, 其中 1 行的权重满足大于或者等于 1, 且小于或者等于 5, 其余 4 行的权重分别满足大于或者等于 17, 且小于或者等于 21。例如, 1 行的权重为 2, 其余 4 行的权重为 18, 或者 1 行的权重为 4, 其余 4 行的权重分别为 17, 18, 19, 19 等等。可以理解, 也可以参照本申请提供的方案, 使其中某些行的权重增加或减少 1~2, 本申请并不对此进行限定。

在子矩阵 A 中也可以包括 1 行, 在该行中除了位于内置打孔列上的元素, 其余元素均为零元素。进一步地, 为了使得这一行在核心矩阵或者基图矩阵中权重最小, 通常和子矩阵 B 中行重为 1 的行在同一行。例如, 内置打孔比特列数为 2, 也就是第 0 列和第 1 列为内置打孔比特列, 如基图 30a 或者 80a 所示, 第 4 行中, 第 0 列和第 1 列上的元素为非零元素, 第 2 列至第 25 列上的元素为零元素, 第 26 列的元素为非零元素, 第 4 行的权重为 3, 不仅在核心矩阵中行的权重最小, 在整个基图矩阵中行的权重也是最小的。这种设置可以改善编码和译码的性能。

为了支持不同块长, LDPC 码需要不同的扩展因子 Z, 例如, 扩展因子 Z 可以包括以下设计中的一个或多个: 16, 18, 20, 22, 24, 26, 28, 30, 32, 36, 40, 44, 48, 52, 56, 60, 64, 72, 80, 88, 96, 104, 112, 120, 128, 144, 160, 176, 192, 208,

224, 240, 256, 288, 320, 352, 384。为了保证不同块长下的 LDPC 码性能, 可以分别基于不同的扩展因子 Z 采用与之对应的基矩阵。如图 3b 所示为基图 30a 中核心矩阵的多个基矩阵示例。各基矩阵是基于基图 30a 的核心矩阵和扩展因子 Z 得到的, 其中, 基图 30a 中第 i 行第 j 列的非零元素在基矩阵第 i 行第 j 列为偏移值 $P_{i,j}$, 基图 30a 中零元素在

5 偏移矩阵中以 -1 或者 null 表示。

其中, 在一种可能的实现方式中:

若扩展因子 Z 为 {16, 18, 20, 22, 24, 26, 28, 30} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-1 所示;

10 若扩展因子 Z 为 {32, 36, 40, 44, 48, 52, 56, 60} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-2 所示;

若扩展因子 Z 为 {60, 64, 72, 80, 88, 96, 104, 112, 120} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-3 所示;

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-4 所示;

15 若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图中基矩阵 30b-5 所示。

在又一种可能的实现方式中, 扩展因子集合可以为 {24, 26, 28, 30, 32, 36, 40, 44, 48, 52, 56, 60, 64, 72, 80, 88, 96, 104, 112, 120, 128, 144, 160, 176, 192, 208, 224, 240, 256, 288, 320, 352, 384}:

20 若扩展因子 Z 为 {24, 26, 28, 30} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-6 所示;

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-7 所示;

25 若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-8 所示;

若扩展因子 Z 为 {60, 64, 72, 80, 88, 96, 104, 112, 120} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-3 所示;

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-4 所示;

30 若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图中基矩阵 30b-5 所示。

基于上述实现方式, 在又一种可能的实现方式中, 为了进一步改善性能, 基图对应的基矩阵也可以更多, 基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以对应到不同的基矩阵, 例如:

35 若扩展因子 Z 为 {24, 26, 28, 30} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-6 所示;

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-7 所示;

若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和

子矩阵 B 的部分可以如图 3b 中基矩阵 30b-8 所示;

若扩展因子 Z 为{64, 72, 80, 88}中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-9 或者 30b-10 所示;

5 若扩展因子 Z 为{96, 104, 112, 120}中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-3 所示;

若扩展因子 Z 为{128, 144, 160, 176, 192, 208, 224, 240}中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 3b 中基矩阵 30b-4 所示;

若扩展因子 Z 为{256, 288, 320, 352, 384}中的一个, 则基图 30a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图中基矩阵 30b-5 所示。

10

在又一种可能的实现方式中, 扩展因子集合可以为{24, 26, 28, 30, 32, 36, 40, 44, 48, 52, 56, 60, 64, 72, 80, 88, 96, 104, 112, 120, 128, 144, 160, 176, 192, 208, 224, 240, 256, 288, 320, 352, 384};

15 若扩展因子 Z 为{24, 26, 28, 30}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-1 所示;

若扩展因子 Z 为{32, 36, 40, 44}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-2 所示;

若扩展因子 Z 为{48, 52, 56, 60}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-3 所示;

20 若扩展因子 Z 为{60, 64, 72, 80, 88, 96, 104, 112, 120}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-4 所示;

若扩展因子 Z 为{128, 144, 160, 176, 192, 208, 224, 240}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-5 所示;

25 若扩展因子 Z 为{256, 288, 320, 352, 384}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图中基矩阵 80b-6 所示。

基于上述实现方式, 在又一种可能的实现方式中, 为了进一步改善性能, 基图对应的基矩阵也可以更多, 基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以对应到不同的基矩阵, 例如, 其中:

30 若扩展因子 Z 为{24, 26, 28, 30}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-1 所示;

若扩展因子 Z 为{32, 36, 40, 44}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-2 所示;

若扩展因子 Z 为{48, 52, 56, 60}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-3 所示;

35 若扩展因子 Z 为{64, 72, 80, 88}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-7 或者 80b-8 所示;

若扩展因子 Z 为{96, 104, 112, 120}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-4 所示;

40 若扩展因子 Z 为{128, 144, 160, 176, 192, 208, 224, 240}中的一个, 则基图 80a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 8b 中基矩阵 80b-5 所示;

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则基图 80a 的基矩阵对应于子矩阵 A 和子矩阵 B 的部分可以如图中基矩阵 80b-6 所示。

同样的, 基矩阵中各行也是可以交换的, 各列也可以交换。若基图经过行交换或列交换中至少一种交换, 则相应部分的基矩阵也进行同样的交换。

5 可以看到, 在上述实现方式中, 80b-1 是相应于 30b-6 的行列交换后的矩阵, 80b-2 是相应于 30b-7 的行列交换后的矩阵, 80b-3 是相应于 30b-8 的行列交换后的矩阵, 80b-4 是相应于 30b-3 的行列交换后的矩阵, 80b-5 是相应于 30b-4 的行列交换后的矩阵, 80b-6 是相应于 30b-5 的行列交换后的矩阵, 80b-7 是相应于 30b-9 的行列交换后的矩阵, 80b-8 是相应于 30b-10 的行列交换后的矩阵。

10 为了获得灵活的码率, 可以基于核心矩阵添加相应大小的子矩阵 C 、子矩阵 D 和子矩阵 E , 来获得不同的码率。由于子矩阵 C 为零矩阵, 子矩阵 E 为单位矩阵, 其大小主要是根据码率来确定, 结构相对固定。影响到编译码性能的主要在于核心矩阵和子矩阵 D 部分。在核心矩阵的基础上添加行列, 形成相应的 C 、 D 和 E 部分可以得到不同码率。

子矩阵 D 的列数为子矩阵 A 和 B 的列数之和, 其行数主要与码率相关。以基图 30a 为例, 则相应的子矩阵 D 的列数 m_D 为 $(n_A + m_A) = 27$ 列, 若 LDPC 码支持的码率为 R_m , 15 则其基图或者基矩阵的大小为 $m \times n$, 其中, $n = \frac{n_A}{R_m} + p$, $m = n - n_A = \frac{n_A}{R_m} + p - n_A$ 。若最低码率 $R_m = 1/3$, 内置打孔列数 $p = 2$, 以基图 30a 为例, 则 $n = 68$, $m = 46$, 子矩阵 D 的行数 m_D 最大可以为 $m - m_A = 46 - 5 = 41$, 也就是 $0 \leq m_D \leq 41$ 。

为了方便描述, 可以定义一个大小为 41 行 27 列的矩阵 F , 则子矩阵 D 可以包括其中的 m_D 行, 和子矩阵 A 、 B 以及相应大小的子矩阵 C 和 E 一起构成码率为 $22/(25 + m_D)$ 20 的 LDPC 码的基图。基图 30a 中, $m_D = 41$, 相应地子矩阵 D 大小为 41 行 27 列, 也就是子矩阵 D 即矩阵 F , 对应 LDPC 码支持的码率为 $22/66 = 1/3$ 。可见, 基图 30a 中第 5 行至第 45 行以及第 0 列至第 26 列构成的矩阵即为矩阵 F 。

在图 30a 所示例的矩阵 F 中, 其行重依次为 7, 7, 9, 8, 7, 7, 8, 6, 6, 5, 25 6, 5, 5, 6, 5, 5, 5, 5, 4, 4, 4, 5, 4, 5, 4, 4, 4, 4, 3, 4, 4, 4, 4, 3, 3, 4, 4, 3, 3, 3, 4。

由于子矩阵 E 为单位矩阵, 因此基图 30a 中每一行的权重为 8, 8, 10, 9, 8, 8, 9, 7, 7, 6, 7, 6, 6, 7, 6, 6, 6, 6, 5, 5, 5, 6, 5, 6, 5, 5, 5, 5, 4, 5, 5, 5, 5, 4, 4, 5, 5, 4, 4, 4, 5。

30 在本发明中, 若基图中相邻两行的同一列最多只有 1 个非零元素, 则这两行彼此正交。

在一种可能的实现方式中, 矩阵 F 可以是一个准正交结构的矩阵, 在矩阵 F 中除了内置打孔比特列以外的其余列构成的矩阵块中, 任意相邻两行的同一列中最多只有一个非零元素, 也就是矩阵 F 中除了内置打孔比特列以外的其余列构成的矩阵块具有正交结构。以基图 30a 为例, 矩阵 F 为第 5 行至第 45 行以及第 0 列至第 26 列构成的矩阵, 其中, 第 0 列和第 1 列为内置打孔比特列, 则由第 5 行至第 45 行以及第 2 列至第 26 列构成的矩阵块中, 第 5 行和第 6 行相互正交, 第 6 行和第 7 行相互正交, 第 23 行和第 24 35 行相互正交, 第 32 行和第 33 行相互正交, 以此类推。若 $m_D = 15$, LDPC 码基图中子矩

阵 D 大小为 15 行 27 列, 可以是由基图 30a 中矩阵 F 的第 0-14 行, 也就是基图 30a 的第 5 行至第 19 行, 第 0 列至第 26 列的矩阵构成, 对应 LDPC 码支持的码率为 $22/40=0.55$, 也就是在该码率下, LDPC 码的基图对应于基图 30a 的第 0 行至第 19 行, 第 0 列至第 41 列构成的矩阵部分, 其中子矩阵 E 为 15 行 15 列的单位矩阵, 子矩阵 C 为 5 行 15 列的全 0 矩阵;

若 $m_D=19$, LDPC 码基图中子矩阵 D 大小为 19 行 27 列, 可以是由基图 30a 中矩阵 F 的第 0-18 行, 也就是基图 30a 的第 5 行至第 23 行, 第 0 列至第 26 列的矩阵构成, 对应 LDPC 码支持的码率为 $22/44 = 1/2$, 也就是在该码率下, LDPC 码的基图对应于基图 30a 的第 0 行至第 23 行, 第 0 列至第 41 列构成的矩阵部分, 其中子矩阵 E 为 19 行 19 列的单位矩阵, 子矩阵 C 为 5 行 19 列的全 0 矩阵。

以此类推, 不一一阐述。

需要说明的是, LDPC 码的基图和基矩阵中各行是可以相互交换的, 各列也是可以相互交换的。例如, 可将基图 30a 的第 17 行和第 19 行进行交换, 并且将第 39 列和第 41 列进行交换得到如图 8a 所示的基图矩阵 80a。又例如, 子矩阵 D 包括矩阵 F 中 m_D 行, 这 m_D 行可以不进行行交换, 也可以将其中一行或多行之间进行行交换, 子矩阵 E 仍为对角结构, 不做行、列交换, 例如, 将矩阵 F 的第 12 行和第 14 行进行行交换, 子矩阵 D 包括矩阵 F 中 m_D 行, 子矩阵 E 仍为对角结构, 从而得到基图 80a。矩阵 F 在进行行交换前是一个准正交的矩阵, 经过交换后仍然为一个准正交的矩阵。例如, 在基图 80a 中, 矩阵 F 为第 5 行至第 45 行以及第 0 列至第 26 列构成的矩阵, 其中, 第 0 列和第 1 列为内置打孔比特列, 则由第 5 行至第 45 行以及第 2 列至第 26 列构成的矩阵块中, 第 5 行和第 6 行相互正交, 第 29 行和第 30 行相互正交, 以此类推。可以理解的是, 若基图或基矩阵包括子矩阵 D, 那么对核心矩阵的列进行交换时, 相应的子矩阵 D 中列也需要进行交换, 例如, 核心矩阵中第 23 列和第 25 列进行交换, 子矩阵 D 中第 23 列和第 25 列也需要相应进行交换。此处仅为举例, 并不以此为限制。

在又一种可能的实现方式中, 准正交结构的矩阵 F 中也可以包括至少 2 行正交行, 至少 2 行正交行中相邻两行第 0 列至第 26 列中每一列最多只有 1 个非零元素。例如, 若 $m_D>30$, 则对应 LDPC 码支持的码率小于 $2/5$, 矩阵 F 中最后 11 行, 也就是矩阵 F 的第 30 行至第 40 行以及第 0 列至第 26 列构成的子矩阵可以是正交的。也就是矩阵 F 第 0 行至第 29 行中相邻两行除了内置打孔比特列以外其他列最多只有一个非零元素, 第 30 行至第 40 行中相邻两行第 0 列至第 26 列各列最多只有一个非零元素。

又例如, 矩阵 F 中第 26 行至第 40 行以及第 0 列至第 26 列构成的子矩阵可以是正交的。也就是矩阵 F 中第 0 行至第 25 行中相邻两行除了内置打孔比特列以外其他列最多只有一个非零元素, 第 26 行至第 40 行中相邻两行第 0 列至第 26 列各列最多只有一个非零元素。如图 11a 所示基图 110a, 或者图 12a 所示基图 120a, 或者图 13a 所示基图 130a 以及图 14a 所示基图 140a, 其中矩阵 F 为基图的第 5 行至第 45 行以及第 0 列至第 26 列构成的矩阵, 矩阵 F 为准正交结构, 并且矩阵 F 的第 26 行至第 40 行是正交的, 其中第 26 行至第 40 行相邻两行各列最多只有一个非零元素。

其中, 基图 110a, 以及基图 120a 的核心矩阵部分与基图 30a 中的核心矩阵部分相同, 基图 110a 的矩阵 F 中第 12 行和第 14 行进行交换后与基图 120a 的矩阵 F 相同。

基图 130a 以及基图 140a 的核心矩阵部分与基图 80a 中的核心矩阵部分相同。基图

130a 的矩阵 F 中第 12 行和第 14 行进行交换后与基图 140a 的矩阵 F 相同。对每一码率中的子矩阵 D，每一行可以进行 1~2 个非零元素或者 1~2 个零元素的修改，而不影响其性能。

如图 3c 所示基矩阵 30c 为基图 30a 的基矩阵示例，其中，基图 30a 中第 i 行第 j 列的非零元素在基矩阵 30c 中位置不变，值为偏移值 $P_{i,j}$ 。其中，子矩阵 D 的部分包括矩阵 F 的偏移矩阵的 m_D 行，对于图 3c 中所示的基矩阵 30c， $m_D=41$ ，可以根据码率的不同选择 m_D 值。子矩阵 D 对应的偏移矩阵为矩阵 F 的偏移矩阵。这里矩阵 F 的偏移矩阵也就是将矩阵 F 中第 i 行第 j 列的非零元素替换为偏移值 $P_{i,j}$ ，零元素在偏移矩阵中以 -1 或者 null 表示。需要说明的是，此处仅为举例基图也可以是 80a、90a、100a、110a、120a、130a 以及 140a 等，此处不一一赘述。

其中，一种可能的实现方式中，

若扩展因子 Z 为 {16, 18, 20, 22, 24, 26, 28, 30} 中的一个，则矩阵 F 的偏移矩阵可以如 30c-1 所示；

若扩展因子 Z 为 {32, 36, 40, 44, 48, 52, 56, 60} 中的一个，则矩阵 F 的偏移矩阵可以如 30c-2 所示；

若扩展因子 Z 为 {60, 64, 72, 80, 88, 96, 104, 112, 120} 中的一个，则矩阵 F 的偏移矩阵可以如 30c-3 所示；

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个，则矩阵 F 的偏移矩阵可以如 30c-4 所示；

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个，则矩阵 F 的偏移矩阵可以如 30c-5 所示。

将基矩阵 30c 中子矩阵 D 替换为上述各矩阵 F 的偏移矩阵中的 m_D 行，可以得到与基图 30a 对应的不同码率的各个基矩阵。若 $m_D=41$ ，将基矩阵 30c 中第 5 行至第 45 行，第 0 列至第 26 列构成的矩阵部分替换为各矩阵 F 的偏移矩阵，可以得到与大小为 46 行 68 列的基图 30a 对应的各个基矩阵，此时码率为 1/3。

又一种可能的实现方式中，扩展因子集合可以为 {24, 26, 28, 30, 32, 36, 40, 44, 48, 52, 56, 60, 64, 72, 80, 88, 96, 104, 112, 120, 128, 144, 160, 176, 192, 208, 224, 240, 256, 288, 320, 352, 384}；

若扩展因子 Z 为 {24, 26, 28, 30} 中的一个，则矩阵 F 的偏移矩阵可以如 30c-6 所示；

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个，则矩阵 F 的偏移矩阵可以如 30c-7 所示；

若扩展因子 Z 为 {48, 52, 56, 60} 中的一个，则矩阵 F 的偏移矩阵可以如 30c-8 所示；

若扩展因子 Z 为 {60, 64, 72, 80, 88, 96, 104, 112, 120} 中的一个，则矩阵 F 的偏移矩阵可以如 30c-3 所示；

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个，则矩阵 F 的偏移矩阵可以如 30c-4 所示；

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个，则矩阵 F 的偏移矩阵可以如

30c-5 所示。

基于上述实现方式，在又一种可能的实现方式中，为了进一步改善性能，矩阵 F 的偏移矩阵有更多的选择。例如矩阵 F 的偏移矩阵还可以是 30c-9 或者 30c-10，例如，可以对扩展因子做如下设计：

5 若扩展因子 Z 为{24, 26, 28, 30}中的一个，则矩阵 F 的偏移矩阵可以如 30c-6 所示；

 若扩展因子 Z 为{32, 36, 40, 44}中的一个，则矩阵 F 的偏移矩阵可以如 30c-7 所示；

10 若扩展因子 Z 为{48, 52, 56, 60}中的一个，则矩阵 F 的偏移矩阵可以如 30c-8 所示；

 若扩展因子 Z 为{64, 72, 80, 88}中的一个，则矩阵 F 的偏移矩阵可以如 30c-9 或者 30c-10 所示；

 若扩展因子 Z 为{96, 104, 112, 120}中的一个，则矩阵 F 的偏移矩阵可以如 30c-3 所示；

15 若扩展因子 Z 为{128, 144, 160, 176, 192, 208, 224, 240}中的一个，则矩阵 F 的偏移矩阵可以如 30c-4 所示；

 若扩展因子 Z 为{256, 288, 320, 352, 384}中的一个，则矩阵 F 的偏移矩阵可以如 30c-5 所示。

20 又一种可能的实现方式中，扩展因子集合可以为{24, 26, 28, 30, 32, 36, 40, 44, 48, 52, 56, 60, 64, 72, 80, 88, 96, 104, 112, 120, 128, 144, 160, 176, 192, 208, 224, 240, 256, 288, 320, 352, 384}：

 若扩展因子 Z 为{24, 26, 28, 30}中的一个，则矩阵 F 的偏移矩阵可以如 80c-1 所示；

25 若扩展因子 Z 为{32, 36, 40, 44}中的一个，则矩阵 F 的偏移矩阵可以如 80c-2 所示；

 若扩展因子 Z 为{48, 52, 56, 60}中的一个，则矩阵 F 的偏移矩阵可以如 80c-3 所示；

30 若扩展因子 Z 为{60, 64, 72, 80, 88, 96, 104, 112, 120}中的一个，则矩阵 F 的偏移矩阵可以如 80c-4 所示；

 若扩展因子 Z 为{128, 144, 160, 176, 192, 208, 224, 240}中的一个，则矩阵 F 的偏移矩阵可以如 80c-5 所示；

 若扩展因子 Z 为{256, 288, 320, 352, 384}中的一个，则矩阵 F 的偏移矩阵可以如 80c-6 所示。

35 基于上述实现方式，在又一种可能的实现方式中，为了进一步改善性能，可以将扩展因子 Z 支持的粒度设计得更细，从而使得矩阵 F 的偏移矩阵有更多的选择。例如矩阵 F 的偏移矩阵还可以是 80c-7 或者 80c-8，例如，可以对扩展因子做如下设计，其中：

 若扩展因子 Z 为{24, 26, 28, 30}中的一个，则矩阵 F 的偏移矩阵可以如 80c-1 所示；

40 若扩展因子 Z 为{32, 36, 40, 44}中的一个，则矩阵 F 的偏移矩阵可以如 80c-2 所

示;

若扩展因子 Z 为{48, 52, 56, 60}中的一个, 则矩阵 F 的偏移矩阵可以如 80c-3 所示;

5 若扩展因子 Z 为{64, 72, 80, 88}中的一个, 则矩阵 F 的偏移矩阵可以如 80c-7 或者 80c-8 所示;

若扩展因子 Z 为{96, 104, 112, 120}中的一个, 则矩阵 F 的偏移矩阵可以如 80c-4 所示;

若扩展因子 Z 为{128, 144, 160, 176, 192, 208, 224, 240}中的一个, 则矩阵 F 的偏移矩阵可以如 80c-5 所示;

10 若扩展因子 Z 为{256, 288, 320, 352, 384}中的一个, 则矩阵 F 的偏移矩阵可以如 80c-6 所示。

又一种可能的实现方式中, 若采用基图 110a:

若扩展因子 Z 为{24, 26, 28, 30}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 110b-1 中第 5 行至第 45 行所示;

15 若扩展因子 Z 为{32, 36, 40, 44}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 110b-2 中第 5 行至第 45 行所示;

若扩展因子 Z 为{48, 52, 56, 60}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 110b-3 中第 5 行至第 45 行所示;

20 若扩展因子 Z 为{64, 72, 80, 88}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 110b-4 中第 5 行至第 45 行所示;

若扩展因子 Z 为{96, 104, 112, 120}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 110b-5 中第 5 行至第 45 行所示;

若扩展因子 Z 为{128, 144, 160, 176, 192, 208, 224, 240}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 110b-6 中第 5 行至第 45 行所示;

25 若扩展因子 Z 为{256, 288, 320, 352, 384}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 110b-7 中第 5 行至第 45 行所示。

又一种可能的实现方式中, 若采用基图 120a:

若扩展因子 Z 为{24, 26, 28, 30}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 120b-1 中第 5 行至第 45 行所示;

30 若扩展因子 Z 为{32, 36, 40, 44}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 120b-2 中第 5 行至第 45 行所示;

若扩展因子 Z 为{48, 52, 56, 60}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 120b-3 中第 5 行至第 45 行所示;

35 若扩展因子 Z 为{64, 72, 80, 88}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 120b-4 中第 5 行至第 45 行所示;

若扩展因子 Z 为{96, 104, 112, 120}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 120b-5 中第 5 行至第 45 行所示;

若扩展因子 Z 为{128, 144, 160, 176, 192, 208, 224, 240}中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 120b-6 中第 5 行至第 45 行所示;

40 若扩展因子 Z 为{256, 288, 320, 352, 384}中的一个, 则矩阵 F 的偏移矩阵可以如

基矩阵 120b-7 中第 5 行至第 45 行所示。

又一种可能的实现方式中, 若采用基图 130a:

若扩展因子 Z 为 $\{24, 26, 28, 30\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 130b-1 中第 5 行至第 45 行所示;

5 若扩展因子 Z 为 $\{32, 36, 40, 44\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 130b-2 中第 5 行至第 45 行所示;

若扩展因子 Z 为 $\{48, 52, 56, 60\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 130b-3 中第 5 行至第 45 行所示;

10 若扩展因子 Z 为 $\{64, 72, 80, 88\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 130b-4 中第 5 行至第 45 行所示;

若扩展因子 Z 为 $\{96, 104, 112, 120\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 130b-5 中第 5 行至第 45 行所示;

若扩展因子 Z 为 $\{128, 144, 160, 176, 192, 208, 224, 240\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 130b-6 中第 5 行至第 45 行所示;

15 若扩展因子 Z 为 $\{256, 288, 320, 352, 384\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 130b-7 中第 5 行至第 45 行所示。

又一种可能的实现方式中, 若采用基图 140a:

若扩展因子 Z 为 $\{24, 26, 28, 30\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 140b-1 中第 5 行至第 45 行所示;

20 若扩展因子 Z 为 $\{32, 36, 40, 44\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 140b-2 中第 5 行至第 45 行所示;

若扩展因子 Z 为 $\{48, 52, 56, 60\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 140b-3 中第 5 行至第 45 行所示;

25 若扩展因子 Z 为 $\{64, 72, 80, 88\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 140b-4 中第 5 行至第 45 行所示;

若扩展因子 Z 为 $\{96, 104, 112, 120\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 140b-5 中第 5 行至第 45 行所示;

若扩展因子 Z 为 $\{128, 144, 160, 176, 192, 208, 224, 240\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 140b-6 中第 5 行至第 45 行所示;

30 若扩展因子 Z 为 $\{256, 288, 320, 352, 384\}$ 中的一个, 则矩阵 F 的偏移矩阵可以如基矩阵 140b-7 中第 5 行至第 45 行所示。

同样的, 基矩阵中各行也是可以交换的, 各列也可以交换。若基图经过了行交换或列交换中至少一种, 则相应部分的基矩阵也进行同样的交换。

35 可以看到, 在上述实现方式中, 80c-1 是相应于 30c-6 的行交换后的矩阵, 80c-2 是相应于 30c-7 的行交换后的矩阵, 80c-3 是相应于 30c-8 的行交换后的矩阵, 80c-4 是相应于 30c-3 的行交换后的矩阵, 80c-5 是相应于 30c-4 的行交换后的矩阵, 80c-6 是相应于 30c-5 的行交换后的矩阵, 80c-7 是相应于 30c-9 的行交换后的矩阵, 80c-8 是相应于 30c-10 的行交换后的矩阵。

40 将基矩阵 80c 中子矩阵 D 替换为上述各矩阵 F 的偏移矩阵中的 m_D 行, 可以得到与基图 80a 对应的不同码率的各个基矩阵。若 $m_D=41$, 将基矩阵 80c 中第 5 行至第 45 行,

第 0 列至第 26 列构成的矩阵部分替换为各矩阵 F 的偏移矩阵, 可以得到与大小为 46 行 68 列的基图 80a 对应的各个基矩阵, 此时码率为 1/3。

需要说明的是, 由于基图和基矩阵中各行、各列都可以交换, 一种可能的实现方式中, 基图的核心矩阵, 也就是子矩阵 A 和 B 构成的部分可以采用基图 30a 中的核心矩阵部分, 基图的子矩阵 D 可以包括基图 30a 中第 5 行到第 45 行, 第 0 列到第 26 列构成的矩阵部分中的 m_D 行。相应地, 基矩阵中核心矩阵部分可以为 30b-3, 30b-4, 30b-5, 30b-6, 30b-7、30b-8、30b-9 以及 30b-10 中的一个, 子矩阵 D 对应的部分可以包括以下任一矩阵的 m_D 行: 30c-3, 30c-4, 30c-5, 30c-6, 30c-7、30c-8、30c-9 和 30c-10。可以根据扩展因子选择核心矩阵和子矩阵 D 对应的部分。

又一种可能的实现方式中, 基图的核心矩阵, 也就是子矩阵 A 和 B 构成的部分可以采用基图 80a 中的核心矩阵部分, 基图的子矩阵 D 可以包括基图 80a 中第 5 行到第 45 行, 第 0 列到第 26 列构成的矩阵部分中的 m_D 行。相应地, 基矩阵中核心矩阵部分可以为 80b-1, 80b-2, 80b-3, 80b-4, 80b-5、80b-6、80b-7 和 80b-8 中的一个, 子矩阵 D 对应的部分可以包括以下任一矩阵的 m_D 行: 80c-1, 80c-2, 80c-3, 80c-4, 80c-5、80c-6、80c-7 和 80c-8。可以根据扩展因子选择核心矩阵和子矩阵 D 对应的部分。

又一种可能的实现方式中, 基图的核心矩阵, 也就是子矩阵 A 和 B 构成的部分可以采用基图 30a 中的核心矩阵部分, 基图的子矩阵 D 可以包括基图 80a 中第 5 行到第 45 行, 第 0 列到第 26 列构成的矩阵部分中的 m_D 行, 如图 10a 所示的基图 100a。相应地, 基矩阵中核心矩阵部分可以为 30b-3, 30b-4, 30b-5, 30b-6, 30b-7、30b-8、30b-9 以及 30b-10 中的一个, 子矩阵 D 对应的部分可以包括以下任一矩阵的 m_D 行: 80c-1, 80c-2, 80c-3, 80c-4, 80c-5、80c-6、80c-7 和 80c-8。可以根据扩展因子选择核心矩阵和子矩阵 D 对应的部分。

又一种可能的实现方式中, 基图的核心矩阵, 可以采用基图 80a 中的核心矩阵部分, 基图的子矩阵 D 可以包括基图 30a 中第 5 行到第 45 行, 第 0 列到第 26 列构成的矩阵部分中的 m_D 行, 如图 9a 所示的基图 90a。相应地, 基矩阵中核心矩阵部分可以为 80b-1, 80b-2, 80b-3, 80b-4, 80b-5、80b-6、80b-7 和 80b-8 中的一个, 子矩阵 D 对应的部分可以包括以下任一矩阵的 m_D 行: 30c-6, 30c-7, 30c-8, 30c-3, 30c-4、30c-5、30c-9 和 30c-10。可以根据扩展因子选择核心矩阵和子矩阵 D 对应的部分。

又一种可能的实现方式中, 基图采用基图 90a, 相应地, 基矩阵可以是包括如图 9b 中以下任一矩阵的第 5 行至第 45 行中的 m_D 行和第 0 行至第 4 行: 90b-1, 90b-2, 90b-3, 90b-4, 90b-5、90b-6、90b-7 和 90b-8 中的一个。可以根据扩展因子选择相应的偏移矩阵。例如:

若扩展因子 Z 为 {24, 26, 28, 30} 中的一个, 则偏移矩阵可以如 90b-1 所示;

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个, 则偏移矩阵可以如 90b-2 所示;

若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 则偏移矩阵可以如 90b-3 所示;

若扩展因子 Z 为 {64, 72, 80, 88} 中的一个, 则偏移矩阵可以如 90b-4 或者 90b-5 所示;

若扩展因子 Z 为 {96, 104, 112, 120} 中的一个, 则偏移矩阵可以如 90b-6 所示;

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个, 则偏移矩阵可以如 90b-7 所示;

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则偏移矩阵可以如 90b-8 所示。

又一种可能的实现方式中, 基图采用基图 100a, 相应地, 基矩阵可以是包括如图 10b 中以下任一矩阵的第 5 行至第 45 行中的 m_D 行和第 0 行至第 4 行: 100b-1, 100b-2, 100b-3,

5 100b-4, 100b-5, 100b-6, 100b-7 和 100b-8 中的一个。可以根据扩展因子选择。例如:

若扩展因子 Z 为 {24, 26, 28, 30} 中的一个, 则偏移矩阵可以如 100b -1 所示;

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个, 则偏移矩阵可以如 100b -2 所示;

若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 则偏移矩阵可以如 100b -3 所示;

10 若扩展因子 Z 为 {64, 72, 80, 88} 中的一个, 则偏移矩阵可以如 100b -4 或者 100b -5 所示;

若扩展因子 Z 为 {96, 104, 112, 120} 中的一个, 则偏移矩阵可以如 100b -6 所示;

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个, 则偏移矩阵可以如 100b -7 所示;

15 若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则偏移矩阵可以如 100b-8 所示。

又一种可能的实现方式中, 基图采用基图 110a, 相应地, 基矩阵可以是包括如图 110b 中以下任一矩阵的第 5 行至第 45 行中的 m_D 行和第 0 行至第 4 行: 110b-1, 110b-2, 110b-3, 110b-4, 110b-5, 110b-6 和 110b-7 中的一个。可以根据扩展因子选择。例如:

若扩展因子 Z 为 {24, 26, 28, 30} 中的一个, 则偏移矩阵可以如 110b-1 所示;

20 若扩展因子 Z 为 {32, 36, 40, 44} 中的一个, 则偏移矩阵可以如 110b-2 所示;

若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 则偏移矩阵可以如 110b-3 所示;

若扩展因子 Z 为 {64, 72, 80, 88} 中的一个, 则偏移矩阵可以如 110b-4 所示;

若扩展因子 Z 为 {96, 104, 112, 120} 中的一个, 则偏移矩阵可以如 110b-5 所示;

25 若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个, 则偏移矩阵可以如 110b-6 所示;

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则偏移矩阵可以如 110b-7 所示。

又一种可能的实现方式中, 基图采用基图 120a, 相应地, 基矩阵可以是包括如图 120b 中以下任一矩阵的第 5 行至第 45 行中的 m_D 行和第 0 行至第 4 行: 120b-1, 120b-2, 120b-3, 120b-4, 120b-5, 120b-6 和 120b-7 中的一个。可以根据扩展因子选择。例如:

30 若扩展因子 Z 为 {24, 26, 28, 30} 中的一个, 则偏移矩阵可以如 120b -1 所示;

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个, 则偏移矩阵可以如 120b -2 所示;

若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 则偏移矩阵可以如 120b -3 所示;

若扩展因子 Z 为 {64, 72, 80, 88} 中的一个, 则偏移矩阵可以如 120b -4 所示;

35 若扩展因子 Z 为 {96, 104, 112, 120} 中的一个, 则偏移矩阵可以如 120b -5 所示;

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个, 则偏移矩阵可以如 120b -6 所示;

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则偏移矩阵可以如 120b-7 所示。

40 又一种可能的实现方式中, 基图采用基图 130a, 相应地, 基矩阵可以是包括如图 130b

中以下任一矩阵的第 5 行至第 45 行中的 m_D 行和第 0 行至第 4 行: 130b-1, 130b-2, 130b-3, 130b-4, 130b-5, 130b-6 和 130b-7 中的一个。可以根据扩展因子选择。例如:

若扩展因子 Z 为 {24, 26, 28, 30} 中的一个, 则偏移矩阵可以如 130b-1 所示;

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个, 则偏移矩阵可以如 130b-2 所示;

5 若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 则偏移矩阵可以如 130b-3 所示;

若扩展因子 Z 为 {64, 72, 80, 88} 中的一个, 则偏移矩阵可以如 130b-4 所示;

若扩展因子 Z 为 {96, 104, 112, 120} 中的一个, 则偏移矩阵可以如 130b-5 所示;

若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个, 则偏移矩阵可以如 130b-6 所示;

10 若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则偏移矩阵可以如 130b-7 所示。

又一种可能的实现方式中, 基图采用基图 140a, 相应地, 基矩阵可以是包括如图 140b 中以下任一矩阵的第 5 行至第 45 行中的 m_D 行和第 0 行至第 4 行: 140b-1, 140b-2, 140b-3, 140b-4, 140b-5, 140b-6 和 140b-7 中的一个。可以根据扩展因子选择。例如:

15 若扩展因子 Z 为 {24, 26, 28, 30} 中的一个, 则偏移矩阵可以如 140b-1 所示;

若扩展因子 Z 为 {32, 36, 40, 44} 中的一个, 则偏移矩阵可以如 140b-2 所示;

若扩展因子 Z 为 {48, 52, 56, 60} 中的一个, 则偏移矩阵可以如 140b-3 所示;

若扩展因子 Z 为 {64, 72, 80, 88} 中的一个, 则偏移矩阵可以如 140b-4 所示;

若扩展因子 Z 为 {96, 104, 112, 120} 中的一个, 则偏移矩阵可以如 140b-5 所示;

20 若扩展因子 Z 为 {128, 144, 160, 176, 192, 208, 224, 240} 中的一个, 则偏移矩阵可以如 140b-6 所示;

若扩展因子 Z 为 {256, 288, 320, 352, 384} 中的一个, 则偏移矩阵可以如 140b-7 所示。

25 图 5a 和图 5b 所示的性能曲线图中, LDPC 1 表示该 LDPC 码是基于基图 30a 对应的各个基矩阵编码得到的, LDPC 2 表示作为对比的一种常用的 LDPC 码, 其中横坐标表示信息比特序列的长度, 单位为比特, 纵坐标为符号信噪比(E_s/N_0), 性能曲线为 BLER 分别为 0.01 和 0.0001 时, LDPC 1 和 LDPC 2 在不同信息比特序列长度下符号信噪比的性能。其中, 图 5a 中码率 $R=8/9$, 图 5b 中码率 $R=1/3$ 。可以看出在同样的 BLER 下, LDPC 30 1 在不同信息比特序列长度下的符号信噪比低于 LDPC 2, 也就是性能优于 LDPC 2。

图 4a 所示为一个 LDPC 码的基图 40a 示例, 其中, 图中最上面一行 0~51 表示列编号, 最左面一列 0~41 表示行编号。

35 子矩阵 A 对应系统比特, 大小为 7 行 10 列, 在基图 40a 中由第 0 行至第 6 行以及第 0 列至第 9 列的元素构成;

子矩阵 B 对应校验比特, 大小为 7 行 7 列, 在基图 40a 中由第 0 行至第 6 行以及第 10 列至第 16 列的元素构成;

子矩阵 A 和子矩阵 B 构成了 LDPC 码基图 40a 的核心矩阵部分, 也即构成了一个 7 行 17 列的矩阵, 可用于高码率编码。

40 其中, 子矩阵 A 中可以包括 2 列内置打孔比特列, 则打孔后, 核心矩阵可以支持的

码率为 $10/(17-2) = 2/3$ 。

其中，子矩阵 B 中最后 1 行（第 6 行）的行重和最后一列（子矩阵 B 的第 6 列，核心矩阵的第 16 列）的列重均为 1，矩阵 B 包括 1 列 3 列重列，即子矩阵 B 的第 0 列（核心矩阵的第 10 列）列重为 3，子矩阵 B 的第 1 至 5 列（核心矩阵的第 11 至 15 列），第 0 至 6 行为双对角结构。

基图 40a 的核心矩阵中，包括了 1 行权重为 3 的行，3 行权重为 8 的行，其余 3 行权重为 7 的行。也就是，子矩阵 A 和子矩阵 B 构成的核心矩阵中各行的权值分别为 8, 7, 7, 7, 8, 8 和 3。需要说明的是，核心矩阵中各行的顺序是可以交换的，例如第 0 行和第 2 行交换，第 1 行和第 3 行交换等等。权重为 3 的行可以如基图 40a 的核心矩阵中第 6 行，第 0 至第 16 列所示；权重为 8 的行可以分别为基图 40a 的核心矩阵中第 0 行，第 4 行以及第 5 行，第 0 至第 26 列所示的各行之一。权重为 7 的行可以分别为基图 40a 的核心矩阵中第 1 行，第 2 行以及第 3 行，第 0 至第 26 列所示的各行之一。这些行顺序可以交换，各列的顺序也可以交换，并不影响编译码性能。

例如，可以将核心矩阵的第 5 行和第 0 行交换，第 4 行和第 1 行交换，第 3 行和第 2 行交换，为了保持子矩阵 B 中的双对角结构，还可以在此基础上将第 15 列和第 11 列交换，第 12 列和第 14 列进行交换得到又一核心矩阵部分。由于子矩阵 C 是全零矩阵，经过行交换和列交换后的基图 80a 的各行的权重没有改变。

在子矩阵 A 中也可以包括 1 行，在该行中除了位于内置打孔列上的元素，其余元素均为零元素。进一步地，为了使得这一行在核心矩阵或者基图矩阵中权重最小，通常和子矩阵 B 中行重为 1 的行在同一行。例如，内置打孔比特列数为 2，也就是第 0 列和第 1 列为内置打孔比特列，如基图 40a 所示，第 6 行中，第 0 列和第 1 列上的元素为非零元素，第 2 列至第 15 列上的元素为零元素，第 16 列的元素为非零元素，第 6 行的权重为 3，不仅在核心矩阵中行的权重最小，在整个基图矩阵中行的权重也是最小的。这种设置可以改善编码和译码的性能。

通常对于一个 LDPC 码给定的基图或者基矩阵而言，对矩阵元素的少量修改对性能影响是可接受的。对于基图 40a 的核心矩阵而言，进行少量修改，例如，使得其中 1 行的权重满足大于或者等于 1，且小于或者等于 5，其余 6 行的权重分别满足大于或者等于 6，且小于或者等于 10，对性能影响较小。

为了支持不同块长，LDPC 码需要不同的扩展因子 Z，例如，扩展因子 Z 可以包括中的一个或多个：8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20, 22, 24, 26, 28, 30, 32, 36, 40, 44, 48, 52, 56, 60, 64, 72, 80, 88, 96, 104, 112, 120, 128, 144, 160, 176, 192, 208, 224, 240, 256。为了保证不同块长下的 LDPC 码性能，可以分别基于不同的扩展因子 Z 采用与之对应的基矩阵。如图 4b 所示为基图 40a 中核心矩阵的多个基矩阵示例。各基矩阵是基于基图 40a 的核心矩阵和扩展因子 Z 得到的，其中，基图 40a 中第 i 行第 j 列的非零元素在基矩阵第 i 行第 j 列为偏移值 $P_{i,j}$ ，基图 40a 中零元素在偏移矩阵中以 -1 或者 null 表示。同样的，基矩阵中各行也是可以交换的，各列也可以交换。

其中，

若扩展因子 Z 为 {8, 9, 10, 11, 12, 13, 14, 15} 中的一个，则基图 40a 的基矩阵

对应子矩阵 A 和子矩阵 B 的部分可以如图 4b 中基矩阵 4b-1 所示;

若扩展因子 Z 为{16, 18, 20, 22, 24, 26, 28, 30}中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b 中基矩阵 4b-2 所示;

5 若扩展因子 Z 为{32, 36, 40, 44}中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b 中基矩阵 4b-3 所示;

若扩展因子 Z 为{48, 52, 56, 60}中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b 中基矩阵 4b-4 所示;

若扩展因子 Z 为{64, 72, 80, 88, 96, 104, 112, 120}中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b-5 所示。

10 若扩展因子 Z 为{128, 144, 160, 176, 192, 208, 224, 240, 256}中的一个, 则基图 40a 的基矩阵对应子矩阵 A 和子矩阵 B 的部分可以如图 4b-6 所示。

为了获得灵活的码率, 可以基于核心矩阵添加相应大小的子矩阵 C、子矩阵 D 和子矩阵 E, 来获得不同的码率。由于子矩阵 C 为零矩阵, 子矩阵 D 为单位矩阵, 其大小主要是根据码率来确定, 结构相对固定。影响到编译码性能的主要在于核心矩阵和子矩阵 D 部分。在核心矩阵的基础上添加行列, 形成相应的 C、D 和 E 部分可以得到不同码率。

子矩阵 D 的列数为子矩阵 A 和 B 的列数之和, 其行数主要与码率相关。以基图 40a 为例, 则相应的子矩阵 D 的列数 m_D 为 $(n_A + m_A) = 17$ 列, 若 LDPC 码支持的码率为 R_m ,

则其基图或者基矩阵的大小为 $m \times n$, 其中, $n = \frac{n_A}{R_m} + p$, $m = n - n_A = \frac{n_A}{R_m} + p - n_A$ 。若

20 最低码率 $R_m = 1/5$, 内置打孔列数 $p = 2$, 以基图 40a 为例, 则 $n = 52$, $m = 42$, 子矩阵 D 的行数 m_D 最大可以为 $m - m_A = 42 - 7 = 35$, 也就是 $0 \leq m_D \leq 35$ 。

为了方便描述, 可以定义一个大小为 35 行 17 列的矩阵 F, 则子矩阵 D 可以包括其中的 m_D 行, 和子矩阵 A、B 以及相应大小的子矩阵 C 和 E 一起构成码率为 $10/(15 + m_D)$ 的 LDPC 码的基图。基图 40a 中, $m_D = 35$, 相应地子矩阵 D 大小为 35 行 17 列, 也就是子矩阵 D 即矩阵 F, 对应 LDPC 码支持的码率为 $10/50 = 1/5$ 。可见, 基图 40a 中第 7 行至第 41 行以及第 0 列至第 16 列构成的矩阵即为矩阵 F。同样地, 矩阵 F 具有前述实施例所述的准正交结构。

在图 40a 所示例的矩阵 F 中, 其行重依次为 5, 4, 4, 4, 4, 4, 4, 3, 3, 3, 4, 2, 3, 3, 4, 4, 2, 3, 3, 3, 3, 3, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 2。

30 由于子矩阵 E 为单位矩阵, 因此基图 40a 中每一行的权重为 6, 5, 5, 5, 5, 5, 5, 4, 4, 4, 4, 5, 3, 4, 4, 5, 5, 3, 4, 4, 4, 4, 4, 3, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 3。

35 若 $m_D = 10$, LDPC 码基图中子矩阵 D 大小为 10 行 17 列, 可以是由基图 40a 中矩阵 F 的第 0-9 行, 也就是基图 40a 的第 7 行至第 16 行, 第 0 列至第 16 列的矩阵构成, 对应 LDPC 码支持的码率为 $10/25 = 0.4$, 也就是在该码率下, LDPC 码的基图对应于基图 40a 的第 0 行至第 16 行, 第 0 列至第 26 列构成的矩阵部分, 其中子矩阵 E 为 10 行 10 列的单位矩阵, 子矩阵 C 为 7 行 10 列的全 0 矩阵;

若 $m_D = 15$, LDPC 码基图中子矩阵 D 大小为 15 行 17 列, 可以是由基图 40a 中矩阵

F的第0-14行,也就是基图40a的第7行至第21行,第0列至第16列的矩阵构成构成,对应LDPC码支持的码率为 $10/30 = 1/3$,也就是在该码率下,LDPC码的基图对应于基图40a的第0行至第21行,第0列至第31列构成的矩阵部分,其中子矩阵E为15行15列的单位矩阵,子矩阵C为7行15列的全0矩阵。

5 以此类推,不一一阐述。

需要说明的是,LDPC码的基图和基矩阵中各行是可以相互交换的,各列也是可以相互交换的。

对每一码率中的子矩阵D,每一行可以进行1~2个非零元素或者1~2个零元素的修改,而不影响其性能。

10 如图4c所示基矩阵40c为基图40a的基矩阵示例,其中,基图40a中第i行第j列的非零元素在基矩阵30c中位置不变,值为偏移值 $P_{i,j}$ 。其中,子矩阵D的部分包括矩阵F的偏移矩阵的 m_D 行,对于图4c中所示的基矩阵40c, $m_D=41$,可以根据码率的不同选择 m_D 值。子矩阵D对应的偏移矩阵为矩阵F的偏移矩阵。这里矩阵F的偏移矩阵也就是将矩阵F中第i行第j列的非零元素替换为偏移值 $P_{i,j}$,零元素在偏移矩阵中以-1或者

15 null表示。

其中,

若扩展因子Z为{8, 9, 10, 11, 12, 13, 14, 15}中的一个,则矩阵F的偏移矩阵可以如4c-1所示;

20 若扩展因子Z为{16, 18, 20, 22, 24, 26, 28, 30}中的一个,则矩阵F的偏移矩阵可以如4c-2所示;

若扩展因子Z为{32, 36, 40, 44}中的一个,则矩阵F的偏移矩阵可以如4c-3所示;

若扩展因子Z为{48, 52, 56, 60}中的一个,则矩阵F的偏移矩阵可以如4c-4所示;

若扩展因子Z为{64, 72, 80, 88, 96, 104, 112, 120}中的一个,则矩阵F的偏移矩阵可以如4c-5所示;

25 若扩展因子Z为{128, 144, 160, 176, 192, 208, 224, 240, 256}中的一个,则矩阵F的偏移矩阵可以如4c-6所示。

30 将基矩阵40c中子矩阵D替换为上述各矩阵F的偏移矩阵中的 m_D 行,可以得到与基图40a对应的不同码率的各个基矩阵。若 $m_D=35$,将基矩阵40c中第7行至第41行,第0列至第16列构成的矩阵部分替换为各矩阵F的偏移矩阵,可以得到与大小为42行52列的基图40a对应的各个基矩阵,此时码率为1/5。

图5c所示为基于基图40a对应的各个基矩阵编码得到的LDPC码,其中横坐标表示信息比特序列的长度,单位为比特,纵坐标为符号信噪比(E_s/N_0),BLER分别为0.01和0.0001时的符号信噪比。

35 在本发明一实施例提供的编码方法中,编码器使用LDPC矩阵对输入序列进行编码;该LDPC矩阵的基图可以为前述示例中的任一基图,该LDPC矩阵的基矩阵 H_B 可以为前述示例中的任一基矩阵。其中,编码器的输入序列可以是信息比特序列。

进一步地,还包括:确定扩展因子Z;可以根据输入序列的长度K来确定扩展因子Z的取值。信息比特序列有时也称为码块(code block),可以通过对传输块进行码块划

分得到。若信息比特序列长度为 K ，可以在多个系统定义的扩展因子中确定满足 $22 \times Z \geq K$ 的最小值，例如， $K=3800$ ，系统定义的扩展因子包括 16, 18, 20, 22, 24, 26, 28, 30, 32, 36, 40, 44, 48, 52, 56, 60, 64, 72, 80, 88, 96, 104, 112, 120, 128, 144, 160, 176, 192, 208, 224, 240, 256, 288, 320, 352, 384，则可以确定 Z 为 176。

5 需要说明的是，此处只是举例，并不以此为限制。

编码器使用 LDPC 矩阵对输入序列进行编码可以是使用扩展因子 Z 对应的 LDPC 矩阵对输入序列进行编码。

10 其中 LDPC 矩阵基矩阵 H_B 可以是前述各实施例中例举的任一基矩阵，其基图至少包括子矩阵 A 和子矩阵 B，还可以包括子矩阵 C、子矩阵 D 和子矩阵 E，各部分可以参考前述各实施例中的描述，此处不再赘述。

15 在一种可能的实现方式中，LDPC 码的基矩阵 H_B 可以是保存在存储器中，编码器获取扩展因子 Z 对应的 LDPC 矩阵，从而对输入序列进行编码。在又一种可能的实现方式中，由于 LDPC 码的基矩阵 H_B 有多个，按照矩阵结构保存会占用较大的存储空间，也可以将 LDPC 码的基图保存在存储器中，分别逐行或者逐列保存各基矩阵中非零元素的偏移值，然后根据基图和扩展因子 Z 对应的基矩阵的偏移值得到 LDPC 矩阵。

需要说明的是，此处均只是举例，并不以此为限制。

20 对信息比特序列进行编码时，可以根据 Z 对基矩阵 H_B 进行扩展得到编码的 LDPC 矩阵 H 。对基矩阵 H_B 中每一非零元素 $P_{i,j}$ ，确定 $Z \times Z$ 大小的循环置换矩阵 $h_{i,j}$ ，其中 $h_{i,j}$ 为单位矩阵经过 $P_{i,j}$ 次循环移位得到的循环置换矩阵，将 $h_{i,j}$ 替换非零元素 $P_{i,j}$ ，将 $Z \times Z$ 大小的全零矩阵替换基矩阵 H_B 中的零元素，从而得到奇偶校验矩阵 H ；

在通信系统中，可采用上述方法编码后得到 LDPC 码。获得 LDPC 码后，通信装置，还可以进行以下一个或多个操作：对 LDPC 码进行速率匹配；根据交织方案对速率匹配后的 LDPC 码进行交织；根据调制方案对交织后的 LDPC 码进行调制得到比特序列 B；发送比特序列 B。

25

在本发明另一实施例提供的译码方法中，译码器使用 LDPC 矩阵对输入序列进行译码；该 LDPC 矩阵的基图可以为前述示例中的任一基图，该 LDPC 矩阵的基矩阵 H_B 可以为前述示例中的任一基矩阵。其中，译码器的输入序列可以是 LDPC 码的软值序列。

30 进一步地，还包括：确定扩展因子 Z 。接收端的通信设备可以接收包含基于 LDPC 编码的信号，获取其中 LDPC 码的软值序列，并确定出相应的扩展因子 Z 。

译码器使用 LDPC 矩阵对输入序列进行译码可以是使用扩展因子 Z 对应的 LDPC 矩阵对 LDPC 码的软值序列进行译码。

35 其中 LDPC 矩阵基矩阵 H_B 可以是前述各实施例中例举的任一基矩阵，其基图至少包括子矩阵 A 和子矩阵 B，还可以包括子矩阵 C、子矩阵 D 和子矩阵 E，各部分可以参考前述各实施例中的描述，此处不再赘述。

在一种可能的设计中，LDPC 码的基矩阵 H_B 可以是保存在存储器中，获取到扩展因子 Z 对应的 LDPC 矩阵可以对 LDPC 码的软值进行译码；

在又一种可能的实现方式中，由于 LDPC 码的基矩阵有多个，按照矩阵结构保存会占用较大的存储空间，也可以将 LDPC 码的基图保存在存储器中，分别逐行或者逐列保

存各基矩阵中非零元素的偏移值，然后根据基图和扩展因子 Z 对应的基矩阵的偏移值得到 LDPC 矩阵。

需要说明的是，此处均只是举例，并不以此为限制。

译码是编码的逆过程，其使用的基矩阵 H_B 具有与编码方法实施例中的基矩阵相同的特征。对基矩阵 H_B 扩展得到 LDPC 矩阵 H 也可以参考编码方法实施例。

在通信系统中，所述译码方法之前，通信装置还可以进行以下一个或多个操作：接收包含基于 LDPC 编码的信号，对信号进行解调，解交织以及解速率匹配得到 LDPC 码的软值。

图 6 给出了一种通信装置 600 的结构示意图，装置 600 可用于实现上述方法实施例中描述的方法，可以参见上述方法实施例中的说明。所述通信装置 600 可以是芯片，基站，终端或者其他网络设备。

所述通信装置 600 包括一个或多个处理器 601。所述处理器 601 可以是通用处理器或者专用处理器等。例如可以是基带处理器、或中央处理器。基带处理器可以用于对通信协议以及通信数据进行处理，中央处理器可以用于对通信装置（如，基站、终端、或芯片等）进行控制，执行软件程序，处理软件程序的数据。

在一种可能的设计中，所述通信装置 600 包括一个或多个所述处理器 601，所述一个或多个处理器 601 可实现上述编码器的功能，在另一种可能的设计中，上述编码器可以是所述处理器 601 的一部分，处理器 601 除了实现编码器的功能，还可以实现其他功能。

所述通信装置 600 使用 LDPC 矩阵对输入序列进行编码；该 LDPC 矩阵的基图可以为前述示例中的任一基图，该 LDPC 矩阵的基矩阵 H_B 可以为前述实施例中的任一基矩阵。其中，编码器的输入序列可以是信息比特序列。

在一种可能的设计中，一个或多个所述处理器 601 可实现上述译码器的功能，在另一种可能的设计中，上述译码器可以是所述处理器 601 的一部分。

所述通信装置 600 可用于使用 LDPC 矩阵对输入序列进行译码；该 LDPC 矩阵的基图可以为前述示例中的任一基图，该 LDPC 矩阵的基矩阵 H_B 可以为前述示例中的任一基矩阵。其中，译码器的输入序列可以是软值序列。

可选的一种设计中，处理器 601 也可以包括指令 603，所述指令可以在所述处理器上被运行，使得所述通信装置 600 执行上述方法实施例中描述的方法。

在又一种可能的设计中，通信装置 600 也可以包括电路，所述电路可以实现前述方法实施例中编码器、或者译码器、或者编码器和译码器的功能。

可选的，所述通信装置 600 中可以包括一个或多个存储器 602，其上存有指令 604，所述指令可在所述处理器上被运行，使得所述通信装置 600 执行上述方法实施例中描述的方法。可选的，所述存储器中还可以存储有数据。可选的处理器中也可以存储指令和/或数据。所述处理器和存储器可以单独设置，也可以集成在一起。可选的，一个或多个存储器 602 可以存储与基矩阵相关的参数，例如偏移值，基图，基于基图扩展到矩阵、基矩阵中的各行，扩展因子等等。可选的，所述一个或者多个存储器 602 可以存储基矩阵或者基于基矩阵扩展到矩阵。

可选的，所述通信装置 600 还可以包括收发器 605 以及天线 606。所述处理器 601 可以称为处理单元，对通信装置（终端或者基站）进行控制。所述收发器 605 可以称为

收发单元、收发机、收发电路、或者收发器等，用于通过天线 606 实现通信装置的收发功能。

可选的，所述通信装置 600 还可以包括用于产生传输块 CRC 的器件、用于码块分割和 CRC 校验的器件、用于交织的交织器、或者用于调制处理的调制器等。可以通过一个或多个处理器 601 实现这些器件的功能。

可选的，所述通信装置 600 还可以包括，用于解调操作的解调器、用于解交织的解交织器、或者用于解速率匹配的器件等等。可以通过一个或多个处理器 601 实现这些器件的功能。

图 7 给出了一种通信系统 700 的示意图，通信系统 700 中包括通信设备 70 和通信设备 71，其中，信息数据在通信设备 70 和通信设备 71 之间接收和发送。通信设备 70 和 71 可以是所述通信装置 600，或者通信设备 70 和 71 分别包括通信装置 600，对信息数据进行接收和发送。在一个例子中，通信设备 70 可以为终端，相应的通信设备 71 可以为基站；在另一个例子中，通信设备 70 为基站，相应的通信设备 71 可以为终端。

本领域技术人员还可以了解到本发明实施例列出的各种说明性逻辑块（illustrative logical block）和步骤（step）可以通过电子硬件、电脑软件，或两者的结合进行实现。这样的功能是通过硬件还是软件来实现取决于特定的应用和整个系统的设计要求。本领域技术人员可以对于每种特定的应用，可以使用各种方法实现所述的功能，但这种实现不应被理解为超出本发明实施例保护的范围。

本发明实施例中所描述的各种说明性的逻辑单元和电路可以通过通用处理器，数字信号处理器，专用集成电路（ASIC），现场可编程门阵列（FPGA）或其它可编程逻辑装置，离散门或晶体管逻辑，离散硬件部件，或上述任何组合的设计来实现或操作所描述的功能。通用处理器可以为微处理器，可选地，该通用处理器也可以为任何传统的处理器、控制器、微控制器或状态机。处理器也可以通过计算装置的组合来实现，例如数字信号处理器和微处理器，多个微处理器，一个或多个微处理器联合一个数字信号处理器核，或任何其它类似的配置来实现。

本发明实施例中所描述的方法或算法的步骤可以直接嵌入硬件、处理器执行的指令、或者这两者的结合。存储器可以是 RAM 存储器、闪存、ROM 存储器、EPROM 存储器、EEPROM 存储器、寄存器、硬盘、可移动磁盘、CD-ROM 或本领域中其它任意形式的存储媒介。示例性地，存储器可以与处理器连接，以使得处理器可以从存储器中读取信息，并可以向存储器存写信息。可选地，存储器还可以集成到处理器中。处理器和存储器可以设置于 ASIC 中，ASIC 可以设置于 UE 中。可选地，处理器和存储器也可以设置于 UE 中的不同的部件中。

通过以上的实施方式的描述，所属领域的技术人员可以清楚地了解到本发明可以用硬件实现，或固件实现，或它们的组合方式来实现。当使用软件程序实现时，可以全部或部分地以计算机程序产品的形式实现，所述计算机程序产品包括一个或多个计算机指令。在计算机上加载和执行所述计算机指令时，全部或部分地产生按照本发明实施例所述的流程或功能。当使用软件程序实现时，也可以将上述功能存储在计算机可读介质中或作为计算机可读介质上的一个或多个指令或代码进行传输。所述计算机可以是通用计算机、专用计算机、计算机网络、或者其他可编程装置。所述计算机指令可以存储在计

计算机可读存储介质中，或者从一个计算机可读存储介质向另一计算机可读存储介质传输。计算机可读介质包括计算机存储介质和通信介质，其中通信介质包括便于从一个地方向另一个地方传送计算机程序的任何介质。存储介质可以是计算机能够存取的任何可用介质。以此为例但不限于：计算机可读介质可以包括 RAM、ROM、EEPROM、CD-ROM 或其他光盘存储、磁盘存储介质或者其他磁存储设备、或者能够用于携带或存储具有指令或数据结构形式的期望的程序代码并能够由计算机存取的任何其他介质。此外，任何连接可以适当的成为计算机可读介质。例如，如果软件是使用同轴电缆、光纤光缆、双绞线、数字用户线（DSL）或者诸如红外线、无线电和微波之类的无线技术从网站、服务器或者其他远程源传输的，那么同轴电缆、光纤光缆、双绞线、DSL 或者诸如红外线、无线和微波之类的无线技术包括在所属介质的定义中。如本发明所使用的，盘（Disk）和碟（disc）包括压缩光碟（CD）、激光碟、光碟、数字通用光碟（DVD）、软盘和蓝光光碟，其中盘通常磁性的复制数据，而碟则用激光来光学的复制数据。上面的组合也应当包括在计算机可读介质的保护范围之内。

总之，以上所述仅为本发明技术方案的较佳实施例而已，并非用于限定本发明的保护范围。凡在本发明的精神和原则之内，所作的任何修改、等同替换、改进等，均应包含在本发明的保护范围之内。

1	1	0	1	1	0	1	1	1	0	1	1	1	1	0	1	1	1	0	1	1	1	0	0	0
1	1	1	0	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	0	0	1	0
1	0	1	1	1	1	0	1	1	1	0	1	1	0	1	1	1	1	0	1	0	1	1	0	1
1	1	1	1	0	1	1	0	0	1	1	1	1	0	1	1	0	1	1	1	1	0	0	1	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

7、根据权利要求1至6任一项所述的方法，其特征在于，所述LDPC矩阵的基矩阵 H_B 对应所述子矩阵A和子矩阵B的部分表示为以下之一：

10	11	1	8	6	1	1	11	7	1	12	10	11	1	7	1	11	0	10	1	9	3	1	0	1	1	1
2	5	4	1	13	3	10	12	5	8	9	1	1	0	9	8	1	3	15	2	5	1	1	0	0	1	1
6	1	12	0	0	13	1	1	0	1	1	8	15	1	8	14	2	0	1	4	1	6	0	1	0	0	1
13	7	9	3	1	6	0	1	1	0	3	14	13	7	1	9	4	1	15	0	1	0	1	1	1	0	1
14	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

5 者，

25	4	-1	6	29	-1	0	18	22	-1	10	27	7	23	21	-1	15	12	5	-1	31	7	1	0	-1	-1	-1
24	0	0	-1	23	23	9	7	0	19	30	-1	-1	15	19	7	-1	28	12	22	12	-1	-1	0	0	-1	-1
20	-1	11	30	15	28	-1	0	9	0	-1	12	18	-1	18	10	30	8	-1	5	-1	11	0	-1	0	0	-1
14	0	1	10	-1	10	11	-1	-1	2	5	0	13	25	-1	25	29	-1	25	11	21	22	1	-1	-1	0	-1
16	19	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

者，

36	11	1	52	0	1	8	41	0	1	24	0	14	29	15	1	35	57	0	1	17	22	1	0	1	1	1
55	2	15	1	11	15	6	9	46	3	26	1	1	47	40	14	1	38	3	14	47	1	1	0	0	1	1
18	1	44	14	1	0	1	13	21	10	1	12	38	1	32	0	63	26	1	3	1	59	0	1	0	0	1
23	46	37	33	1	29	17	1	1	2	0	8	46	48	1	17	50	1	23	45	13	49	1	1	1	0	1
62	51	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

者，

20	52	-1	75	0	-1	4	21	78	-1	29	33	91	34	96	-1	29	21	21	-1	70	45	1	0	-1	-1	-1
9	16	83	-1	28	17	0	26	102	23	0	-1	-1	59	72	79	-1	6	15	32	49	-1	-1	0	0	-1	-1
63	-1	53	0	80	0	-1	53	43	0	-1	0	71	-1	10	92	33	8	-1	0	-1	3	0	-1	0	0	-1
97	25	93	100	-1	4	59	-1	-1	87	108	52	87	12	-1	1	22	-1	0	30	94	27	1	-1	-1	0	-1
85	60	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

10

，或者，

247	172	1	87	215	1	203	172	1	1	215	99	247	21	172	1	246	153	20	1	177	202	1	0	1	1	1
135	212	32	1	85	222	61	221	157	105	168	1	1	0	116	80	1	146	128	193	218	1	1	0	0	1	1
125	1	66	101	148	237	1	139	139	240	1	232	211	1	220	127	198	63	1	236	1	48	0	1	0	0	1
160	198	106	119	1	185	232	1	1	162	236	110	224	59	1	103	254	1	33	195	214	173	1	1	1	0	1
54	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

。

8、根据权利要求1至7任一项所述的方法，其特征在于，所述基图还包括子矩阵C、子矩阵D和子矩阵E，其中，

所述子矩阵C为5行 m_D 列的全零矩阵；

所述子矩阵D为 m_D 行27列的矩阵；

所述子矩阵E为 m_D 行 m_D 列的单位矩阵；

m_D 为整数且 $0 \leq m_D \leq 41$ 。

20

9、根据权利要求8所述的方法，其特征在于，所述子矩阵D包括矩阵F中的 m_D 行，所述矩阵F为41行27列，所述矩阵F的各行的行重分别为7，7，9，8，7，7，8，6，6，5，6，5，5，6，5，5，5，5，4，4，4，5，4，5，4，4，4，4，3，4，4，4，3，3，4，4，3，3，3，4。

10、根据权利要求9所述的方法，其特征在于，所述矩阵F表示为：

25

10	0	1	1	1	1	1	1	1	2	13	1	9	1	1	1	1	3	0	1	1	1	1	1	1	1	1
14	1	1	1	11	1	3	1	1	1	1	5	1	0	1	1	1	1	1	4	15	1	1	1	1	1	1
14	0	1	1	1	1	1	1	1	15	8	6	1	11	1	1	1	1	2	1	1	1	4	0	1	1	1
11	10	1	1	1	1	4	1	1	1	1	14	1	3	1	1	1	1	7	15	1	1	1	1	15	1	1
1	8	1	1	1	1	1	1	1	3	0	1	2	1	1	1	1	12	0	1	1	1	1	1	1	1	1
6	1	1	1	13	1	0	1	1	1	1	1	1	3	1	0	1	1	10	1	1	1	1	1	1	1	1
4	1	1	1	1	9	1	1	1	0	2	3	8	1	1	1	1	7	1	1	1	1	1	1	1	1	1
6	1	1	1	12	1	2	1	1	1	1	1	1	11	1	1	1	1	13	1	1	1	6	1	1	1	1
9	7	1	0	1	1	1	1	1	1	1	1	1	14	1	1	1	1	1	1	1	8	1	1	1	1	1
1	14	1	1	1	1	0	0	1	15	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	3	1	1	0	1	1	1	0	1	1	1	8	1	1	4	1	1
0	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	7	1	1	1	1	1	1	1
10	1	1	1	14	1	1	1	1	1	5	1	6	1	9	1	1	1	1	1	1	1	1	1	1	1	1
1	3	1	1	1	1	4	1	1	0	1	1	1	0	1	1	1	2	1	1	1	1	1	1	1	7	1
0	1	1	1	2	1	1	1	1	1	0	8	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	12	1	1	1	1	7	1	1	8	1	1	1	1	1	1	1	1	13	1	1	1	1	12	1	1	1
0	1	1	4	0	1	1	1	1	1	5	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
8	0	1	1	1	1	1	1	1	6	1	1	1	1	1	1	1	11	1	1	1	1	1	1	0	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	10	1	1	1	1	1	1	1	1	1	1	1
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3	0	10	1	1	1	7	1	1	1	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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1	4	1	1	1	1	0	1	1	1	1	8	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	7	1	1	1	1	
1	2	1	1	1	1	1	1	1	1	5	1	1	1	15	1	1	1	1	1	1	1	1	0	1	1	1
1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1
12	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	11	1	1	1	3	1	1	1	1	6	1	1	1	1	1	1	1	1	1	1	1
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0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
9	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	1	1	1	1	1	1
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1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
1	4	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
1	0	1	1	1	1	1	1	1	1	1	1	1	7	1	1	1	1	1	1	1	1	1	3	1	6	1

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27	11	1	1	1	1	1	1	1	16	0	1	5	1	1	1	1	17	29	1	1	1	1	1	1	1	1
27	1	1	1	17	1	0	1	1	1	1	9	1	0	1	1	1	1	1	17	4	1	1	1	1	1	1
16	29	1	1	1	1	1	1	20	27	0	1	28	1	1	1	1	15	1	1	1	13	0	1	1	1	1
3	10	1	1	1	1	5	1	1	1	1	18	1	6	1	1	1	1	4	9	1	1	1	1	22	1	1
1	5	1	1	1	1	1	1	1	8	0	1	16	1	1	1	4	0	1	1	11	1	1	1	1	1	1
30	2	1	1	0	1	24	1	1	1	1	1	18	1	12	1	1	4	1	1	1	1	1	1	1	1	1
0	1	1	1	1	24	1	1	1	15	30	4	29	1	1	1	1	18	1	1	1	1	1	5	1	1	1
0	1	1	1	21	1	0	1	1	1	1	1	1	12	1	1	1	1	27	1	1	1	0	1	1	1	1
30	0	1	16	1	1	1	1	1	1	1	1	22	1	1	1	1	3	1	1	1	0	1	1	1	1	1
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4	1	1	1	1	1	1	1	1	1	19	1	1	14	1	1	1	10	1	1	1	28	1	1	7	1	1
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26	1	1	1	13	1	1	1	1	1	6	1	0	1	19	1	1	1	1	1	1	1	1	1	1	1	1
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0	1	1	1	24	1	1	1	1	1	10	6	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	5	1	1	1	1	31	1	1	21	1	1	1	1	1	1	1	1	27	1	1	1	1	10	1	1	1
25	1	1	24	0	1	1	1	1	1	12	1	1	21	1	1	1	1	1	1	1	1	1	1	1	1	1
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0	1	1	1	1	1	1	1	1	2	0	1	1	1	1	1	1	1	1	9	1	1	1	1	1	1	1
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1	20	1	1	1	1	1	1	1	1	1	1	1	13	1	1	1	1	1	1	1	1	1	1	10	1	1
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1	14	1	1	21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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1	0	1	1	1	1	1	1	1	1	1	1	1	8	1	1	1	1	1	1	1	1	1	24	1	9	1

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50	53	-1	-1	-1	-1	-1	-1	-1	-1	112	93	-1	84	-1	-1	-1	-1	64	36	-1	-1	-1	-1	-1	-1	-1	
54	-1	-1	-1	60	-1	47	-1	-1	-1	-1	24	-1	87	-1	-1	-1	-1	-1	37	110	-1	-1	-1	-1	-1	-1	
74	120	-1	-1	-1	-1	-1	-1	104	43	87	1	85	-1	-1	-1	-1	124	-1	-1	-1	78	70	-1	-1	-1	-1	
45	100	-1	-1	-1	-1	92	-1	-1	-1	-1	70	-1	80	-1	-1	-1	-1	45	4	-1	-1	-1	-1	10	-1	-1	
-1	62	-1	-1	-1	-1	-1	-1	-1	-1	40	32	-1	46	-1	-1	-1	72	6	-1	-1	36	-1	-1	-1	-1	-1	
85	101	-1	-1	31	-1	27	-1	-1	-1	-1	-1	-1	80	-1	38	-1	-1	117	-1	-1	-1	-1	-1	-1	-1	-1	
86	-1	-1	-1	-1	2	-1	-1	-1	-1	11	105	81	42	-1	-1	-1	-1	41	-1	-1	-1	-1	-1	16	-1	-1	
37	-1	-1	-1	75	-1	106	-1	-1	-1	-1	-1	-1	69	-1	-1	-1	-1	104	-1	-1	-1	74	-1	-1	-1	-1	
19	0	-1	91	-1	-1	-1	-1	-1	-1	-1	-1	37	-1	-1	-1	-1	0	-1	-1	-1	73	-1	-1	-1	-1	-1	
-1	31	-1	-1	-1	-1	82	56	-1	44	-1	-1	-1	-1	-1	-1	-1	-1	-1	37	-1	-1	-1	-1	-1	-1	-1	
18	-1	-1	-1	-1	-1	-1	-1	-1	-1	21	-1	-1	115	-1	-1	-1	-1	14	-1	-1	-1	79	-1	-1	42	-1	-1
31	0	64	-1	-1	-1	60	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	103	-1	-1	-1	-1	-1	-1	
67	-1	-1	-1	101	-1	-1	-1	-1	-1	10	-1	58	-1	94	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
-1	109	-1	-1	-1	-1	111	-1	-1	49	-1	-1	-1	105	-1	-1	-1	24	-1	-1	-1	-1	-1	-1	-1	74	-1	
90	-1	-1	-1	15	-1	-1	-1	-1	-1	75	13	93	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
-1	40	-1	-1	-1	-1	116	-1	-1	66	-1	-1	-1	-1	-1	-1	-1	-1	80	-1	-1	-1	-1	115	-1	-1	-1	
120	-1	-1	66	29	-1	-1	-1	-1	-1	-1	88	-1	-1	126	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
100	0	-1	-1	-1	-1	-1	-1	-1	44	-1	-1	-1	-1	-1	-1	-1	20	-1	-1	-1	-1	-1	-1	-1	29	-1	-1
-1	112	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	85	-1	60	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	
-1	73	-1	-1	-1	-1	-1	-1	79	119	-1	-1	5	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
35	-1	-1	-1	-1	63	97	-1	-1	-1	-1	85	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
77	106	-1	-1	-1	-1	-1	-1	-1	66	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	19	5	-1	-1	
111	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	45	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	35	-1	
75	54	14	-1	-1	-1	52	-1	-1	-1	93	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
-1	112	-1	-1	-1	-1	-1	116	-1	-1	-1	-1	122	-1	-1	-1	-1	21	-1	-1	-1	-1	-1	-1	-1	-1	-1	
58	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	62	99	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	49	-1	
47	-1	-1	-1	-1	-1	-1	-1	-1	-1	110	27	-1	-1	-1	-1	-1	-1	-1	121	-1	-1	-1	-1	-1	-1	-1	
-1	36	-1	-1	-1	-1	103	-1	-1	-1	-1	-1	114	-1	-1	-1	-1	-1	-1	-1	-1	-1	125	-1	-1	-1	-1	
15	-1	-1	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	84	-1	-1	
-1	92	-1	-1	-1	-1	-1	-1	-1	-1	53	-1	-1	-1	115	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	8	-1	-1
-1	19	-1	-1	-1	-1	-1	-1	-1	-1	46	-1	-1	-1	50	-1	-1	20	-1	-1	-1	-1	-1	-1	-1	-1	-1	
101	0	-1	51	-1	92	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
75	-1	-1	-1	-1	-1	125	-1	-1	-1	50	-1	-1	-1	-1	-1	27	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
-1	44	-1	-1	-1	-1	-1	-1	4	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	71	-1	
0	-1	-1	-1	-1	-1	-1	54	-1	-1	-1	-1	-1	-1	-1	-1	-1	60	-1	-1	-1	-1	-1	-1	-1	-1	-1	
22	111	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	68	-1	-1	-1	-1	-1	-1	-1	-1	52	-1	-1	-1	
122	-1	-1	-1	-1	-1	53	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	63	-1	-1	-1	76	-1	-1	-1	
-1	20	-1	-1	36	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	40	-1	-1	-1	-1	-1	
-1	96	82	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	93	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
106	-1	-1	-1	-1	15	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	57	-1	-1	
-1	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	33	-1	95	-1

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187	91	1	1	1	1	1	1	1	63	207	1	228	1	1	1	1	14	67	1	1	1	1	1	1	1	1	1	1
151	1	1	1	136	1	175	1	1	1	1	245	1	15	1	1	1	1	1	238	183	1	1	1	1	1	1	1	1
191	230	1	1	1	1	1	1	179	104	240	1	196	1	1	1	1	182	1	1	1	215	123	1	1	1	1	1	1
133	152	1	1	1	1	139	1	1	1	1	81	1	6	1	1	1	1	39	106	1	1	1	1	1	69	1	1	
1	199	1	1	1	1	1	1	1	145	110	1	96	1	1	1	1	219	148	1	1	129	1	1	1	1	1	1	1
188	98	1	1	133	1	25	1	1	1	1	1	1	77	1	74	1	1	43	1	1	1	1	1	1	1	1	1	1
196	1	1	1	1	184	1	1	1	194	201	154	99	1	1	1	1	103	1	1	1	1	1	1	249	1	1	1	1
220	1	1	1	197	1	152	1	1	1	1	1	1	219	1	1	1	1	96	1	1	1	1	1	134	1	1	1	1
118	131	1	90	1	1	1	1	1	1	1	1	113	1	1	1	1	1	47	1	1	1	1	1	34	1	1	1	1
1	57	1	1	1	1	17	110	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
178	1	1	1	1	1	1	1	1	1	150	1	1	115	1	1	1	1	58	1	1	1	1	1	146	1	1	1	1
99	96	65	1	1	1	165	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	59	1	1	1	1	1
49	1	1	1	8	1	1	1	1	1	175	1	102	1	129	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	114	1	1	1	1	169	1	1	53	1	1	1	121	1	1	1	1	207	1	1	1	1	1	1	1	1	1	1
89	1	1	1	141	1	1	1	1	1	239	142	100	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	246	1	1	1	1	188	1	1	17	1	1	1	1	1	1	1	1	205	1	1	1	1	1	1	124	1	1	1
83	1	1	138	155	1	1	1	1	1	84	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
186	145	1	1	1	1	1	1	1	203	1	1	1	1	1	1	1	1	166	1	1	1	1	1	1	1	1	1	1
1	202	1	1	1	1	1	1	1	1	1	1	1	117	1	119	1	228	1	1	1	1	1	1	1	1	1	1	1
1	108	1	1	1	1	1	1	238	0	1	1	212	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
126	1	1	1	1	105	4	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
186	43	1	1	1	1	1	1	1	252	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	187	20	1	1
9	1	1	1	1	1	1	1	1	1	1	1	166	57	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
136	0	243	1	1	1	128	1	1	1	103	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	122	1	1	1	1	1	158	1	1	1	1	111	1	1	1	1	1	155	1	1	1	1	1	1	1	1	1	1
97	1	1	1	1	1	1	1	1	1	1	1	1	27	242	1	1	1	1	1	1	1	1	1	1	1	1	1	1
177	1	1	1	1	1	1	1	1	100	35	1	1	1	1	1	1	1	1	137	1	1	1	1	1	1	1	1	1
1	61	1	1	1	1	28	1	1	1	1	1	148	1	1	1	1	1	1	1	1	1	1	1	198	1	1	1	1
177	1	1	59	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	90	1	1	1
1	246	1	1	1	1	1	1	1	1	110	1	1	1	56	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	237	1	1	1	1	1	1	1	33	1	1	1	140	1	1	1	183	1	1	1	1	1	1	1	1	1	1	1
223	176	1	139	1	234	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
26	1	1	1	1	1	248	1	1	1	148	1	1	1	1	1	1	226	1	1	1	1	1	1	1	1	1	1	1
1	165	1	1	1	1	1	1	243	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
233	1	1	1	1	1	1	138	1	1	1	1	1	1	1	1	1	1	192	1	1	1	1	1	1	1	1	1	1
213	0	1	1	1	1	1	1	1	1	1	1	1	71	1	1	1	1	1	1	1	1	1	1	10	1	1	1	1
210	1	1	1	1	1	85	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1	1	216	1	1	1	1
1	74	1	1	156	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	98	1	1	1	1
1	36	27	1	1	1	1	1	1	1	1	1	1	169	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
161	1	1	1	1	57	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	43	1	1	1
1	156	1	1	1	1	1	1	1	1	1	1	1	54	1	1	1	1	1	1	1	1	1	1	1	102	1	230	1

。

12、一种编码方法，其特征在于，所述方法包括：

5 使用低密度奇偶校验 LDPC 矩阵对输入序列进行编码；

所述 LDPC 矩阵的基图表示为 m 行 n 列的矩阵， m 为大于或者等于 7 的整数， n 为大于或者等于 17 的整数；

所述基图至少包括子矩阵 A 和子矩阵 B，其中，

所述子矩阵 A 为 7 行 10 列的矩阵；

10 所述子矩阵 B 为 7 行 7 列的矩阵，所述子矩阵 B 包括权重为 3 的列和双对角结构的子矩阵 B'。

13. 一种译码方法，其特征在于，所述方法包括：

使用低密度奇偶校验 LDPC 矩阵对输入序列进行译码；

15 所述 LDPC 矩阵的基图表示为 m 行 n 列的矩阵， m 为大于或者等于 7 的整数， n 为大于或者等于 17 的整数；

所述基图至少包括子矩阵 A 和子矩阵 B，其中，

所述子矩阵 A 为 7 行 10 列的矩阵；

所述子矩阵 B 为 7 行 7 列的矩阵, 所述子矩阵 B 包括一权重为 3 的列和双对角结构的子矩阵 B'。

14、根据权利要求 12 或 13 所述的方法，其特征在于，所述子矩阵 A 和所述子矩阵 B 构成的矩阵中，其中 1 行的权重满足大于或者等于 1，且小于或者等于 5，其余 6 行的权重分别满足大于或者等于 6，且小于或者等于 10。

15、根据权利要求 12 至 14 任一项所述的方法，其特征在于，所述子矩阵 A 和所述子矩阵 B 构成的矩阵中，其中 1 行的权重为 3，3 行的权重为 8，其余 3 行的权重为 7。

16、根据权利要求 12 至 15 任一项所述的方法，其特征在于，所述子矩阵 A 和所述子矩阵 B 构成的矩阵中，其中 1 行为，

[illegible]

其余 3 行分别为以下各行之一,

1	0	1	1	0	1	1	1	0	0	1	1	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

15

1	1	1	1	0	0	0	1	0	1	0	0	0	0	1	1	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

1	1	0	0	1	1	0	0	1	1	1	0	0	0	0	1	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

权重为 7 的 3 行分别为以下各行之一,

0	1	0	0	1	0	1	1	1	0	0	1	1	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

20

1	0	1	1	0	1	0	0	0	1	0	0	1	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

0	1	0	0	1	0	1	0	1	0	1	0	1	1	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

25

17、根据权利要求 12 至 16 任一项所述的方法，其特征在于，所述子矩阵 A 和子矩阵 B 构成的矩阵表示为

[illegible]

18、根据权利要求 12 至 17 任一项所述的方法，其特征在于，所述 LDPC 矩阵的基矩阵对应所述子矩阵 A 和子矩阵 B 的部分表示为以下之一

[illegible]

或者，

7	1	2	14	1	7	0	11	1	1	15	0	1	1	1	1
1	6	1	1	14	1	1	6	2	1	1	0	0	1	1	1
4	1	10	12	1	13	1	1	1	3	1	1	0	0	1	1
1	3	1	1	6	1	2	1	11	1	10	1	1	0	0	1
15	11	0	15	1	1	1	5	1	12	1	1	1	1	0	0
4	9	1	1	9	9	1	1	10	0	15	1	1	1	1	0
2	13	1	1	1	1	1	1	1	1	1	1	1	1	1	0

, 或者,

1	-1	6	21	-1	15	29	6	-1	-1	31	0	-1	-1	-1	-1
1	18	-1	-1	20	-1	22	9	12	-1	-1	0	0	-1	-1	-1
23	-1	13	8	-1	24	-1	-1	-1	19	-1	-1	0	0	-1	-1
-1	30	-1	-1	29	-1	26	-1	2	-1	30	-1	-1	0	0	-1
19	16	20	23	-1	-1	-1	26	-1	25	-1	-1	-1	-1	0	0
27	20	-1	-1	28	8	-1	-1	4	28	31	-1	-1	-1	-1	0
15	27	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

, 或者,

31	1	35	38	1	27	15	16	1	1	18	0	1	1	1	1
1	2	1	1	22	1	36	3	18	1	1	0	0	1	1	1
41	1	19	30	1	20	1	1	1	8	1	1	0	0	1	1
1	29	1	1	43	1	37	1	17	1	24	1	1	0	0	1
44	47	42	47	1	1	1	21	1	30	1	1	1	1	0	0
15	8	1	1	46	25	1	1	28	10	18	1	1	1	1	0
10	40	1	1	1	1	1	1	1	1	1	1	1	1	1	0

, 或者,

11	1	16	52	1	47	39	24	1	1	24	0	1	1	1	1
1	57	1	1	57	1	20	12	1	1	1	0	0	1	1	1
52	1	5	25	1	53	1	1	1	56	1	1	0	0	1	1
1	26	1	1	0	1	55	1	0	1	32	1	1	0	0	1
6	6	0	10	1	1	1	14	1	35	1	1	1	1	0	0
17	0	1	1	21	61	1	1	23	60	24	1	1	1	1	0
37	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0

, 或者,

125	1	13	39	1	50	99	56	1	1	48	0	1	1	1	1
1	87	1	1	38	1	2	7	66	1	1	0	0	1	1	1
95	1	9	26	1	65	1	1	1	111	1	1	0	0	1	1
1	122	1	1	96	1	14	1	40	1	64	1	1	0	0	1
104	25	31	83	1	1	1	59	1	97	1	1	1	1	0	0
94	27	1	1	116	12	1	1	23	76	48	1	1	1	1	0
69	82	1	1	1	1	1	1	1	1	1	1	1	1	1	0

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19、根据权利要求 12 至 18 任一项任一项所述的方法, 其特征在于, 所述基图还包括子矩阵 C、子矩阵 D 和子矩阵 E, 其中,

所述子矩阵 C 为 7 行 m_D 列的全零矩阵;

所述子矩阵 D 为 m_D 行 17 列的矩阵;

10 所述子矩阵 E 为 m_D 行 m_D 列的单位矩阵;

m_D 为整数且 $0 \leq m_D \leq 35$ 。

20、根据权利要求 19 所述的方法, 其特征在于, 所述子矩阵 D 包括矩阵 F 中的 m_D 行, 所述矩阵 F 为 35 行 17 列, 所述矩阵 F 的各行的行重分别为 5, 4, 4, 4, 4, 4, 4, 3, 3, 3, 4, 2, 3, 3, 4, 4, 2, 3, 3, 3, 3, 3, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 2。

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21、根据权利要求 20 所述的方法, 其特征在于, 所述矩阵 F 表示为:

1	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0
1	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0
1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0
1	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

22、根据权利要求 21 所述的方法，其特征在于，所述基矩阵 H_B 对应于矩阵 D 的部分包括所述矩阵 F 的偏移矩阵中的 m_D 行，所述矩阵 F 的偏移矩阵表示为以下之一：

6	4	1	1	3	5	1	1	1	1	2	1	1	1	1	1	1
1	6	1	1	1	4	0	1	1	1	1	1	1	1	1	1	1
2	1	1	1	4	0	1	1	1	0	1	1	1	1	1	1	1
5	1	1	7	1	6	1	1	1	1	1	1	1	0	1	1	1
3	0	1	1	2	1	1	1	1	1	1	1	1	5	1	1	1
1	3	1	6	1	1	2	1	1	1	1	1	1	1	0	1	1
5	1	1	1	1	1	1	1	0	2	1	1	1	1	1	1	6
0	0	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1
1	7	0	1	1	4	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	6	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	0	1	4	1	1	1	1	1	1	1	1	1	6	1
2	1	1	1	1	1	7	1	1	1	1	1	1	1	1	1	1
0	1	5	3	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	6	1	1	1	1	3	1	1	1
0	1	1	1	1	3	1	1	1	1	1	1	1	0	1	1	1
7	1	1	4	1	1	1	1	1	3	1	1	1	0	1	1	1
1	4	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
0	1	0	1	1	1	1	1	1	5	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	2	1
5	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	5	0	1	1	1
0	1	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1
1	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	7	1	4	1	1	1	1
0	1	1	1	1	1	1	1	1	0	1	1	1	1	2	1	1
6	1	1	0	1	2	1	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1	1	1	1	2	1	3	1
0	1	1	1	1	1	1	5	1	1	1	1	1	1	5	1	1
1	1	1	1	1	1	7	1	1	1	1	1	1	1	5	1	1
0	1	1	1	1	1	1	1	1	1	1	4	1	1	1	1	1
6	1	1	1	1	1	1	1	2	1	1	1	1	0	1	1	1
5	1	3	1	3	1	1	1	1	1	1	1	1	1	1	1	1
4	1	7	1	1	1	1	1	1	1	1	0	1	1	1	1	1
7	1	1	2	1	1	1	1	1	1	1	1	1	1	3	1	1
1	5	1	1	1	1	1	1	1	1	1	4	1	1	1	1	1

, 或者,

2	10	1	1	11	0	1	1	1	1	9	1	1	1	1	1	1
1	1	1	1	15	0	4	1	1	1	1	1	1	1	1	1	1
0	1	1	1	7	15	1	1	1	1	1	1	1	1	1	1	1
4	1	1	15	1	7	1	1	1	1	1	1	1	8	1	1	1
12	6	1	1	11	1	1	1	1	1	1	1	1	12	1	1	1
1	4	1	6	1	1	0	1	1	1	1	1	1	1	8	1	1
8	1	1	1	1	1	1	1	13	12	1	1	1	1	1	1	1
0	0	1	1	1	1	1	13	1	1	1	1	1	1	1	1	1
1	12	15	1	1	14	1	1	1	1	1	1	1	1	1	1	1
2	1	1	11	0	1	1	1	1	1	1	1	1	1	1	1	1
6	1	1	0	1	2	1	1	1	1	1	1	1	1	1	10	1
0	1	1	1	1	1	12	1	1	1	1	1	1	1	1	1	1
0	1	0	5	1	1	1	1	1	1	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1	13	1	1	1	1	5	1	1	1
11	1	1	1	1	3	1	1	1	1	14	1	1	0	1	1	1
5	1	1	1	1	1	1	1	1	7	1	1	1	0	1	1	1
1	2	1	1	1	1	1	13	1	1	1	1	1	1	1	1	1
4	1	0	1	1	1	1	1	1	4	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1	6	5	1	1
10	1	2	1	1	14	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	13	0	1	1	1
0	1	1	1	1	1	1	1	1	1	2	1	1	3	1	1	1
1	1	1	1	5	1	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	0	1	9	1	1	1	1	1
14	1	1	1	1	1	1	1	1	8	1	1	1	1	0	1	1
3	1	1	1	1	4	1	1	1	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1	1	1	12	1	11	1
8	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1
6	1	1	1	1	1	12	1	1	1	1	1	1	0	1	1	1
11	1	1	1	1	1	1	1	1	1	1	11	1	1	1	1	1
0	1	1	1	1	1	1	1	13	1	1	1	1	1	1	1	1
15	1	2	1	10	1	1	1	1	1	1	1	1	1	1	1	1
9	1	11	1	1	1	1	1	1	1	1	1	15	1	1	1	1
8	1	1	11	1	1	1	1	1	1	1	1	1	7	1	1	1
1	11	1	1	1	1	1	1	1	1	1	8	1	1	1	1	1

, 或者,

4	0	1	1	14	22	1	1	1	1	24	1	1	1	1	1	1
1	0	1	1	28	3	26	1	1	1	1	1	1	1	1	1	1
17	1	1	1	30	12	1	1	1	14	1	1	1	1	1	1	1
13	1	1	10	1	0	1	1	1	1	1	1	1	17	1	1	1
0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
1	14	1	16	1	1	9	1	1	1	1	1	1	1	5	1	1
0	1	1	1	1	1	1	1	7	19	1	1	1	1	1	1	12
6	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
1	18	2	1	1	29	1	1	1	1	1	1	1	1	1	1	1
11	1	1	17	0	1	1	1	1	1	1	1	1	1	1	1	1
11	1	1	0	1	0	1	1	1	1	1	1	1	1	1	6	1
18	1	1	1	1	1	24	1	1	1	1	1	1	1	1	1	1
30	1	5	13	1	1	1	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	0	1	1	1	1	8	1	1	1
2	1	1	1	1	28	1	1	1	1	27	1	1	12	1	1	1
18	1	1	0	1	1	1	1	1	30	1	1	1	9	1	1	1
1	25	1	1	1	1	1	5	1	1	1	1	1	1	1	1	1
13	1	25	1	1	1	1	1	1	27	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1	1	1	26	0	1	1
30	1	22	1	1	23	1	1	1	1	1	1	1	1	1	1	1
16	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
1	1	1	1	1	1	1	1	1	1	30	1	1	19	1	1	1
1	24	1	1	11	1	1	1	1	1	1	1	1	1	1	1	1
18	1	1	1	1	1	1	1	1	4	1	10	1	1	1	1	1
12	1	1	1	1	1	1	1	1	28	1	1	1	1	24	1	1
30	1	1	21	1	9	1	1	1	1	1	1	1	1	1	1	1
27	1	1	1	1	1	1	1	1	1	1	1	1	14	1	17	1
0	1	1	1	1	1	1	1	14	1	1	1	1	1	22	1	1
4	1	1	1	1	1	15	1	1	1	1	1	1	7	1	1	1
0	1	1	1	1	1	1	1	1	11	1	0	1	1	1	1	1
11	1	1	1	1	1	1	1	6	1	1	1	1	8	1	1	1
8	1	10	1	0	1	1	1	1	1	1	1	1	1	1	1	1
15	1	0	1	1	1	1	1	1	1	1	22	1	1	1	1	1
20	1	1	28	1	1	1	1	1	1	1	1	1	1	29	1	1
1	17	1	1	1	1	1	1	1	1	1	6	1	1	1	1	1

, 或者,

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

, 或者,

29	38	1	1	51	49	1	1	1	1	17	1	1	1	1	1	1
1	18	1	1	16	22	23	1	1	1	1	1	1	1	1	1	1
13	1	1	1	31	8	1	1	1	1	63	1	1	1	1	1	1
39	1	1	36	1	8	1	1	1	1	1	1	1	46	1	1	1
13	0	1	1	45	1	1	1	1	1	1	1	1	18	1	1	1
1	58	1	50	1	1	29	1	1	1	1	1	1	1	21	1	1
41	1	1	1	1	1	1	1	25	42	1	1	1	1	1	1	23
33	12	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1
1	62	26	1	1	50	1	1	1	1	1	1	1	1	1	1	1
11	1	1	44	27	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	11	1	21	1	1	1	1	1	1	1	1	1	6	1
8	1	1	1	1	1	27	1	1	1	1	1	1	1	1	1	1
59	1	1	62	1	1	1	1	1	1	1	1	1	1	1	1	1
61	1	1	1	1	1	1	1	50	1	1	1	1	37	1	1	1
0	1	1	1	1	12	1	1	1	1	23	1	1	34	1	1	1
52	1	1	58	1	1	1	1	1	61	1	1	1	42	1	1	1
1	57	1	1	1	1	1	55	1	1	1	1	1	1	1	1	1
5	1	23	1	1	1	1	1	1	35	1	1	1	1	1	1	1
33	1	1	1	1	1	1	1	1	1	1	1	1	31	0	1	1
0	1	34	1	1	19	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
36	1	1	1	1	1	1	1	1	1	46	1	1	55	1	1	1
1	7	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
51	1	1	1	1	1	1	1	1	47	1	18	1	1	1	1	1
30	1	1	1	1	1	1	1	1	27	1	1	1	1	16	1	1
14	1	1	4	1	29	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1	1	1	12	1	0	1
49	1	1	1	1	1	1	48	1	1	1	1	1	0	1	1	1
13	1	1	1	1	1	10	1	1	1	1	1	1	9	1	1	1
43	1	1	1	1	1	1	1	1	42	1	3	1	1	1	1	1
53	1	1	1	1	1	1	1	0	1	1	1	1	11	1	1	1
8	1	45	1	7	1	1	1	1	1	1	1	1	1	1	1	1
61	1	51	1	1	1	1	1	1	1	1	1	41	1	1	1	1
39	1	1	20	1	1	1	1	1	1	1	1	1	21	1	1	1
1	23	1	1	1	1	1	1	1	1	22	1	1	1	1	1	1

, 或者,

41	20	1	1	67	100	1	1	1	1	30	1	1	1	1	1	1
1	65	1	1	19	41	83	1	1	1	1	1	1	1	1	1	1
6	1	1	1	4	12	1	1	1	33	1	1	1	1	1	1	1
68	1	1	113	1	39	1	1	1	1	1	1	1	1	1	1	1
47	75	1	1	116	1	1	1	1	1	1	1	1	5	1	1	1
1	15	1	12	1	1	14	1	1	1	1	1	1	1	51	1	1
109	1	1	1	1	1	1	1	63	103	1	1	1	1	1	1	127
106	66	1	1	1	1	1	44	1	1	1	1	1	1	1	1	1
1	16	0	1	1	100	1	1	1	1	1	1	1	1	1	1	1
124	1	1	46	85	1	1	1	1	1	1	1	1	1	1	1	1
47	1	1	10	1	26	1	1	1	1	1	1	1	1	1	10	1
120	1	1	1	1	1	42	1	1	1	1	1	1	1	1	1	1
53	1	55	79	1	1	1	1	1	1	1	1	1	1	1	1	1
106	1	1	1	1	1	1	1	125	1	1	1	1	27	1	1	1
97	1	1	1	1	43	1	1	1	15	1	1	66	1	1	1	1
61	1	1	54	1	1	1	1	35	1	1	1	17	1	1	1	1
1	94	1	1	1	1	1	33	1	1	1	1	1	1	1	1	1
120	1	99	1	1	1	1	1	86	1	1	1	1	1	1	1	1
36	1	1	1	1	1	1	1	1	1	1	1	32	0	1	1	1
65	1	12	1	1	6	1	1	1	1	1	1	1	1	1	1	1
80	1	1	1	1	1	1	1	1	1	1	62	0	1	1	1	1
77	1	1	1	1	1	1	1	1	40	1	1	0	1	1	1	1
1	34	1	1	108	1	1	1	1	1	1	1	1	1	1	1	1
38	1	1	1	1	1	1	1	19	1	1	1	1	1	1	1	1
127	1	1	1	1	1	1	1	100	1	1	1	1	122	1	1	1
43	1	1	106	1	72	1	1	1	1	1	1	1	1	1	1	1
126	1	1	1	1	1	1	1	1	1	1	1	26	1	95	1	1
110	1	1	1	1	1	1	1	119	1	1	1	1	7	1	1	1
85	1	1	1	1	1	96	1	1	1	1	1	1	14	1	1	1
15	1	1	1	1	1	1	1	12	1	0	1	1	1	1	1	1
111	1	1	1	1	1	1	1	121	1	1	1	1	24	1	1	1
98	1	81	1	97	1	1	1	1	1	1	1	1	1	1	1	1
106	1	42	1	1	1	1	1	1	1	1	31	1	1	1	1	1
112	1	1	123	1	1	1	1	1	1	1	1	1	77	1	1	1
1	118	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

23、根据权利要求 1 至 22 任一项所述的方法，其特征在于，用于编码或者译码的基图和基矩阵中至少一个是所述 LDPC 矩阵的基图和基矩阵中至少一个经过行交换、或者列交换、或者行交换和列交换后得到的。

5 24、一种装置，用于执行如权利要求 1 至 23 项任一项所述的方法。

25、一种通信装置，其特征在于，所述通信装置包括处理器、存储器以及存储在存储器上并可在处理器上运行的指令，当所述指令被运行时，使得所述通信装置执行如权利要求 1 至 23 项任一项所述的方法。

10 26、一种终端，其特征在于，包括如权利要求 24 所述的装置或权利要求 25 所述的通信装置。

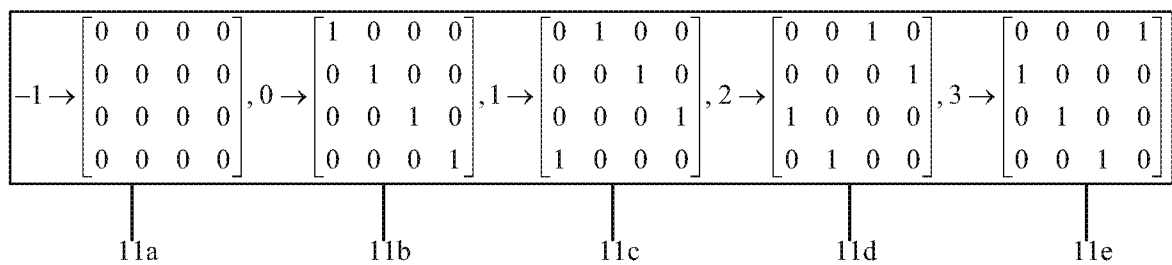
27、一种基站，其特征在于，包括如权利要求 24 所述的装置或权利要求 25 所述的通信装置。

28、一种通信系统，其特征在于包括如权利要求 26 所述的终端以及如权利要求 27 所述的基站。

15 29、一种计算机可读存储介质，包括指令，当其在计算机上运行时，使得计算机执行如权利要求 1 至 23 任一项所述的方法。

30、一种计算机程序产品，当其在计算机上运行时，使得计算机执行权利要求 1 至 23 任一项所述的方法。

Figure 10a is a schematic diagram of a grid structure, likely representing a memory array or a sensor array. The grid is composed of 4 rows and 24 columns of cells. The grid is divided into four horizontal sections by thick lines. The top section has 12 columns labeled 'back' and 12 columns labeled 'front'. The second section has 12 columns labeled 'back' and 12 columns labeled 'front'. The third section has 12 columns labeled 'back' and 12 columns labeled 'front'. The bottom section has 12 columns labeled 'back' and 12 columns labeled 'front'. A label '10a' points to the top right corner of the grid.

[illegible]

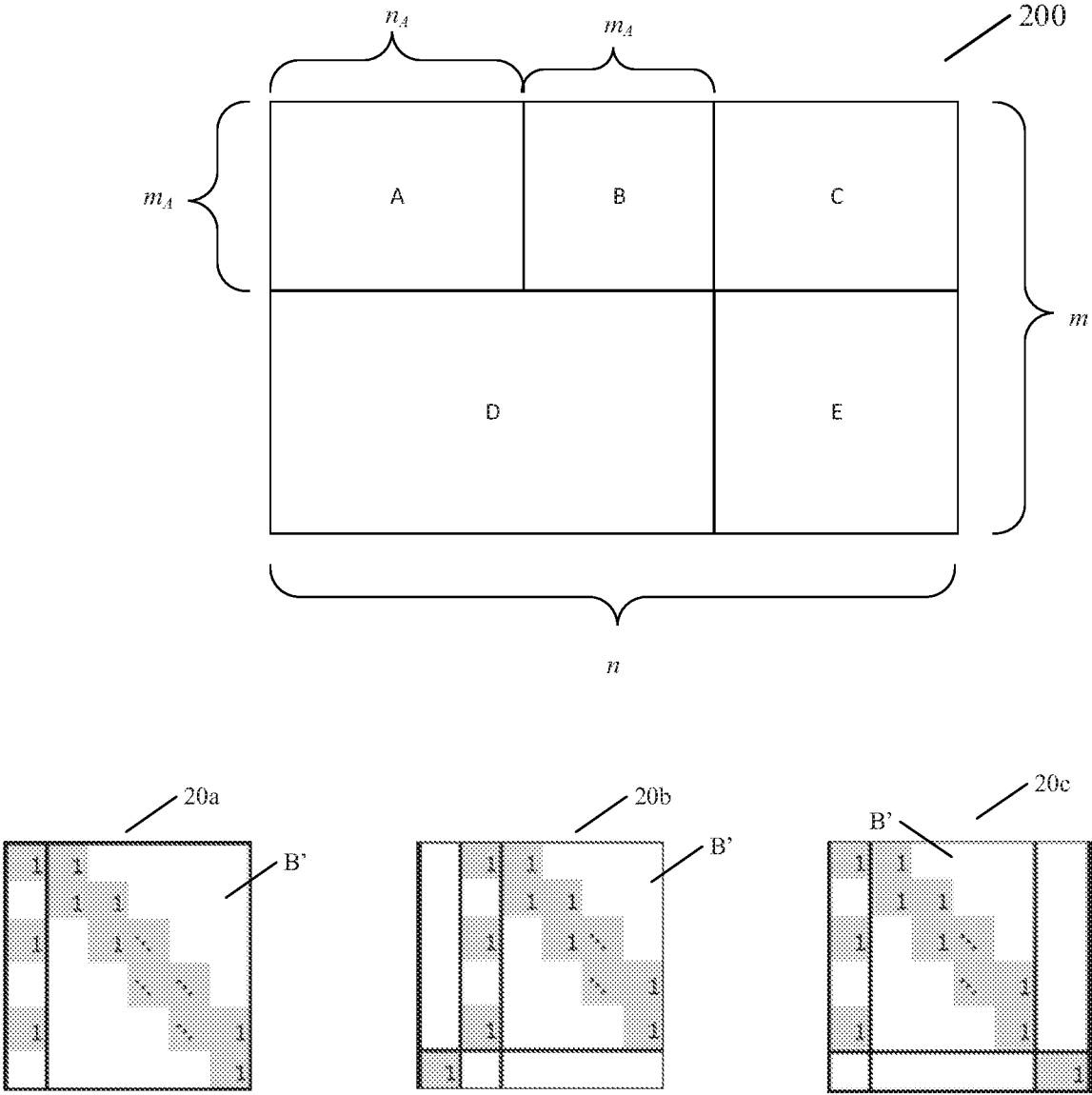


图2

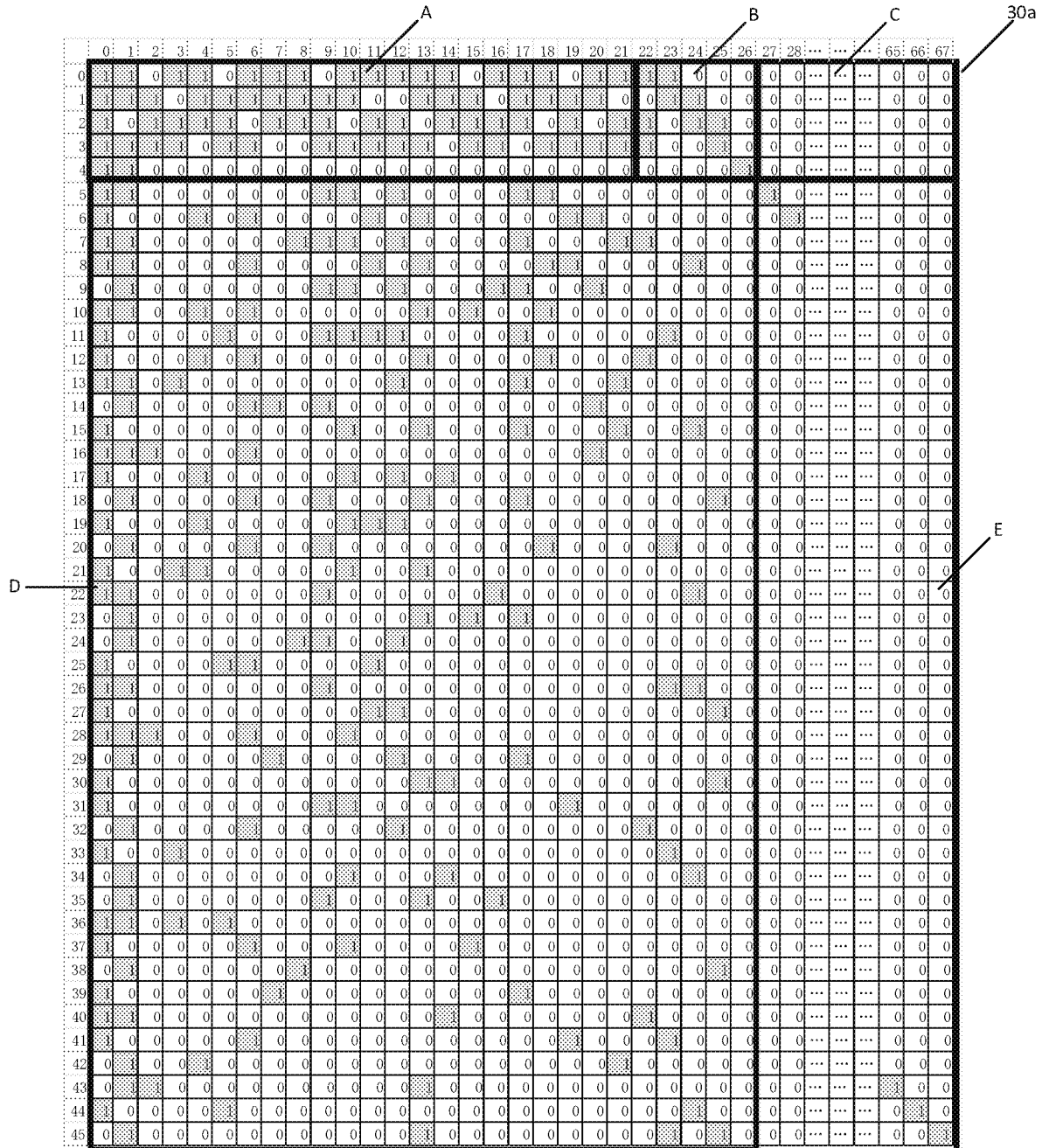
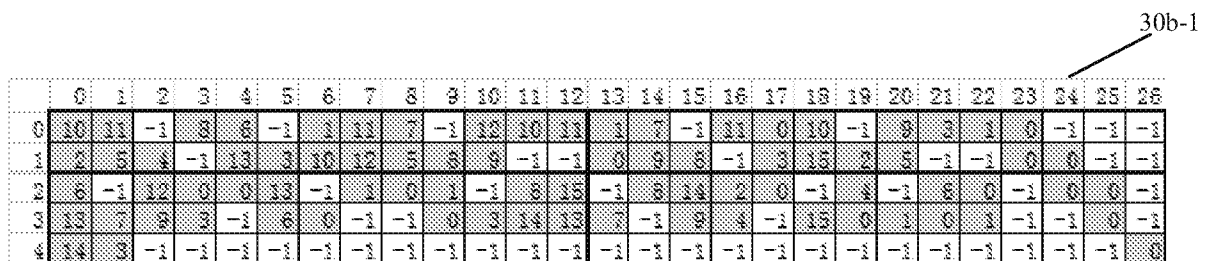


图3a



30b-2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	25	4	-1	6	39	-1	0	18	22	-1	10	27	-1	23	21	-1	13	12	5	-1	31	7	-1	0	-1	-1	-1
1	24	0	0	-1	23	23	5	7	0	19	30	-1	-1	15	19	7	-1	26	12	22	11	-1	-1	0	0	-1	-1
2	20	-1	11	30	15	25	-1	0	9	0	-1	12	18	-1	16	10	35	5	-1	5	-1	11	0	-1	0	0	-1
3	14	0	1	10	-1	10	11	-1	-1	2	5	0	13	25	-1	25	29	-1	25	11	21	22	1	-1	-1	0	-1
4	16	19	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

30b-3

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	38	11	-1	52	0	-1	8	41	0	-1	24	0	14	29	15	-1	35	57	0	-1	17	22	1	0	-1	-1	-1
1	55	2	15	-1	11	15	6	9	45	5	26	-1	-1	47	40	14	-1	38	3	14	47	-1	-1	0	0	-1	-1
2	18	-1	44	14	1	0	-1	13	21	10	-1	12	38	-1	32	0	63	26	-1	3	-1	59	0	-1	0	0	-1
3	23	46	37	33	-1	29	17	-1	-1	1	0	8	46	43	-1	17	50	-1	23	45	13	49	1	-1	-1	0	-1
4	82	51	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

30b-4

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	20	52	-1	75	0	-1	4	21	78	-1	38	33	31	24	95	-1	39	21	21	-1	70	45	1	0	-1	-1	-1
1	8	16	33	-1	26	17	0	26	44	23	0	-1	-1	59	72	78	-1	6	15	32	42	-1	-1	0	0	-1	-1
2	63	-1	53	0	80	0	-1	53	43	0	-1	0	71	-1	10	92	33	8	-1	0	-1	3	0	-1	0	0	-1
3	97	25	93	44	-1	4	59	-1	-1	27	44	52	57	13	-1	1	32	-1	0	36	34	27	1	-1	-1	0	-1
4	85	60	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

30b-5

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	247	172	-1	87	215	-1	203	172	1	-1	215	99	247	21	172	-1	248	153	20	-1	177	202	1	8	-1	-1	-1
1	135	212	52	-1	85	222	8	221	157	103	168	-1	-1	0	115	80	-1	145	128	133	218	-1	-1	0	0	-1	-1
2	125	-1	68	101	145	237	-1	132	139	240	-1	235	211	-1	220	127	198	63	-1	235	-1	45	5	-1	0	0	-1
3	165	198	105	115	-1	165	212	-1	-1	162	238	115	234	59	-1	153	254	-1	33	165	214	173	1	-1	-1	0	-1
4	53	6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

30b-6

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	20	14	-1	21	10	-1	9	7	9	-1	5	11	21	20	7	-1	9	2	3	-1	7	7	1	0	-1	-1	-1
1	6	2	0	-1	12	4	14	3	4	0	11	-1	-1	18	4	8	-1	13	4	1	8	-1	-1	0	0	-1	-1
2	4	-1	1	7	19	1	-1	13	0	13	-1	3	11	-1	8	11	2	15	-1	13	-1	1	5	-1	0	0	-1
3	15	12	4	17	-1	3	6	-1	-1	14	4	2	8	5	-1	16	16	-1	11	6	1	9	1	-1	-1	0	-1
4	15	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

30b-7

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	14	11	-1	7	19	-1	12	2	28	-1	10	26	7	11	0	-1	10	7	8	-1	4	2	1	0	-1	-1	-1
1	28	7	4	-1	30	19	16	25	23	0	2	-1	-1	21	20	0	-1	2	17	26	5	-1	-1	0	0	-1	-1
2	11	-1	18	26	21	6	-1	15	31	10	-1	24	13	-1	12	1	18	23	-1	14	-1	9	0	-1	0	0	-1
3	15	6	29	17	-1	22	0	-1	-1	8	0	12	18	23	-1	8	31	-1	0	0	0	19	1	-1	-1	8	-1
4	11	12	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

30b-8

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	2	18	-1	42	0	-1	34	1	8	-1	3	41	0	43	45	-1	39	46	14	-1	9	31	1	0	-1	-1	-1
1	1	0	33	-1	4	6	14	8	2	41	0	-1	-1	32	32	0	-1	24	38	46	20	-1	-1	0	0	-1	-1
2	25	-1	23	25	15	12	-1	10	24	23	-1	44	5	-1	46	13	24	44	-1	24	-1	43	0	-1	0	0	-1
3	11	32	41	14	-1	15	13	-1	-1	45	21	25	30	18	-1	5	40	-1	36	37	16	25	1	-1	-1	8	-1
4	27	17	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

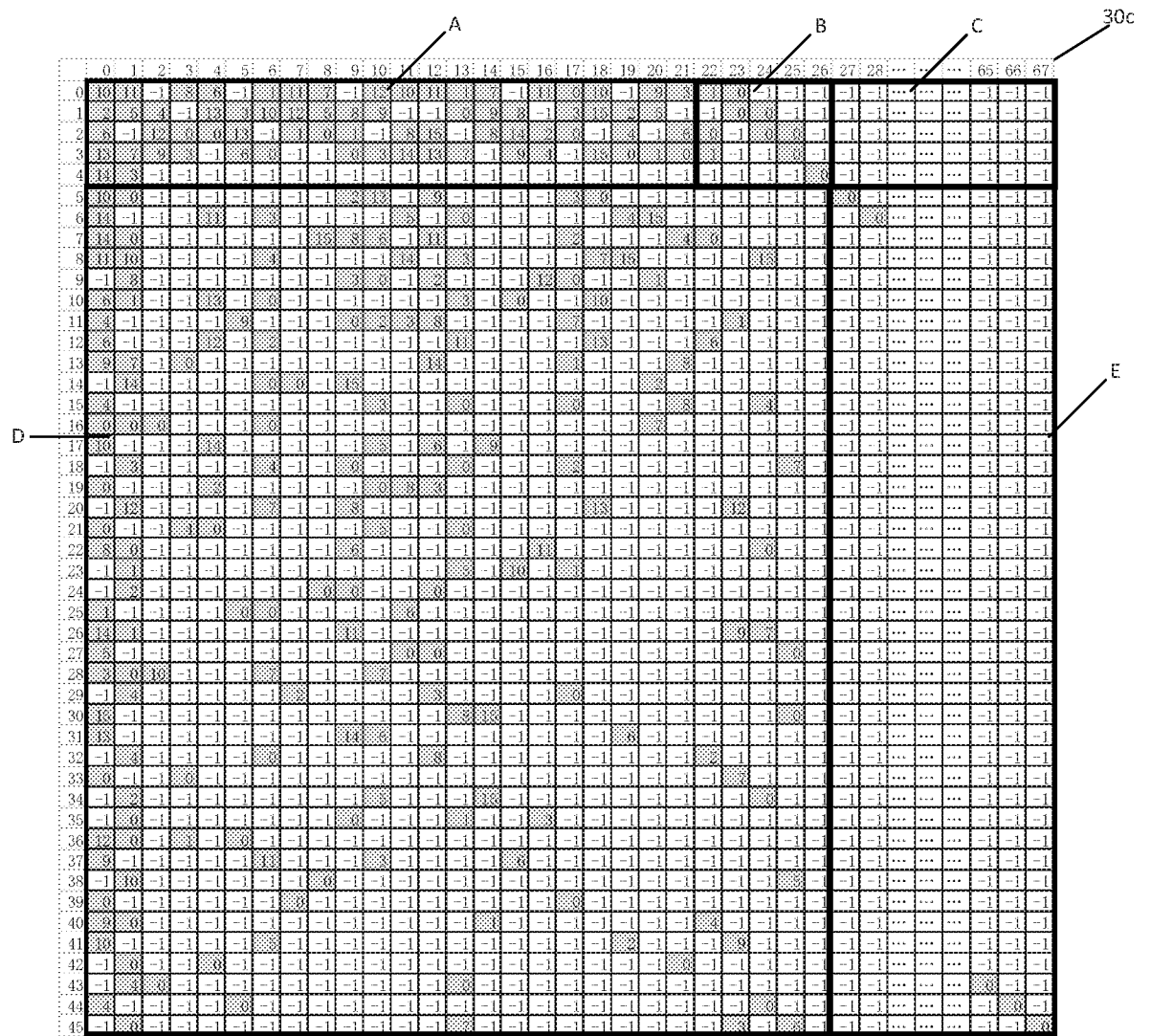
30b-9

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	35	0	-1	38	31	-1	31	33	35	-1	6	17	33	37	13	-1	33	37	23	-1	27	23	1	0	-1	-1	-1
1	37	0	0	-1	0	0	0	0	0	0	0	-1	-1	1	36	0	-1	0	17	42	-1	-1	0	0	-1	-1	-1
2	23	-1	37	23	33	0	-1	32	36	30	-1	36	-1	8	37	16	43	-1	32	-1	37	23	0	-1	0	0	-1
3	37	31	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
4	36	23	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

30b-10

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
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1	20	10	53	-1	11	52	31	16	0	58	36	-1	-1	19	0	47	-1	35	48	10	28	-1	-1	0	0	-1	-1	
2	11	-1	46	32	24	10	-1	18	6	46	-1	45	23	-1	7	63	48	29	-1	30	-1	29	0	-1	0	0	-1	
3	55	34	48	9	-1	28	9	-1	-1	55	6	55	17	0	-1	22	60	-1	46	43	14	50	1	-1	-1	-1	0	-1
4	22	49	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	

图 3b



30c-1

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
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1	14	-1	-1	-1	-1	-1	3	-1	-1	-1	-1	5	-1	0	-1	-1	-1	-1	-1	4	13	-1	-1	-1	-1	-1	-1
2	14	0	-1	-1	-1	-1	-1	-1	15	8	0	-1	11	-1	-1	-1	-1	2	-1	-1	-1	4	0	-1	-1	-1	-1
3	13	10	-1	-1	-1	-1	4	-1	-1	-1	-1	14	-1	3	-1	-1	-1	-1	7	15	-1	-1	-1	-1	15	-1	-1
4	-1	8	-1	-1	-1	-1	-1	-1	-1	3	0	-1	2	-1	-1	-1	12	0	-1	-1	-1	-1	-1	-1	-1	-1	-1
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11	0	0	3	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	7	-1	-1	-1	-1	-1	-1	-1
12	10	-1	-1	-1	14	-1	-1	-1	-1	-1	5	-1	6	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
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17	8	0	-1	-1	-1	-1	-1	-1	-1	6	-1	-1	-1	-1	-1	11	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1
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19	-1	2	-1	-1	-1	-1	-1	-1	0	0	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
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21	14	1	-1	-1	-1	-1	-1	-1	-1	11	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	9	7	-1	-1
22	5	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1
23	3	0	10	-1	-1	-1	7	-1	-1	-1	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
24	-1	4	-1	-1	-1	-1	-1	2	-1	-1	-1	-1	3	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1
25	15	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	8	15	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1
26	13	-1	-1	-1	-1	-1	-1	-1	-1	14	6	-1	-1	-1	-1	-1	-1	-1	-1	-1	6	-1	-1	-1	-1	-1	-1
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28	0	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1	-1
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31	12	0	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
32	9	-1	-1	-1	-1	-1	11	-1	-1	-1	3	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
33	-1	10	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	5	-1
34	0	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
35	9	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	4	-1	-1	-1	-1
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38	-1	4	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
39	4	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1
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30c-2

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9	-1	5	-1	-1	-1	-1	19	0	-1	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	
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13	-1	22	-1	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	17	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	35	-1	
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33	-1	1	-1	-1	-1	-1	-1	-1	17	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	8	-1	
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38	-1	0	30	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
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30c-3

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30c-4

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30c-5

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30c-6

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30c-7

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30c-8

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30c-9

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30c-10

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5	2	0	-1	-1	33	-1	14	-1	-1	-1	-1	-1	-1	17	-1	23	-1	-1	36	-1	-1	-1	-1	-1	-1	-1	-1	
6	3	-1	-1	-1	-1	13	-1	-1	-1	-1	9	0	55	46	-1	-1	-1	-1	6	-1	-1	-1	-1	12	-1	-1	-1	
7	37	-1	-1	-1	30	-1	-1	-1	-1	-1	-1	-1	-1	39	-1	-1	-1	-1	27	-1	-1	-1	18	-1	-1	-1	-1	
8	52	35	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	50	-1	-1	-1	-1	37	-1	-1	-1	29	-1	-1	-1	-1	-1	
9	-1	33	-1	-1	-1	-1	33	0	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	46	-1	-1	-1	-1	-1	-1	-1	
10	30	-1	-1	-1	-1	-1	-1	-1	-1	-1	51	-1	-1	8	-1	-1	-1	20	-1	-1	-1	0	-1	-1	0	-1	-1	
11	30	33	42	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	60	-1	-1	-1	-1	-1	-1	-1	
12	16	-1	-1	-1	58	-1	-1	-1	-1	-1	0	-1	0	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
13	-1	25	-1	-1	-1	-1	50	-1	-1	0	-1	-1	-1	62	-1	-1	-1	41	-1	-1	-1	-1	-1	-1	-1	-1	6	-1
14	58	-1	-1	-1	0	-1	-1	-1	-1	-1	51	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
15	-1	12	-1	-1	-1	-1	31	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	47	-1	-1	-1	-1	6	-1	-1	-1	
16	60	-1	-1	22	33	-1	-1	-1	-1	-1	40	-1	-1	16	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
17	42	24	-1	-1	-1	-1	-1	-1	-1	17	-1	-1	-1	-1	-1	-1	28	-1	-1	-1	-1	-1	-1	-1	16	-1	-1	
18	-1	15	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	7	-1	0	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	
19	-1	19	-1	-1	-1	-1	-1	-1	25	33	-1	-1	62	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
20	24	-1	-1	-1	-1	48	0	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
21	30	30	-1	-1	-1	-1	-1	-1	-1	37	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	5	43	-1	-1	
22	33	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	39	32	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	32	-1	
23	11	0	0	-1	-1	-1	2	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
24	-1	22	-1	-1	-1	-1	50	-1	-1	-1	-1	-1	53	-1	-1	-1	20	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
25	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	13	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	3	-1
26	15	-1	-1	-1	-1	-1	-1	-1	-1	60	9	-1	-1	-1	-1	-1	-1	-1	58	-1	-1	-1	-1	-1	-1	-1	-1	-1
27	-1	16	-1	-1	-1	-1	34	-1	-1	-1	-1	-1	34	-1	-1	-1	-1	-1	-1	-1	-1	-1	20	-1	-1	-1	-1	
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30	-1	13	-1	-1	-1	-1	-1	-1	-1	13	-1	-1	-1	21	-1	-1	27	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
31	39	58	-1	34	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
32	50	-1	-1	-1	-1	-1	29	-1	-1	-1	4	-1	-1	-1	-1	23	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
33	-1	10	-1	-1	-1	-1	-1	-1	19	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	63	-1	
34	36	-1	-1	-1	-1	-1	-1	62	-1	-1	-1	-1	-1	-1	-1	-1	38	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
35	22	43	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	-1	-1	37	-1	-1	-1	-1	
36	31	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1	4	-1	-1	-1	-1	
37	-1	9	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	61	-1	-1	-1	-1	-1	-1	
38	-1	56	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	36	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
39	16	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	46	-1	-1	
40	-1	46	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	46	-1	-1	-1	-1	-1	-1	-1	-1	-1	12	-1	-1	-1	

图3c

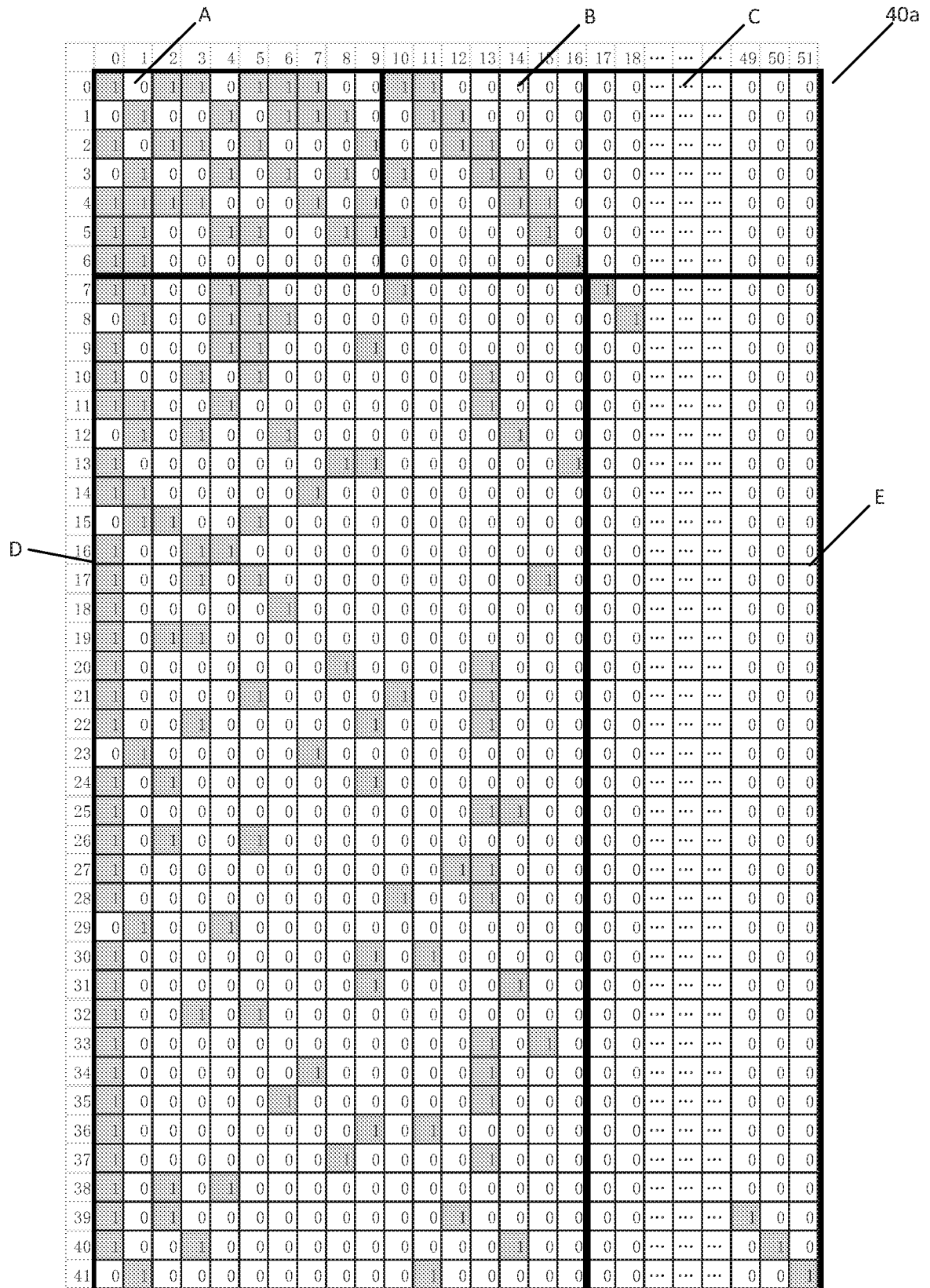


图 4a

4b-1

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	2	-1	1	3	-1	4	4	0	-1	-1	4	0	-1	-1	-1	-1	-1
1	1	7	1	1	5	1	3	5	7	1	1	0	0	1	1	1	1
2	3	-1	5	1	-1	7	-1	-1	-1	5	-1	-1	0	0	-1	-1	-1
3	-1	0	-1	-1	0	-1	1	-1	1	-1	3	-1	-1	0	0	-1	-1
4	1	2	2	1	-1	-1	-1	3	-1	4	-1	-1	-1	-1	0	0	-1
5	4	7	-1	-1	4	1	-1	-1	3	3	4	-1	-1	-1	-1	0	-1
6	5	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

4b-2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	7	-1	2	13	-1	7	0	11	-1	-1	15	0	-1	-1	-1	-1	-1
1	-1	6	-1	-1	14	-1	1	6	2	-1	-1	0	0	-1	-1	-1	-1
2	4	-1	10	12	-1	13	-1	-1	-1	3	-1	-1	0	0	-1	-1	-1
3	-1	3	-1	-1	6	-1	2	-1	11	-1	10	-1	-1	0	0	-1	-1
4	15	11	0	15	1	1	1	5	1	12	1	1	1	1	0	0	1
5	4	9	-1	-1	9	9	-1	-1	10	0	15	-1	-1	-1	-1	0	-1
6	2	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

4b-3

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	1	-1	6	21	-1	15	29	6	-1	-1	31	0	-1	-1	-1	-1	-1
1	-1	13	-1	-1	20	-1	22	9	12	-1	-1	0	0	-1	-1	-1	-1
2	23	-1	13	8	1	24	1	1	1	19	1	1	0	0	1	1	1
3	-1	30	-1	-1	29	-1	26	-1	2	-1	30	-1	-1	0	0	-1	-1
4	19	16	20	23	-1	-1	-1	26	-1	25	-1	-1	-1	-1	0	0	-1
5	27	20	1	1	28	8	1	1	4	28	31	1	1	1	1	0	1
6	15	27	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

4b-4

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	31	-1	35	38	-1	27	15	16	-1	-1	18	0	-1	-1	-1	-1	-1
1	-1	2	-1	-1	22	-1	36	3	18	-1	-1	0	0	-1	-1	-1	-1
2	41	1	19	30	1	20	1	1	1	8	1	1	0	0	1	1	1
3	-1	29	-1	-1	43	-1	37	-1	17	-1	24	-1	-1	0	0	-1	-1
4	44	47	42	47	-1	-1	-1	21	-1	36	-1	-1	-1	-1	0	0	-1
5	15	8	1	1	46	25	1	1	28	10	18	1	1	1	1	0	1
6	10	40	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

4b-5

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	11	-1	16	52	-1	47	39	24	-1	-1	24	0	-1	-1	-1	-1	-1
1	1	57	1	1	57	1	20	12	1	1	1	0	0	1	1	1	1
2	52	-1	5	25	-1	53	-1	-1	-1	56	-1	-1	0	0	-1	-1	-1
3	-1	26	-1	-1	0	-1	55	-1	0	-1	32	-1	-1	0	0	-1	-1
4	6	8	0	10	-1	-1	-1	14	-1	35	-1	-1	-1	-1	0	0	-1
5	17	0	-1	-1	21	61	-1	-1	23	60	24	-1	-1	-1	-1	0	-1
6	37	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

4b-6

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	125	-1	13	39	-1	50	99	56	-1	-1	48	0	-1	-1	-1	-1	-1
1	-1	87	-1	-1	38	-1	2	7	66	-1	-1	0	0	-1	-1	-1	-1
2	95	-1	9	26	-1	65	-1	-1	-1	111	-1	-1	0	0	-1	-1	-1
3	-1	122	-1	-1	96	-1	14	-1	40	-1	64	-1	-1	0	0	-1	-1
4	104	25	31	83	-1	-1	-1	59	-1	97	-1	-1	-1	-1	0	0	-1
5	94	27	-1	-1	116	12	-1	-1	23	76	48	-1	-1	-1	-1	0	-1
6	69	82	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

图4b

40c

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	...	...	...	49	50	51
0	2	1	1	3	1	4	4	0	1	1	4	0	1	1	1	1	1	1	1	...	...	...	1	1	1
1	1	7	-1	-1	5	-1	3	5	7	-1	-1	0	0	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
2	3	-1	5	1	-1	7	-1	-1	-1	5	-1	-1	0	0	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
3	-1	0	-1	-1	0	-1	1	-1	1	-1	3	-1	-1	0	0	-1	-1	-1	-1	...	...	...	-1	-1	-1
4	1	2	2	1	-1	-1	-1	3	-1	4	-1	-1	-1	-1	0	0	-1	-1	-1	...	...	...	-1	-1	-1
5	4	7	-1	-1	4	1	-1	-1	3	2	4	-1	-1	-1	-1	0	-1	-1	-1	...	...	...	-1	-1	-1
6	5	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	...	...	...	-1	-1	-1
7	6	4	-1	-1	3	-1	-1	-1	-1	-1	2	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
8	1	6	-1	-1	1	4	0	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	0	...	...	...	-1	-1	-1	
9	2	-1	-1	-1	4	0	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
10	5	-1	-1	7	-1	6	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	...	...	...	-1	-1	-1	
11	3	0	-1	-1	2	-1	-1	-1	-1	-1	-1	-1	-1	5	-1	-1	-1	-1	...	...	...	-1	-1	-1	
12	-1	3	-1	6	-1	-1	2	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	...	...	...	-1	-1	-1	
13	5	-1	-1	-1	-1	-1	-1	0	2	-1	-1	-1	-1	-1	-1	-1	6	-1	...	...	...	-1	-1	-1	
14	0	0	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
15	-1	7	0	-1	-1	4	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
16	2	-1	-1	1	6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
17	4	-1	-1	0	-1	4	-1	-1	-1	-1	-1	-1	-1	-1	-1	6	-1	-1	...	...	...	-1	-1	-1	
18	2	-1	-1	-1	-1	-1	7	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
19	0	-1	5	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
20	4	-1	-1	-1	-1	-1	-1	-1	6	-1	-1	-1	-1	3	-1	-1	-1	-1	...	...	...	-1	-1	-1	
21	0	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	...	...	...	-1	-1	-1	
22	7	-1	-1	4	-1	-1	-1	-1	3	-1	-1	-1	-1	0	-1	-1	-1	-1	...	...	...	-1	-1	-1	
23	-1	4	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
24	0	-1	0	-1	-1	-1	-1	-1	5	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
25	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	4	2	-1	-1	-1	...	...	...	-1	-1	-1	
26	5	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
27	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	5	0	-1	-1	-1	-1	...	...	...	-1	-1	-1	
28	0	-1	-1	-1	-1	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
29	-1	5	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
30	3	-1	-1	-1	-1	-1	-1	-1	7	-1	4	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
31	0	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	2	-1	-1	-1	-1	...	...	...	-1	-1	-1	
32	6	-1	-1	0	-1	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
33	6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	3	-1	-1	-1	...	...	...	-1	-1	-1	
34	0	-1	-1	-1	-1	-1	5	-1	-1	-1	-1	-1	5	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
35	1	-1	-1	-1	-1	-1	7	-1	-1	-1	-1	-1	5	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
36	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	4	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
37	6	-1	-1	-1	-1	-1	-1	2	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
38	5	-1	3	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
39	4	-1	7	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	...	...	...	0	-1	-1	
40	7	-1	-1	2	-1	-1	-1	-1	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	...	...	...	-1	0	-1	
41	1	5	-1	-1	-1	-1	-1	-1	-1	-1	4	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	0	

D

A

B

C

E

4c-1

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	6	4	-1	-1	3	5	-1	-1	-1	-1	2	-1	-1	-1	-1	-1	-1
1	-1	6	-1	-1	1	3	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
2	2	-1	-1	-1	4	0	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1
3	5	1	1	7	1	6	1	1	1	1	1	1	1	0	1	1	1
4	3	0	-1	-1	2	-1	-1	-1	-1	-1	-1	-1	-1	5	-1	-1	-1
5	-1	3	-1	6	-1	-1	2	-1	-1	-1	-1	-1	-1	-1	0	-1	-1
6	5	-1	-1	-1	-1	-1	-1	0	2	-1	-1	-1	-1	-1	-1	-1	6
7	0	0	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1
8	-1	7	0	-1	-1	4	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
9	2	-1	-1	1	6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
10	4	1	1	0	1	4	1	1	1	1	1	1	1	1	1	6	1
11	2	-1	-1	-1	-1	-1	7	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
12	0	-1	5	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
13	4	-1	-1	-1	-1	-1	-1	-1	6	-1	-1	-1	-1	3	-1	-1	-1
14	0	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1
15	7	-1	-1	4	-1	-1	-1	-1	-1	3	-1	-1	-1	0	-1	-1	-1
16	1	4	-1	-1	-1	-1	-1	0	1	-1	-1	-1	-1	-1	-1	-1	-1
17	0	-1	0	-1	-1	-1	-1	-1	-1	5	-1	-1	-1	-1	-1	-1	-1
18	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	4	2	-1	-1
19	5	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
20	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	5	0	-1	-1
21	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1
22	-1	5	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
23	3	-1	-1	-1	-1	-1	-1	-1	-1	7	-1	4	-1	-1	-1	-1	-1
24	0	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	2	-1	-1
25	6	-1	-1	0	-1	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
26	6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	3	-1
27	0	-1	-1	-1	-1	-1	-1	5	-1	-1	-1	-1	-1	5	-1	-1	-1
28	1	-1	-1	-1	-1	-1	7	-1	-1	-1	-1	-1	-1	5	-1	-1	-1
29	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	4	-1	-1	-1	-1	-1	-1
30	6	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1	-1	0	-1	-1	-1
31	5	-1	3	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
32	4	-1	7	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1
33	7	-1	-1	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	3	-1	-1
34	-1	5	-1	-1	-1	-1	-1	-1	-1	-1	-1	4	-1	-1	-1	-1	-1

4c-2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	2	10	-1	-1	11	0	-1	-1	-1	-1	9	-1	-1	-1	-1	-1	-1
1	-1	-1	-1	-1	15	0	4	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
2	0	-1	-1	-1	7	15	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
3	4	1	1	15	1	7	1	1	1	1	1	1	1	8	1	1	1
4	12	6	-1	-1	11	-1	-1	-1	-1	-1	-1	-1	-1	12	-1	-1	-1
5	-1	4	-1	6	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	8	-1	-1
6	8	-1	-1	-1	-1	-1	-1	-1	13	12	-1	-1	-1	-1	-1	-1	-1
7	0	0	1	1	1	1	1	13	1	1	1	1	1	1	1	1	1
8	-1	12	15	-1	-1	14	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
9	2	-1	-1	11	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
10	6	1	1	0	1	2	1	1	1	1	1	1	1	1	1	10	1
11	0	-1	-1	-1	-1	-1	12	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
12	0	-1	0	5	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
13	14	-1	-1	-1	-1	-1	-1	-1	13	-1	-1	-1	-1	5	-1	-1	-1
14	11	-1	-1	-1	-1	3	-1	-1	-1	-1	14	-1	-1	0	-1	-1	-1
15	5	-1	-1	-1	-1	-1	-1	-1	-1	7	-1	-1	-1	0	-1	-1	-1
16	1	2	-1	-1	-1	-1	-1	13	-1	-1	-1	-1	-1	-1	-1	-1	-1
17	4	-1	0	-1	-1	-1	-1	-1	-1	4	-1	-1	-1	-1	-1	-1	-1
18	8	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	6	5	-1	-1
19	10	-1	2	-1	-1	14	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
20	10	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	13	0	-1	-1	-1
21	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	3	-1	-1	-1
22	-1	1	-1	-1	5	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
23	8	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	9	-1	-1	-1	-1	-1
24	14	-1	-1	-1	-1	-1	-1	-1	-1	8	-1	-1	-1	-1	0	-1	-1
25	3	-1	-1	-1	-1	4	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
26	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	12	-1	11	-1
27	8	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	0	-1	-1	-1
28	6	-1	-1	-1	-1	-1	12	-1	-1	-1	-1	-1	-1	0	-1	-1	-1
29	11	-1	-1	-1	-1	-1	-1	-1	-1	-1	11	-1	-1	-1	-1	-1	-1
30	0	-1	-1	-1	-1	-1	-1	-1	13	-1	-1	-1	-1	-1	-1	-1	-1
31	15	-1	2	-1	10	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
32	9	-1	11	-1	-1	-1	-1	-1	-1	-1	-1	-1	15	-1	-1	-1	-1
33	8	-1	-1	11	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	7	-1	-1
34	-1	11	-1	-1	-1	-1	-1	-1	-1	-1	-1	8	-1	-1	-1	-1	-1

4c-3

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
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1	1	0	1	1	28	3	26	1	1	1	1	1	1	1	1	1	1
2	17	-1	-1	-1	30	12	-1	-1	-1	14	-1	-1	-1	-1	-1	-1	-1
3	13	-1	-1	10	-1	0	-1	-1	-1	-1	-1	-1	-1	17	-1	-1	-1
4	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
5	-1	14	-1	16	-1	-1	9	-1	-1	-1	-1	-1	-1	-1	5	-1	-1
6	0	-1	-1	-1	-1	-1	-1	-1	7	19	-1	-1	-1	-1	-1	-1	12
7	6	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
8	-1	18	2	-1	-1	29	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
9	11	-1	-1	17	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
10	11	-1	1	0	1	0	1	1	1	1	1	1	1	1	1	6	1
11	18	-1	-1	-1	-1	-1	24	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
12	30	-1	5	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
13	0	1	1	1	1	1	1	1	0	1	1	1	1	8	1	1	1
14	2	-1	-1	-1	-1	28	-1	-1	-1	-1	27	-1	-1	12	-1	-1	-1
15	18	-1	-1	0	-1	-1	-1	-1	-1	20	-1	-1	-1	9	-1	-1	-1
16	-1	25	-1	-1	-1	-1	-1	5	-1	-1	-1	-1	-1	-1	-1	-1	-1
17	13	-1	25	-1	-1	-1	-1	-1	-1	27	-1	-1	-1	-1	-1	-1	-1
18	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26	0	-1	-1
19	30	-1	23	-1	-1	23	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
20	16	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	0	-1	-1
21	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	30	-1	-1	19	-1	-1	-1
22	-1	24	-1	-1	11	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
23	18	1	1	1	1	1	1	1	1	4	1	10	1	1	1	1	1
24	12	-1	-1	-1	-1	-1	-1	-1	-1	28	-1	-1	-1	-1	24	-1	-1
25	30	-1	-1	21	-1	9	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
26	27	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	14	-1	17	-1
27	0	-1	-1	-1	-1	-1	-1	14	-1	-1	-1	-1	-1	22	-1	-1	-1
28	4	1	1	1	1	1	15	-1	1	1	1	1	1	7	-1	-1	-1
29	0	-1	-1	-1	-1	-1	-1	-1	11	-1	0	-1	-1	-1	-1	-1	-1
30	11	-1	-1	-1	-1	-1	-1	-1	6	-1	-1	-1	-1	8	-1	-1	-1
31	8	1	10	1	0	1	1	1	1	1	1	1	1	1	1	1	1
32	15	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	-1
33	20	-1	-1	28	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	29	-1	-1
34	1	17	-1	-1	-1	-1	-1	-1	-1	-1	6	-1	-1	-1	-1	-1	-1

4c-4

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

4c-5

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	29	38	-1	-1	51	49	-1	-1	1	-1	17	-1	-1	-1	-1	-1	-1
1	-1	18	-1	-1	16	22	23	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
2	13	-1	-1	-1	31	8	-1	-1	-1	63	-1	-1	-1	-1	-1	-1	-1
3	39	-1	-1	36	-1	8	-1	-1	-1	-1	-1	-1	-1	46	-1	-1	-1
4	13	0	-1	-1	45	-1	-1	-1	-1	-1	-1	-1	-1	18	-1	-1	-1
5	-1	58	-1	50	-1	-1	29	-1	-1	-1	-1	-1	-1	-1	21	-1	-1
6	41	-1	-1	-1	-1	-1	-1	-1	25	42	-1	-1	-1	-1	-1	-1	23
7	33	12	-1	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1
8	-1	62	26	-1	-1	50	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
9	11	-1	-1	44	27	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
10	-1	-1	-1	11	-1	21	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	6
11	8	-1	-1	-1	-1	-1	27	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
12	59	-1	-1	62	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
13	61	-1	-1	-1	-1	-1	-1	-1	50	-1	-1	-1	-1	37	-1	-1	-1
14	0	-1	-1	-1	-1	12	-1	-1	-1	-1	23	-1	-1	34	-1	-1	-1
15	52	-1	-1	58	-1	-1	-1	-1	-1	61	-1	-1	-1	42	-1	-1	-1
16	-1	57	-1	-1	-1	-1	-1	55	-1	-1	-1	-1	-1	-1	-1	-1	-1
17	5	-1	23	-1	-1	-1	-1	-1	-1	35	-1	-1	-1	-1	-1	-1	-1
18	33	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	31	0	-1	-1
19	0	-1	34	-1	-1	19	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
20	8	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1
21	36	-1	-1	-1	-1	-1	-1	-1	-1	-1	46	-1	-1	55	-1	-1	-1
22	-1	7	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
23	51	-1	-1	-1	-1	-1	-1	-1	-1	47	-1	18	-1	-1	-1	-1	-1
24	30	-1	-1	-1	-1	-1	-1	-1	-1	27	-1	-1	-1	-1	16	-1	-1
25	14	-1	-1	4	-1	29	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
26	9	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	12	-1	0	-1
27	49	-1	-1	-1	-1	-1	-1	48	-1	-1	-1	-1	-1	0	-1	-1	-1
28	13	-1	-1	-1	-1	-1	10	-1	-1	-1	-1	-1	-1	9	-1	-1	-1
29	43	-1	-1	-1	-1	-1	-1	-1	-1	42	-1	3	-1	-1	-1	-1	-1
30	53	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	11	-1	-1	-1
31	8	-1	45	-1	7	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
32	61	-1	51	-1	-1	-1	-1	-1	-1	-1	-1	-1	41	-1	-1	-1	-1
33	39	-1	-1	20	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	21	-1	-1
34	-1	23	-1	-1	-1	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	-1	-1

4c-6

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	41	20	-1	-1	67	100	-1	-1	-1	-1	30	-1	-1	-1	-1	-1	-1
1	-1	65	-1	-1	19	41	83	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
2	6	-1	-1	-1	4	12	-1	-1	-1	33	-1	-1	-1	-1	-1	-1	-1
3	68	-1	-1	113	-1	39	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1
4	47	73	-1	-1	116	-1	-1	-1	-1	-1	-1	-1	-1	5	-1	-1	-1
5	-1	15	-1	12	-1	-1	14	-1	-1	-1	-1	-1	-1	-1	51	-1	-1
6	109	-1	-1	-1	-1	-1	-1	-1	63	103	-1	-1	-1	-1	-1	-1	127
7	106	66	-1	-1	-1	-1	-1	44	-1	-1	-1	-1	-1	-1	-1	-1	-1
8	-1	16	0	-1	-1	100	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
9	124	-1	-1	46	85	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
10	47	-1	-1	10	-1	26	-1	-1	-1	-1	-1	-1	-1	-1	-1	10	-1
11	120	-1	-1	-1	-1	-1	42	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
12	53	-1	55	79	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
13	106	-1	-1	-1	-1	-1	-1	-1	125	-1	-1	-1	-1	27	-1	-1	-1
14	97	-1	-1	-1	-1	43	-1	-1	-1	-1	15	-1	-1	66	-1	-1	-1
15	61	-1	-1	54	-1	-1	-1	-1	-1	35	-1	-1	-1	17	-1	-1	-1
16	-1	94	-1	-1	-1	-1	-1	33	-1	-1	-1	-1	-1	-1	-1	-1	-1
17	120	-1	99	-1	-1	-1	-1	-1	-1	86	-1	-1	-1	-1	-1	-1	-1
18	36	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	32	0	-1	-1
19	65	-1	12	-1	-1	6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
20	80	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	62	0	-1	-1	-1
21	77	-1	-1	-1	-1	-1	-1	-1	-1	-1	40	-1	-1	0	-1	-1	-1
22	-1	34	-1	-1	108	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
23	38	-1	-1	-1	-1	-1	-1	-1	-1	19	-1	1	-1	-1	-1	-1	-1
24	127	-1	-1	-1	-1	-1	-1	-1	-1	100	-1	-1	-1	-1	122	-1	-1
25	43	-1	-1	106	-1	72	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
26	126	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26	-1	95	-1
27	110	-1	-1	-1	-1	-1	-1	119	-1	-1	-1	-1	-1	7	-1	-1	-1
28	85	-1	-1	-1	-1	-1	96	-1	-1	-1	-1	-1	-1	14	-1	-1	-1
29	15	-1	-1	-1	-1	-1	-1	-1	-1	12	-1	0	-1	-1	-1	-1	-1
30	111	-1	-1	-1	-1	-1	-1	-1	121	-1	-1	-1	-1	24	-1	-1	-1
31	98	-1	81	-1	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
32	106	-1	42	-1	-1	-1	-1	-1	-1	-1	-1	-1	31	-1	-1	-1	-1
33	112	-1	-1	123	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	77	-1	-1
34	-1	118	-1	-1	-1	-1	-1	-1	-1	-1	-1	117	-1	-1	-1	-1	-1

图4c

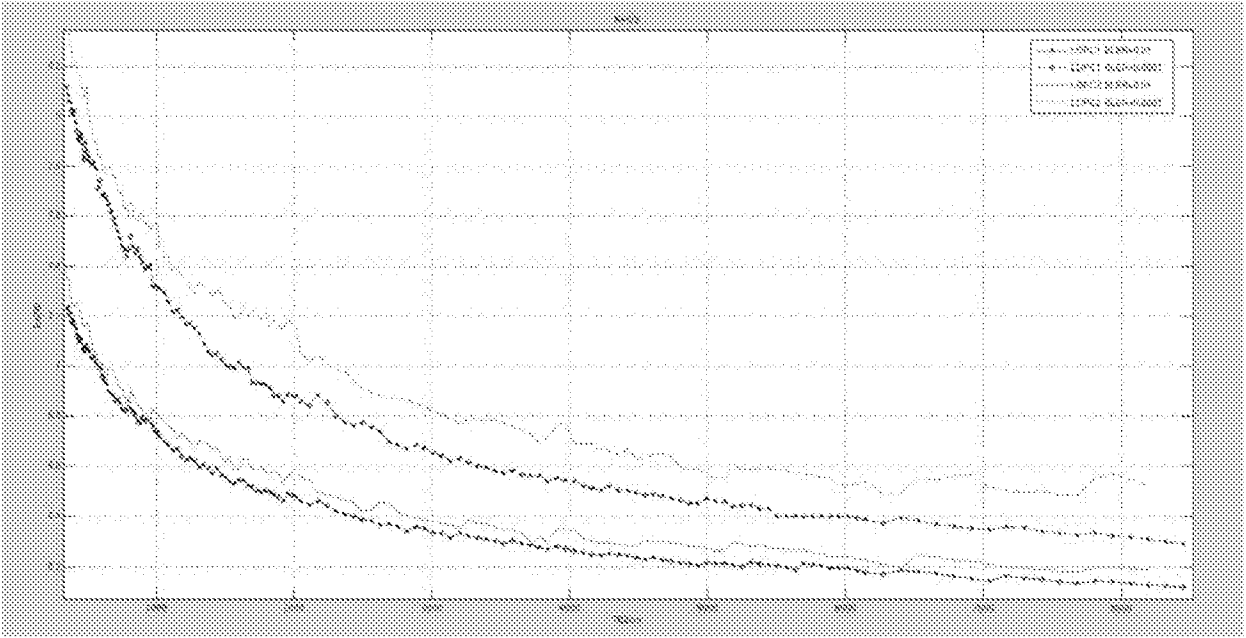


图 5a

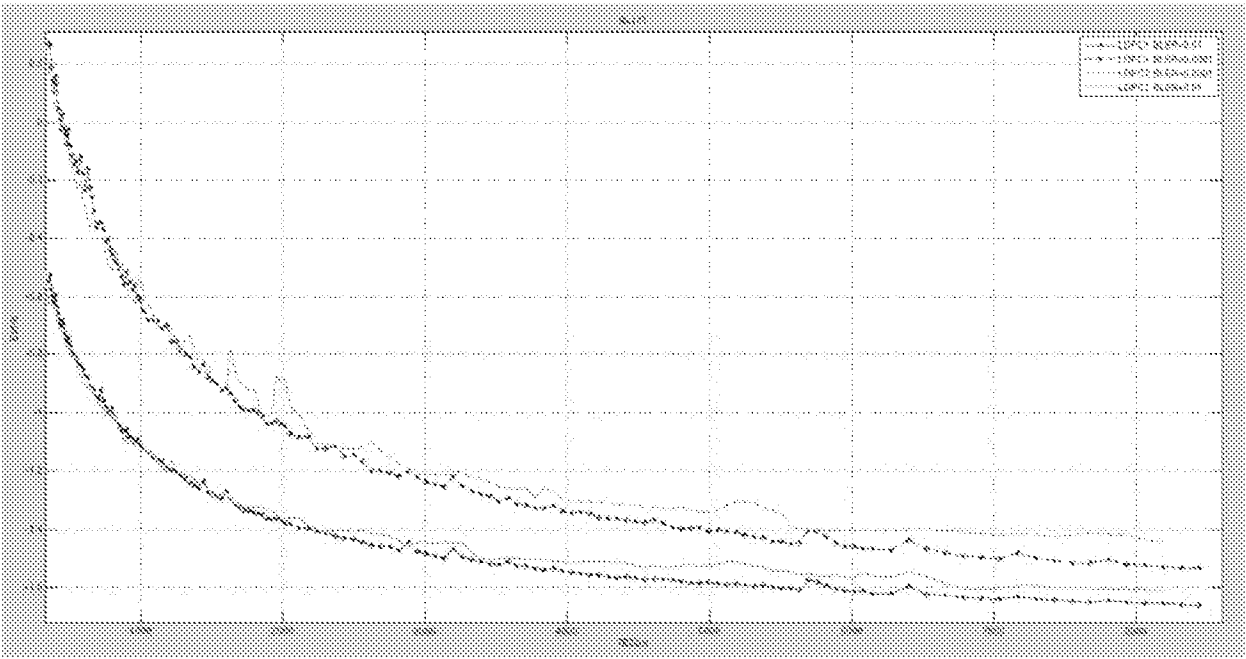


图 5b

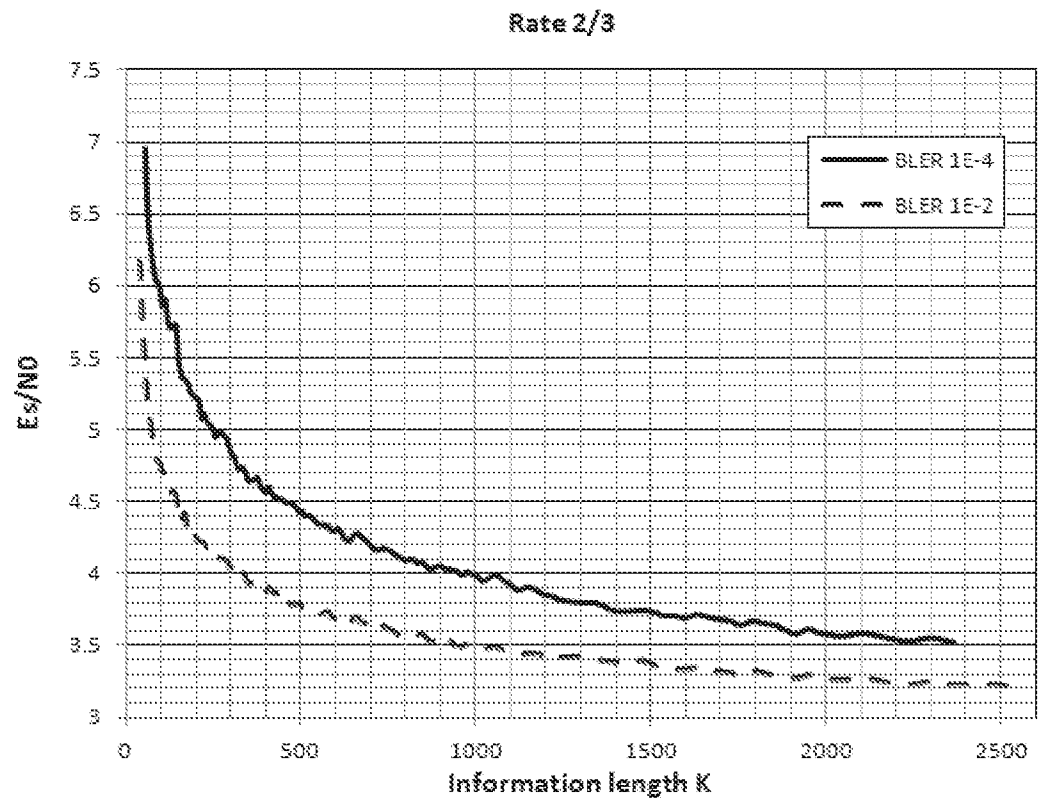


图5c

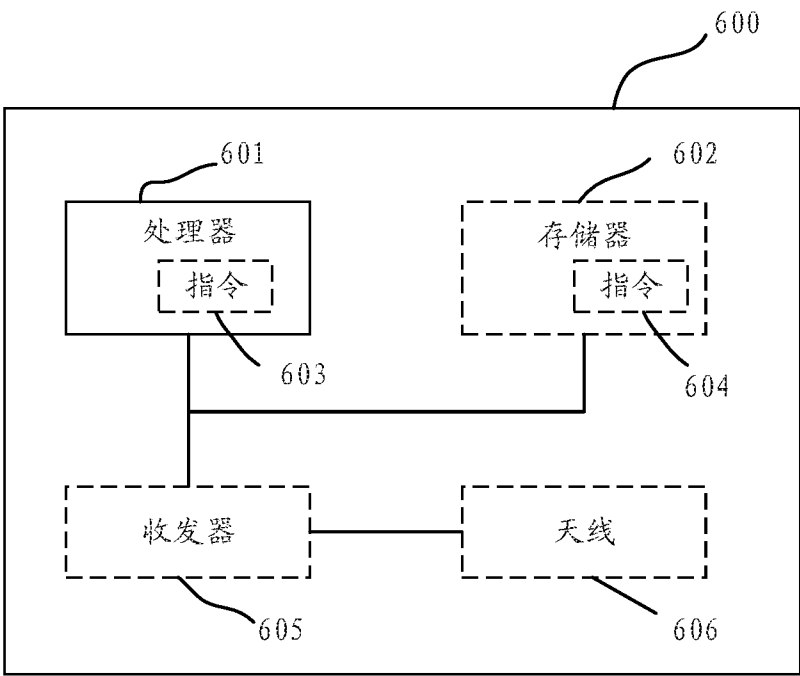


图6

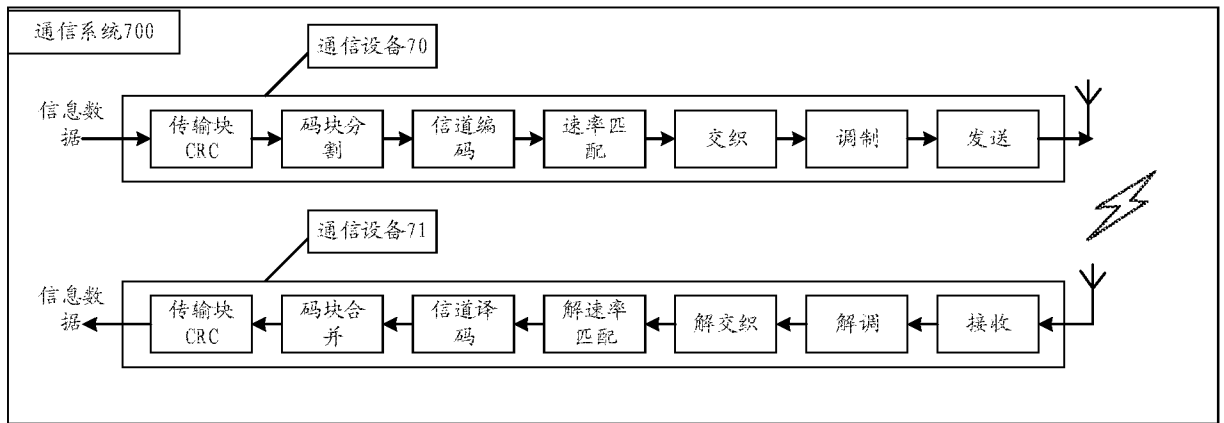


图7

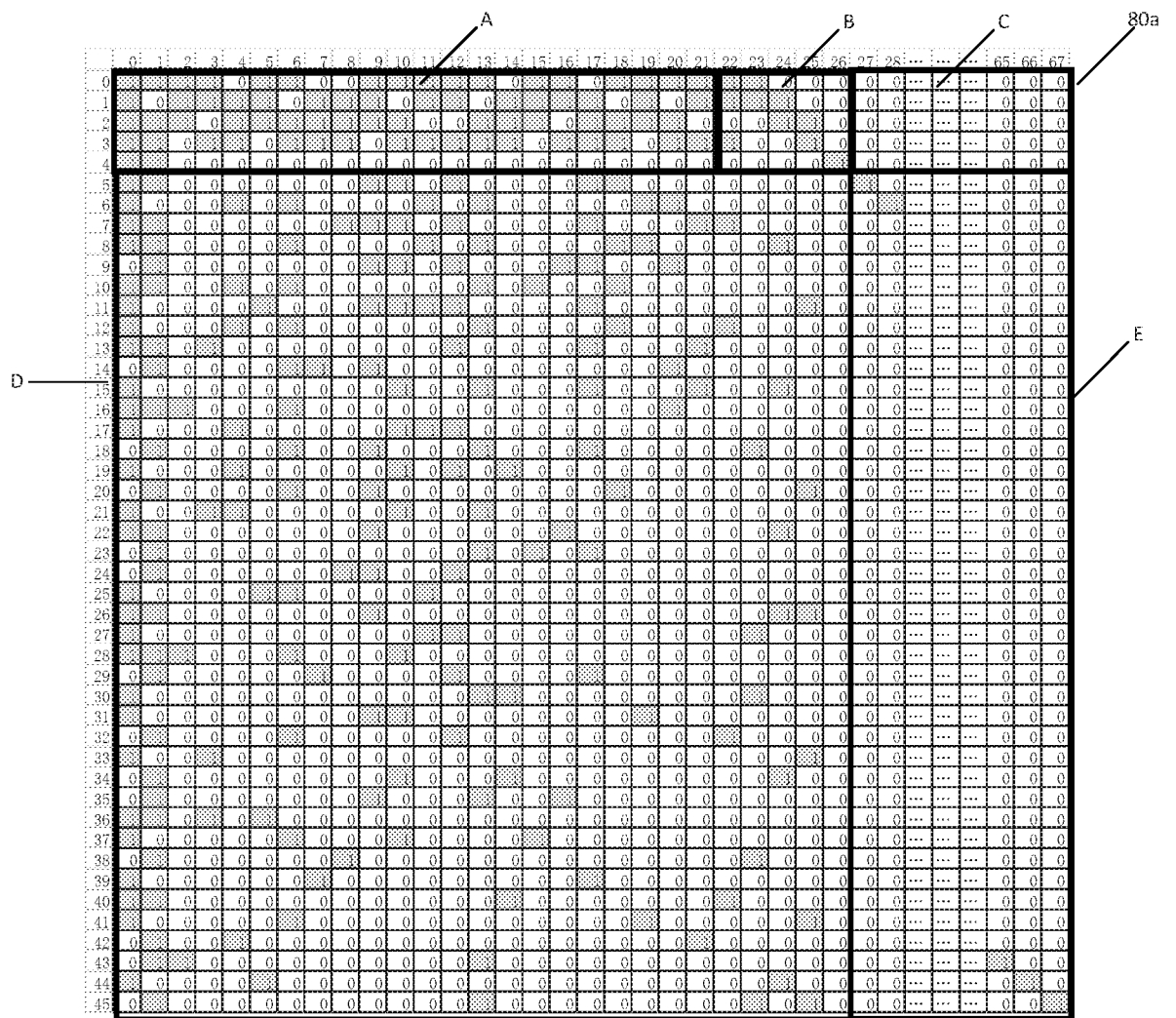


图8a

80b-1

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	15	12	4	17	-1	3	6	-1	-1	14	4	2	8	5	-1	16	10	-1	11	8	1	9	1	0	-1	-1	-1
1	4	-1	1	7	19	-1	13	0	13	-1	3	11	-1	8	11	2	15	-1	13	-1	1	5	0	0	-1	-1	
2	6	2	0	-1	13	4	14	3	4	0	11	-1	-1	18	3	8	-1	13	4	1	6	-1	-1	-1	0	0	-1
3	20	14	-1	21	10	-1	9	7	9	-1	5	11	21	20	7	-1	9	2	3	-1	7	7	1	-1	-1	0	-1
4	15	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

80b-2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	15	6	29	17	-1	22	0	-1	-1	6	0	12	18	25	-1	8	31	-1	0	0	0	19	1	0	-1	-1	-1
1	11	-1	18	26	21	5	-1	15	31	10	-1	24	13	-1	12		18	23	-1	14	-1	9	0	0	0	-1	-1
2	28	7	4	-1	30	19	16	25	23	0	2	-1	-1	21	20	0	-1	3	17	20	5	-1	-1	-1	0	0	-1
3	14	11	-1	7	19	-1	12	2	28	-1	10	26	7	11	0	-1	10	7	8	-1	4	2	1	-1	-1	0	-1
4	11	12	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

80b-3

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	11	32	41	14	-1	15	13	-1	-1	45	21	25	30	18	-1	5	40	-1	38	37	16	25	1	0	-1	-1	-1
1	35	-1	23	25	15	12	-1	10	24	23	-1	43	5	-1	46	13	24	44	-1	24	-1	43	0	0	0	-1	-1
2	1	0	33	-1	4	6	14	8	2	41	0	-1	-1	32	32	0	-1	24	32	46	30	-1	-1	-1	0	0	-1
3	2	18	-1	42	0	-1	34	1	8	-1	3	41	0	43	45	-1	29	46	14	-1	9	31	1	-1	-1	0	-1
4	27	17	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

80b-4

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	23	46	37	33	-1	29	17	-1	-1	2	0	8	46	48	-1	17	50	-1	23	45	13	49	1	0	-1	-1	-1
1	18	-1	44	14	1	0	-1	13	21	16	-1	12	38	-1	32	0	63	26	-1	3	-1	59	0	0	0	-1	-1
2	55	2	15	-1	11	15	8	9	46	3	28	-1	-1	47	40	14	-1	38	3	14	47	-1	-1	-1	0	0	-1
3	36	11	-1	52	0	-1	8	11	0	-1	23	0	12	29	15	-1	35	57	0	-1	17	22	1	-1	-1	0	-1
4	62	51	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

80b-5

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	97	2	33	100	-1		59	-1	-1	37	108	33	27	12	-1		22	-1	6	30	9	27		0	-1	-1	-1
1	163	-1	53	36	240	0	-1	53	33	20	-1	33	37	-1	40	32	33	0	-1	0	-1	3	36	0	0	-1	-1
2	3	16	22	-1	28	17	0	26	102	23	0	-1	-1	39	72	76	-1	0	15	32	76	-1	-1	-1	0	0	-1
3	39	52	-1	33	0	-1	3	24	78	-1	38	22	21	34	36	-1	28	23	34	-1	70	45	1	-1	-1	0	-1
4	83	40	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

80b-6

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	160	198	196	119	-1	185	232	-1	-1	163	236	110	224	35	-1	193	254	-1	33	195	214	133	1	0	-1	-1	-1
1	123	-1	66	101	145	217	-1	30	139	240	-1	242	211	-1	220	127	198	31	-1	226	-1	45	0	0	0	-1	-1
2	35	212	33	-1	35	222	61	221	157	106	163	-1	-1	0	115	30	-1	146	138	123	218	-1	-1	-1	0	0	-1
3	247	172	-1	57	215	-1	203	172		-1	215	39	247	21	172	-1	246	153	20	-1	172	202	1	-1	-1	0	-1
4	54	6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0

80c-1

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0	3	7	-1	-1	-1	-1	-1	-1	-1	1	14	-1	13	-1	-1	-1	-1	12	10	-1	-1	-1	-1	-1	-1	-1	-1
1	7	-1	-1	-1	15	-1	3	-1	-1	-1	-1	17	-1	16	-1	-1	-1	-1	-1	8	2	-1	-1	-1	-1	-1	-1
2	9	16	-1	-1	-1	-1	-1	-1	14	0	0	-1	5	-1	-1	-1	-1	6	-1	-1	-1	10	0	-1	-1	-1	-1
3	11	0	-1	-1	-1	-1	15	-1	-1	-1	-1	7	-1	20	-1	-1	-1	-1	1	0	-1	-1	-1	-1	3	-1	-1
4	-1	18	-1	-1	-1	-1	-1	-1	-1	6	0	-1	19	-1	-1	-1	5	10	-1	-1	13	-1	-1	-1	-1	-1	-1
5	13	22	-1	-1	15	-1	0	-1	-1	-1	-1	-1	-1	18	-1	19	-1	-1	4	-1	-1	-1	-1	-1	-1	-1	-1
6	10	-1	-1	-1	-1	9	-1	-1	-1	23	3	16	20	-1	-1	-1	-1	13	-1	-1	-1	-1	-1	-1	-1	15	-1
7	0	-1	-1	-1	21	-1	7	-1	-1	-1	-1	-1	-1	21	-1	-1	-1	-1	5	-1	-1	-1	18	-1	-1	-1	-1
8	2	0	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	8	-1	-1	-1	-1	0	-1	-1	-1	0	-1	-1	-1	-1	-1
9	-1	10	-1	-1	-1	-1	7	14	-1	16	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	12	-1	-1	-1	-1	-1	-1
10	16	-1	-1	-1	-1	-1	-1	-1	-1	-1	13	-1	-1	30	-1	-1	-1	19	-1	-1	-1	16	-1	-1	16	-1	-1
11	18	0	-1	-1	-1	10	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	-1
12	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	4	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
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17	5	0	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	8	-1	-1	-1	-1	-1	-1	-1	10	-1	-1
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20	21	-1	-1	-1	-1	0	7	-1	-1	-1	-1	14	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
21	9	0	-1	-1	-1	-1	-1	-1	-1	17	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	3	-1
22	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	3	-1	-1	-1
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25	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	19	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	13	-1	-1	-1
26	8	-1	-1	-1	-1	-1	-1	-1	-1	5	0	-1	-1	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	-1
27	-1	10	-1	-1	-1	-1	2	-1	-1	-1	-1	-1	10	-1	-1	-1	-1	-1	-1	-1	-1	-1	13	-1	-1	-1	-1
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80c-2

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80c-3

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80c-4

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80c-6

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图8c

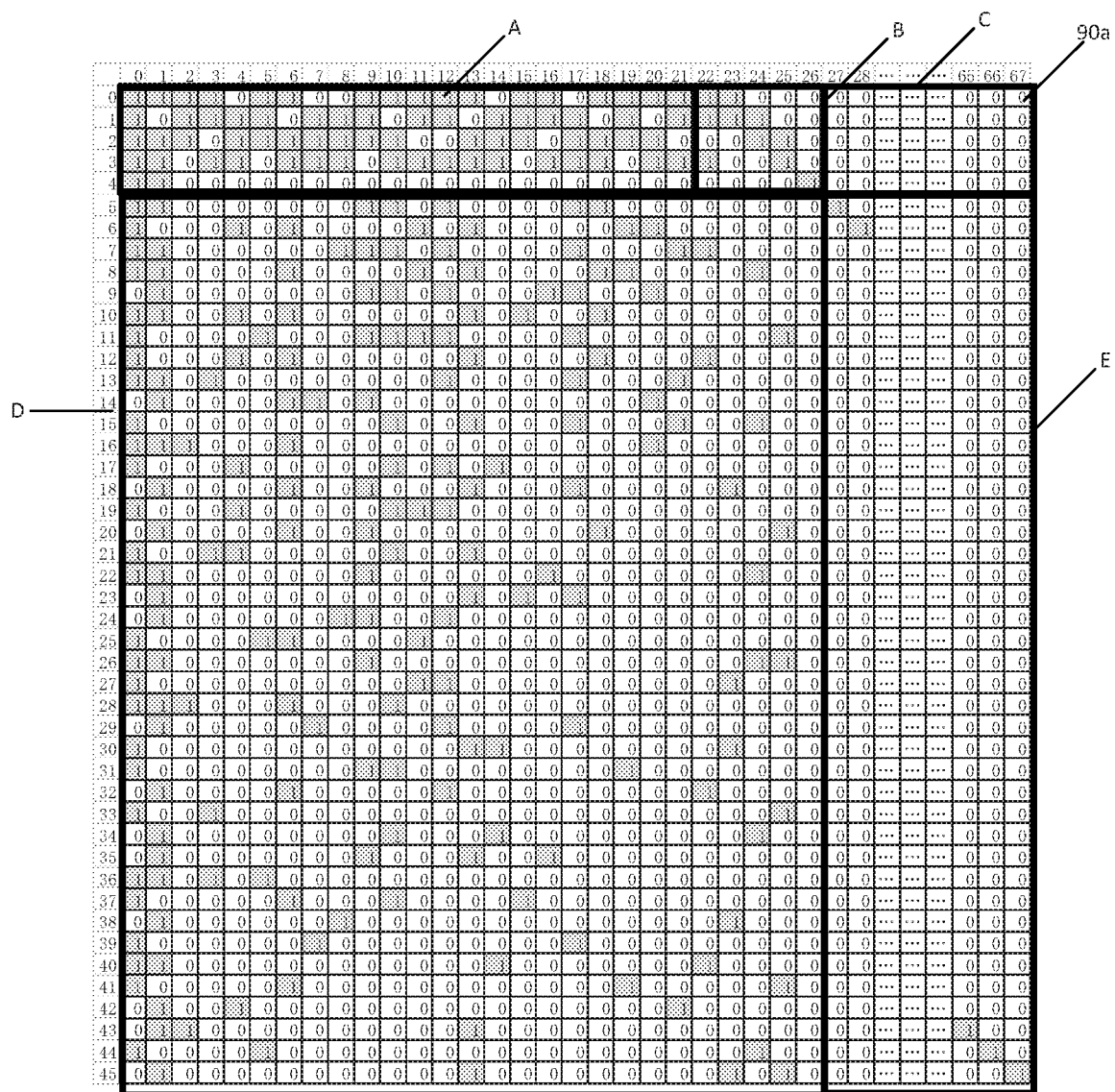


图9a

90b-1

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67
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90b-2

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38	-1	28	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	21	-1	-1	-1	-1	...	...	...	-1	-1	-1		
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90b-3

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90b-4

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11	51	-1	-1	-1	-1	30	-1	-1	-1	3	53	16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	-1	-1	-1	
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19	4	-1	-1	-1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	-1	-1	-1	
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21	0	-1	-1	33	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	-1	-1	-1	
22	50	0	-1	-1	-1	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	40	-1	-1	-1	...	...	-1	-1	-1		
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26	37	0	-1	-1	-1	-1	-1	-1	-1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	-1	-1	-1		
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28	38	32	0	-1	-1	-1	43	-1	-1	49	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	-1	-1	-1		
29	-1	52	-1	-1	-1	-1	-1	33	-1	-1	-1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	-1	-1	-1	
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31	10	-1	-1	-1	-1	-1	-1	-1	13	32	-1	-1	-1	-1	-1	-1	-1	...	...	...	...	...	...	...	...	...	...	...	...	...	-1	-1	-1		
32	-1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	-1	-1	-1		
33	33	-1	-1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	-1	-1	-1		
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42	-1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	-1	-1	-1		
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17	3	-1	-1	-1	19	-1	-1	-1	-1	-1	25	-1	53	-1																					

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	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67	
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1	63	1	33	0	80	0	1	33	43	0	1	0	71	1	10	92	33	8	1	0	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	
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3	30	32	1	37	0	1	4	24	75	1	29	33	34	34	96	1	32	34	21	1	30	45	1	1	1	0	1	1	1	1	1	1	1	1	1	
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5	30	33	1	1	1	1	1	1	1	113	32	1	33	1	1	1	1	64	30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
6	34	1	1	1	38	1	37	1	1	1	1	29	1	37	1	1	1	1	1	1	27	100	1	1	1	1	1	1	1	1	1	1	1	1	1	
7	74	120	1	1	1	1	1	1	104	43	37	1	35	1	1	1	1	124	1	1	1	75	70	1	1	1	1	1	1	1	1	1	1	1	1	1
8	15	100	1	1	1	1	34	1	1	1	1	70	1	30	1	1	1	1	45	4	1	1	1	1	1	10	1	1	1	1	1	1	1	1	1	
9	1	62	1	1	1	1	1	1	1	40	32	1	46	1	1	1	72	6	1	1	36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
10	85	101	1	1	31	1	27	1	1	1	1	1	1	32	1	1	1	117	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
11	36	1	1	1	1	2	1	1	1	11	105	31	43	1	1	1	1	43	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
12	37	1	1	1	35	1	106	1	1	1	1	1	1	36	1	1	1	1	101	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
13	19	0	1	21	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
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15	18	1	1	1	1	1	1	1	1	1	21	1	1	103	1	1	1	42	1	1	70	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
16	31	0	63	1	1	1	60	1	1	1	1	1	1	1	1	1	1	1	1	1	122	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
17	37	1	1	1	103	1	1	1	1	1	10	1	35	1	34	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
18	1	100	1	1	1	1	111	1	1	39	1	1	1	107	1	1	1	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
19	20	1	1	1	33	1	1	1	1	1	75	13	33	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
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21	130	1	1	67	3	1	1	1	1	1	33	1	1	121	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
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24	1	73	1	1	1	1	1	1	1	72	113	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
25	48	1	1	1	1	63	37	1	1	1	1	35	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
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27	111	1	1	1	1	1	1	1	1	1	1	35	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
28	75	54	1	1	1	52	1	1	1	32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
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37	76	1	1	1	1	1	125	1	1	1	30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
38	1	44	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
39	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
40	22	111	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
41	125	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
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43	1	90	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
44	106	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
45	1	33	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

100a

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67	
0	0	1	0	1	0	1	1	0	1	0	1	1	1	0	1	1	0	1	1	0	1	1	1	1	0	0	0	0	0	0	...	...	...	0	0	0
1	1	1	0	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	0	0	1	0	0	1	0	0	0	0	0	...	...	...	0	0	0	
2	0	1	1	1	1	0	1	1	1	0	1	1	1	1	1	0	1	1	0	1	0	1	1	1	0	1	0	0	0	...	...	...	0	0	0	
3	1	1	1	1	0	1	1	0	0	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	0	0	1	0	0	0	...	...	...	0	0	0
4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
5	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	...	...	...	0	0	0
6	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
7	1	1	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	...	...	...	0	0	0
8	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	...	...	...	0	0	0	
9	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	...	...	...	0	0	0	
10	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
11	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
12	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
13	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
14	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
16	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
17	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
18	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
19	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
20	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
21	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
22	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
23	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
24	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
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27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
28	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
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30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
31	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
32	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
33	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
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35	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
36	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
38	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
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41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
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43	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	
45	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0	

图 10a

100b-1

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67	
0	30	14	-1	21	10	-1	9	7	9	-1	5	11	31	20	7	-1	9	3	3	-1	7	7	1	0	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
1	6	2	0	-1	12	4	14	2	4	0	11	-1	-1	18	4	6	-1	13	2	...	6	-1	-1	0	0	-1	-1	-1	-1	...	...	...	-1	-1	-1	
2	4	-1	...	7	18	1	-1	13	0	13	-1	...	11	-1	8	11	...	18	-1	13	-1	1	6	-1	0	0	-1	-1	-1	...	...	...	-1	-1	-1	
3	15	12	3	17	-1	3	6	-1	-1	14	4	...	8	5	-1	16	16	-1	11	...	1	9	1	-1	-1	0	-1	-1	-1	...	...	...	-1	-1	-1	
4	15	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	...	...	...	-1	-1	-1	
5	6	2	-1	-1	-1	-1	-1	-1	-1	...	24	-1	18	-1	-1	-1	-1	12	10	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	...	...	...	-1	-1	-1	
6	7	-1	-1	-1	12	-1	23	-1	-1	-1	-1	...	32	-1	10	-1	-1	-1	-1	...	2	-1	-1	-1	-1	-1	-1	-1	0	...	...	...	-1	-1	-1	
7	9	18	-1	-1	-1	-1	-1	-1	13	0	0	-1	...	5	-1	-1	-1	-1	...	3	-1	-1	10	0	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
8	11	0	-1	-1	-1	17	-1	-1	-1	-1	...	-1	20	-1	-1	-1	-1	...	1	0	-1	-1	-1	-1	...	3	-1	-1	-1	...	...	...	-1	-1	-1	
9	-1	13	-1	-1	-1	-1	-1	-1	-1	...	1	...	10	-1	-1	-1	...	18	-1	-1	13	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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100b-2

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100b-4

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100b-5

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14	-1	33	-1	-1	-1	-1	53	0	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	16	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
15	10	-1	-1	-1	-1	-1	-1	-1	-1	33	-1	-1	18	-1	-1	-1	36	-1	-1	-1	0	-1	-1	0	-1	-1	-1	-1	...	...	...	-1	-1	-1	
16	20	35	43	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	33	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
17	58	-1	-1	-1	0	-1	-1	-1	-1	33	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
18	-1	35	-1	-1	-1	-1	50	-1	-1	0	-1	-1	-1	62	-1	-1	-1	41	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	...	...	...	-1	-1	-1	
19	19	-1	-1	-1	56	-1	-1	-1	-1	0	-1	0	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
20	-1	12	-1	-1	-1	-1	11	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	32	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
21	80	-1	-1	35	63	-1	-1	-1	-1	40	-1	-1	16	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
22	42	30	-1	-1	-1	-1	-1	-1	32	-1	-1	-1	33	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	18	-1	-1	-1	-1	...	...	...	-1	-1	-1	
23	-1	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	27	-1	0	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
24	-1	49	-1	-1	-1	-1	-1	-1	23	32	-1	-1	62	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
25	24	-1	-1	-1	-1	46	0	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
26	20	36	-1	-1	-1	-1	-1	-1	-1	32	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	33	-1	-1	-1	-1	...	...	...	-1	-1	-1	
27	33	-1	-1	-1	-1	-1	-1	-1	-1	52	52	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
28	11	0	0	-1	-1	-1	26	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
29	-1	23	-1	-1	-1	-1	36	-1	-1	-1	-1	33	-1	-1	-1	-1	33	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
30	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	12	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
31	43	-1	-1	-1	-1	-1	-1	-1	60	9	-1	-1	-1	-1	-1	-1	38	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
32	-1	16	-1	-1	-1	-1	24	-1	-1	-1	-1	-1	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	32	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
33	18	-1	-1	27	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	33	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
34	-1	12	-1	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	56	-1	-1	-1	-1	-1	-1	-1	-1	-1	32	-1	-1	-1	-1	...	...	...	-1	-1	-1	
35	-1	13	-1	-1	-1	-1	-1	-1	-1	10	-1	-1	21	-1	-1	47	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
36	39	35	-1	33	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
37	50	-1	-1	-1	-1	-1	29	-1	-1	24	-1	-1	-1	-1	23	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
38	-1	10	-1	-1	-1	-1	-1	19	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
39	36	-1	-1	-1	-1	-1	32	-1	-1	-1	-1	-1	-1	-1	-1	-1	33	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
40	22	42	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	-1	32	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
41	31	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	31	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
42	-1	0	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	31	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
43	-1	56	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	0	-1	
44	16	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
45	-1	48	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	36	-1	-1	-1	-1	-1	-1	-1	-1	-1	12	-1	27	-1	-1	-1	...	...	...	-1	-1	-1	

[illegible]

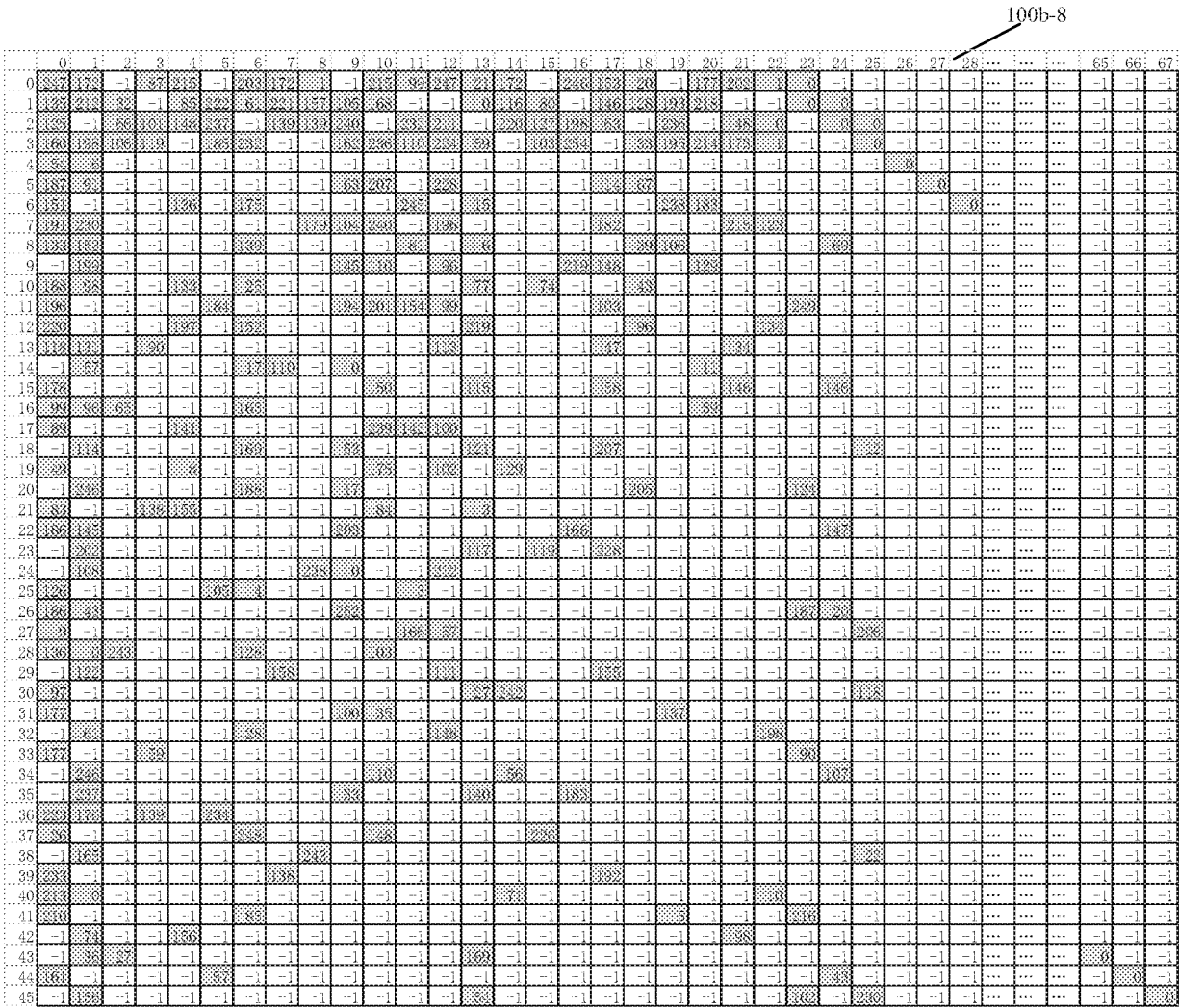


图 10b

Figure 10a displays a 45x67 grid of binary data (0s and 1s), representing a 45x67 matrix. The grid is labeled with row indices 0 to 45 on the left and column indices 0 to 67 on the top. The matrix is sparse, with most entries being 0 and some entries being 1. The pattern of 1s is complex and non-uniform, with some rows having more 1s than others. The grid is labeled "10a" in the top right corner.

图 11a

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	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67
0	20	14	-1	21	10	-1	9	7	9	-1	5	11	21	20	7	-1	9	2	3	-1	7	7	1	0	-1	-1	-1	-1	...	...	...	-1	-1	-1	
1	6	2	0	-1	12	4	14	3	4	0	11	-1	-1	18	4	8	-1	13	4	1	6	-1	-1	0	0	-1	-1	-1	-1	...	...	...	-1	-1	-1
2	4	-1	1	7	19	1	-1	13	0	13	-1	3	11	-1	8	11	2	15	-1	13	-1	1	5	-1	0	0	-1	-1	-1	...	...	...	-1	-1	-1
3	15	12	4	17	-1	3	6	-1	-1	14	4	2	8	5	-1	16	16	-1	11	6	1	9	1	-1	-1	0	-1	-1	-1	...	...	...	-1	-1	-1
4	15	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	...	...	...	-1	-1	-1
5	8	7	-1	-1	-1	-1	-1	-1	-1	1	14	-1	13	-1	-1	-1	-1	12	10	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	...	...	...	-1	-1	-1
6	7	-1	-1	-1	15	-1	3	-1	-1	-1	-1	17	-1	10	-1	-1	-1	-1	8	2	-1	-1	-1	-1	-1	-1	-1	-1	0	...	...	...	-1	-1	-1
7	9	16	-1	-1	-1	-1	-1	-1	14	0	0	-1	5	-1	-1	-1	6	-1	-1	-1	10	0	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
8	11	0	-1	-1	-1	-1	15	-1	-1	-1	-1	7	-1	20	-1	-1	-1	1	0	-1	-1	-1	-1	-1	3	-1	-1	-1	-1	...	...	...	-1	-1	-1
9	-1	18	-1	-1	-1	-1	-1	-1	-1	6	0	-1	19	-1	-1	-1	5	10	-1	-1	13	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
10	13	22	-1	-1	15	-1	0	-1	-1	-1	-1	-1	-1	19	-1	19	-1	-1	4	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
11	10	-1	-1	-1	-1	9	-1	-1	-1	23	3	16	20	-1	-1	-1	-1	15	-1	-1	-1	-1	-1	15	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
12	0	-1	-1	-1	21	-1	7	-1	-1	-1	-1	-1	-1	21	-1	-1	-1	-1	5	-1	-1	-1	18	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
13	2	0	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	8	-1	-1	-1	0	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
14	-1	10	-1	-1	-1	-1	7	14	-1	16	-1	-1	-1	-1	-1	-1	-1	-1	-1	12	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
15	16	-1	-1	-1	-1	-1	-1	-1	-1	12	-1	-1	20	-1	-1	-1	19	-1	-1	-1	16	-1	-1	-1	16	-1	-1	-1	-1	...	...	...	-1	-1	-1
16	18	0	4	-1	-1	-1	10	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
17	0	-1	-1	-1	0	-1	-1	-1	-1	8	-1	14	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
18	-1	11	-1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	6	-1	-1	-1	15	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
19	0	-1	-1	-1	1	-1	-1	-1	-1	4	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
20	-1	7	-1	-1	-1	3	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	9	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
21	12	-1	-1	22	0	-1	-1	-1	-1	0	-1	-1	20	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
22	5	0	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	8	-1	-1	-1	-1	-1	-1	-1	-1	10	-1	-1	-1	-1	...	...	...	-1	-1	-1
23	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	7	-1	15	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
24	-1	8	-1	-1	-1	-1	-1	-1	23	0	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
25	21	-1	-1	-1	-1	0	7	-1	-1	-1	-1	14	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
26	9	0	-1	-1	-1	-1	-1	-1	-1	17	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	4	0	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
27	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
28	20	0	0	-1	-1	-1	3	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
29	-1	6	-1	-1	-1	-1	13	-1	-1	-1	-1	-1	0	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
30	12	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	19	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
31	8	-1	-1	-1	-1	-1	-1	-1	5	0	-1	-1	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
32	-1	10	-1	-1	-1	-1	9	-1	-1	-1	-1	-1	10	-1	-1	-1	-1	-1	-1	-1	-1	-1	13	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
33	0	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
34	-1	22	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1	20	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
35	10	-1	-1	-1	21	0	-1	-1	-1	6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
36	-1	10	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	23	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
37	19	-1	-1	-1	-1	-1	-1	-1	-1	14	-1	-1	-1	-1	-1	10	-1	-1	-1	-1	-1	-1	-1	9	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
38	-1	3	-1	-1	-1	-1	11	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
39	10	-1	-1	-1	-1	-1	13	-1	7	-1	12	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
40	-1	17	0	-1	-1	-1	-1	0	-1	-1	-1	-1	5	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
41	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
42	-1	12	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	6	-1	-1	22	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
43	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	15	-1	-1	-1	-1	-1	-1	...	...	...	0	-1	-1
44	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	20	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	0	-1
45	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	21	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1

110b-2

110b-2

[illegible]

[illegible]

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0	25	1	1	2	0	1	2	1	0	1	2	0	1	2	1	1	2	0	1	2	2	1	1	1	1	1	1	1	1	...	...	...	1	1	1
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43		0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	...	...	...	0	0	0		
44	0			0	0	0	0	0	0	0	0	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
45		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	...	...	...	0	0	0		

图 12a

120b-1

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120b-2

120b-4

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0	48	49	-1	18	21	-1	33	6	5	-1	34	39	56	28	11	-1	31	63	59	-1	40	23	-1	0	-1	-1	-1	-1	...	...	...	-1	-1	-1		
1	20	10	23	-1	11	32	31	15	0	56	25	-1	-1	15	0	47	-1	35	43	10	22	-1	-1	0	0	-1	-1	-1	...	...	...	-1	-1	-1		
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9	-1	10	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	33	0	-1	-1	-1	45	28	-1	-1	33	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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13	33	22	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	33	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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15	10	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	33	-1	37	-1	-1	-1	22	-1	-1	2	-1	0	-1	-1	0	-1	-1	-1	...	...	...	-1	-1	-1	
16	20	33	14	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	33	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
17	33	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	33	0	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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38	-1	20	-1	-1	-1	-1	22	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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43	30	-1	-1	-1	-1	33	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
44	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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2	15	-1	19	12	-1	0	-1	13	21	0	-1	17	35	-1	20	0	42	23	-1	2	-1	9	-1	-1	0	-1	-1	-1	-1	...	...	...	-1	-1	-1
3	23	16	37	23	-1	23	17	-1	-1	-1	0	33	46	32	-1	17	33	-1	22	46	23	19	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
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5	46	42	-1	-1	-1	-1	-1	-1	33	-1	32	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
6	33	-1	-1	-1	13	-1	36	-1	-1	-1	-1	10	-1	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
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21	35	-1	-1	35	38	-1	-1	-1	-1	13	-1	-1	39	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
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44	-1	30	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
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2	25	-1	-1	0	8	0	-1	51	43	0	-1	-1	-1	1	10	23	23	-1	-1	0	-1	-1	-1	0	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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4	28	36	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
5	30	33	-1	-1	-1	-1	-1	-1	-1	112	33	-1	33	-1	-1	33	3	-1	-1	33	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
6	33	-1	-1	-1	33	-1	33	-1	-1	-1	-1	33	-1	33	-1	-1	-1	-1	-1	33	113	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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8	35	100	-1	-1	-1	33	-1	-1	-1	-1	33	33	-1	33	-1	-1	-1	-1	-1	4	-1	-1	-1	-1	100	-1	-1	-1	-1	...	...	...	-1	-1	-1	
9	-1	32	-1	-1	-1	-1	-1	-1	-1	33	33	-1	33	-1	-1	-1	33	-1	-1	33	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
10	35	103	-1	-1	33	-1	33	-1	-1	-1	-1	-1	-1	26	-1	33	-1	-1	33	-1	112	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
11	36	-1	-1	-1	-1	-1	-1	-1	-1	102	33	43	-1	-1	-1	33	-1	-1	33	-1	-1	-1	33	-1	33	-1	-1	-1	-1	...	...	...	-1	-1	-1	
12	37	-1	-1	-1		-1	106	-1	-1	-1	-1	-1	-1	36	-1	-1	-1	-1	102	-1	-1	-1	74	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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16	31	23	23	-1	-1	30	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	100	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	

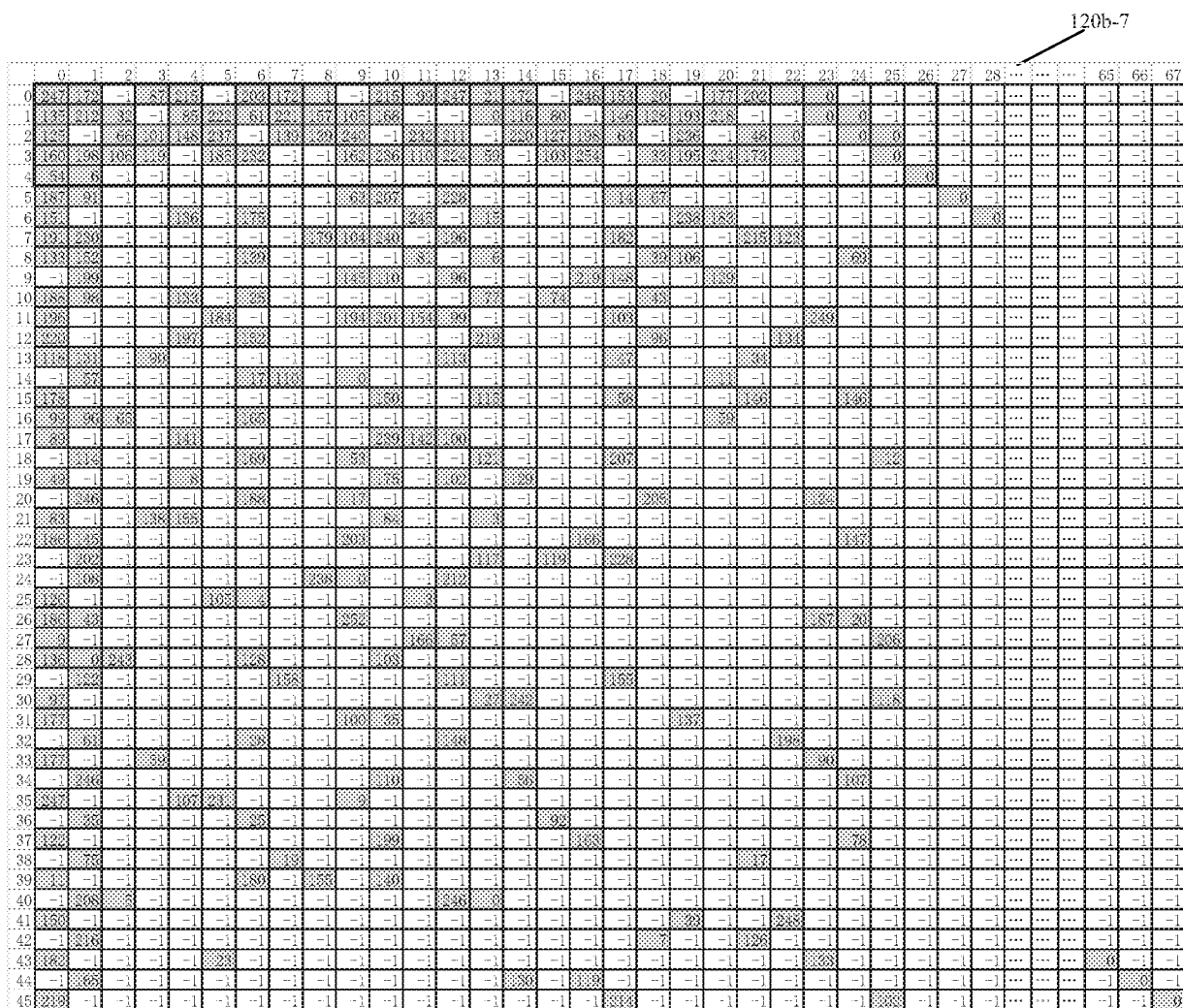


图 12b

[illegible]

图 13a

130b-1

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67	
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4	15	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	...	...	...	-1	-1	-1
5	8	7	-1	-1	-1	-1	-1	-1	-1	1	14	-1	13	-1	-1	-1	-1	12	10	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	...	...	...	-1	-1	-1
6	7	-1	-1	-1	15	-1	3	-1	-1	-1	17	-1	10	-1	-1	-1	-1	8	2	-1	-1	-1	-1	-1	-1	-1	-1	0	...	...	...	-1	-1	-1	
7	9	16	-1	-1	-1	-1	-1	14	0	0	-1	5	-1	-1	-1	-1	6	-1	-1	-1	10	0	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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9	-1	18	-1	-1	-1	-1	-1	-1	6	0	-1	19	-1	-1	-1	5	10	-1	13	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
10	13	22	-1	-1	15	-1	0	-1	-1	-1	-1	-1	19	-1	19	-1	-1	4	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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130b-2

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130b-3

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[illegible]

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	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	...	65	66	67
0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	...	65	66	67
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44	44 <td>45</td> <td>42</td> <td>43</td> <td>40</td> <td>41</td> <td>38</td> <td>39</td> <td>36</td> <td>48</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>65</td> <td>66</td> <td>67</td>	45	42	43	40	41	38	39	36	48	...	...	...	...	65	66	67																			
45	45	46	43	44	41	42	39	40	37	49	...	...	...	...	65	66	67																			

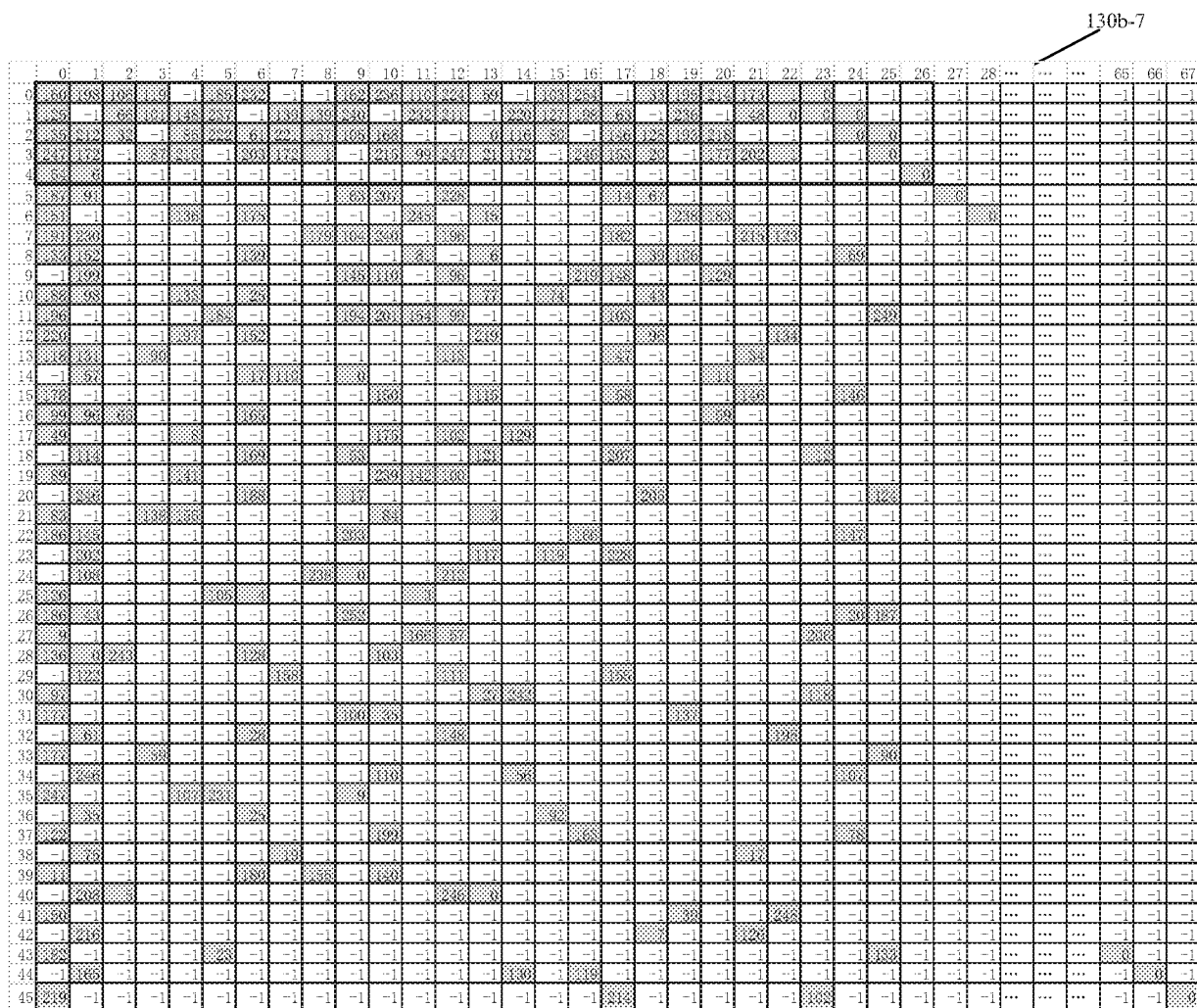


图 13b

140a

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67
0	1	1	1	1	0	1	1	0	0	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	0	0	0	0	0	...	...	...	0	0	0
1	1	0	1	1	1	1	0	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0	...	...	...	0	0	0	
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3	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0	...	...	...	0	0	0		
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6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
7	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
8	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
10	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
13	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
14	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
16	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
17	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
18	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
20	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
22	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
23	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
24	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
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26	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
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29	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
31	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
32	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
33	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		
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45	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	0	0	0		

图14a

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0	15	12	1	12	1	1	6	7	1	14	4	12	6	1	1	16	6	1	1	6	2	9	1	1	1	1	1	1	1	...	...	...	...	1	1	1
1	4	1	1	1	1	1	1	1	1	14	7	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	1	1	1
2	6	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	1	1	1
3	20	14	1	1	1	1	1	7	9	1	1	1	1	1	1	9	2	1	1	1	7	7	1	1	1	1	1	1	1	...	...	...	...	1	1	1
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6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	1	1	1
7	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	1	1	1
8	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	1	1	1
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10	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	1	1	1
11	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	1	1	1
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14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	1	1	1
15	16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	1	1	1
16	16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	1	1	1
17	0	1																																		

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67
0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67
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2	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67		
3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67			
4	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67				
5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67					
6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67						
7	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67							
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10	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67										
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17	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67																	
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45	...	65	66	67																															

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2	-1	38				14	8	2	11	0		-1	32	12	0			2	38	37	20							-1	-1	...	...	...						
3	2	19	-1	2	0		14	0	2	1	3	11	0	32	33			23	36	14	-1	32	31				0	-1	-1	...	...	...						
4	23	33					3	-1	-1	-1	-1	-1						-1	-1	-1	-1	-1						38	-1	-1	...	...	...					
5	26	37	-1			-1	-1	-1	-1	37	31	33	1							-1	-1	-1	-1					-1	-1	...	...	...						
6	32	-1						-1	-1	-1	-1	32								-1	38	36	-1						-1	-1	...	...	...					
7	3	3	-1			-1	-1	-1	-1										-1	-1	-1	-1						-1	-1	...	...	...						
8	0	23	-1			23	-1	-1	-1	-1	-1	20	20					-1	-1	-1	-1	-1						-1	-1	...	...	...						
9	-1	38						-1	-1	-1	26	34	30						-1	-1									-1	-1	...	...	...					
10	34	30					-1	-1	-1	-1	-1								-1	-1	-1	-1							-1	-1	...	...	...					
11	6	-1	-1				-1	-1	-1	32	33	0						16	-1	-1	-1	-1						-1	-1	...	...	...						
12	6	-1					-1	-1	-1	-1	-1							-1	-1	-1	-1	32						-1	-1	-1	...	...	...					
13	38	37				-1	-1	-1	-1	-1	-1	32	30						-1	-1	-1	-1							-1	-1	...	...	...					
14	-1	32	-1				7			-1	21	21	0					-1	-1	-1	-1							-1	-1	-1	...	...	...					
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16	11	38	-1				-1	-1	-1	-1									-1	-1	-1								-1	-1	...	...	...					
17	30	-1					-1	-1	-1	-1	30	30							-1	-1	-1	-1							-1	-1	...	...	...					
18	-1	30						-1	-1	32	-1	-1							-1	-1	-1	-1							-1	-1	-1	...	...	...				
19	-1	-1	-1					-1	-1	-1	-1								-1	-1																		

[illegible]

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	...	...	...	65	66	67	
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1	15	-1	-1	-1	-1	3	0	-1	13	23	16	-1	-1	-1	18	-1	63	36	-1	23	43	13	40	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
2	23	43	13	-1	-1	15	23	43	13	23	24	-1	-1	-1	20	17	18	28	-1	23	43	13	40	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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4	63	36	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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7	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
8	-1	-1	-1	-1	-1	12	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	20	17	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
9	-1	32	-1	-1	-1	-1	-1	-1	-1	33	0	-1	30	-1	-1	-1	23	38	-1	-1	33	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1
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14	-1	-1	-1	-1	-1	-1	36	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
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16	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	...	...	...	-1	-1	-1	
17	-1	-1	-1	-1	33	-1																														

[illegible]

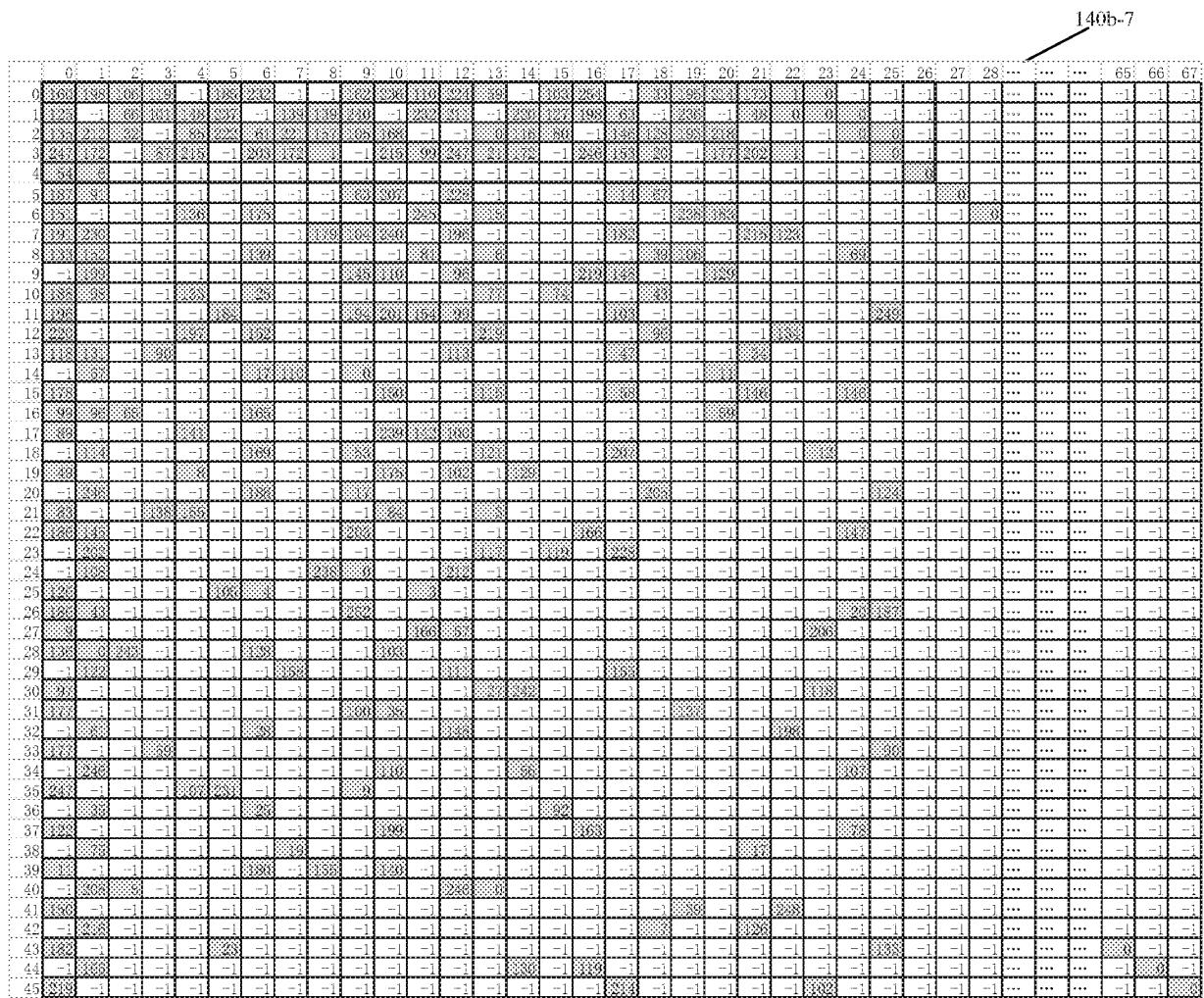


图 14b

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/087073

A. CLASSIFICATION OF SUBJECT MATTER

H03M 13/11(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H03M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC, GOOGLE: 低密度奇偶校验码, 基图, 基矩阵, 矩阵, 子矩阵, 行, 列, 权重, 双对角, LDPC, base, graph, matrix, sub, row, column, weight, dual, double, diagonal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	QUALCOMM et al. "WF on LDPC Matrix" <i>3GPP TSG RAN WG1 Meeting #88 R1-1703xxx</i> , 17 February 2017 (2017-02-17), pp. 1-4	1-30
X	SAMSUNG. "Consideration on LDPC Proto-Matrix Design" <i>3GPP TSG RAN WG1 #88 R1-1703000</i> , 17 February 2017 (2017-02-17), sections 1-3	1-30
X	KT CORP. "Number of LDPC Codes in NR" <i>3GPP TSG RAN WG1 Meeting #88 R1-1703210</i> , 17 February 2017 (2017-02-17), sections 1-3	1-30
X	3GPP. "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on New Radio (NR) Access Technology (Release 14)" <i>3GPP TR 38.912 V1.0.0 (2017-03)</i> , 31 March 2017 (2017-03-31), section 8.2.1.5.1	1-30
A	CN 102035556 A (THE HONG KONG POLYTECHNIC UNIVERSITY) 27 April 2011 (2011-04-27) entire document	1-30

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

28 January 2018

Date of mailing of the international search report

09 February 2018

Name and mailing address of the ISA/CN

State Intellectual Property Office of the P. R. China
No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing
100088
China

Facsimile No. (86-10)62019451

Authorized officer

Telephone No.

国际检索报告

国际申请号

PCT/CN2017/087073

A. 主题的分类 H03M 13/11 (2006.01) i 按照国际专利分类 (IPC) 或者同时按照国家分类和 IPC 两种分类																				
B. 检索领域 检索的最低限度文献 (标明分类系统和分类号) H03M 包含在检索领域中的除最低限度文献以外的检索文献 在国际检索时查阅的电子数据库 (数据库的名称, 和使用的检索词 (如使用)) CNPAT, CNKI, WPI, EPODOC, GOOGLE: 低密度奇偶校验码, 基图, 基矩阵, 矩阵, 子矩阵, 行, 列, 权重, 双对角, LDPC, base, graph, matrix, sub, row, column, weight, dual, double, diagonal																				
C. 相关文件 <table border="1"> <thead> <tr> <th>类 型*</th> <th>引用文件, 必要时, 指明相关段落</th> <th>相关的权利要求</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>QUALCOMM 等. "WF on LDPC Matrix" 3GPP TSG RAN WG1 Meeting #88 R1-1703xxx, 2017年 2月 17日 (2017 - 02 - 17), 第1-4页</td> <td>1-30</td> </tr> <tr> <td>X</td> <td>SAMSUNG. "Consideration on LDPC Proto-Matrix Design" 3GPP TSG RAN WG1 #88 R1-1703000, 2017年 2月 17日 (2017 - 02 - 17), 第1-3节</td> <td>1-30</td> </tr> <tr> <td>X</td> <td>KT CORP. "Number of LDPC codes in NR" 3GPP TSG RAN WG1 Meeting #88 R1-1703210, 2017年 2月 17日 (2017 - 02 - 17), 第1-3节</td> <td>1-30</td> </tr> <tr> <td>X</td> <td>3GPP. "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on New Radio (NR) Access Technology (Release 14)" 3GPP TR 38.912 V1.0.0 (2017-03), 2017年 3月 31日 (2017 - 03 - 31), 第8.2.1.5.1节</td> <td>1-30</td> </tr> <tr> <td>A</td> <td>CN 102035556 A (香港理工大学) 2011年 4月 27日 (2011 - 04 - 27) 全文</td> <td>1-30</td> </tr> </tbody> </table>			类 型*	引用文件, 必要时, 指明相关段落	相关的权利要求	X	QUALCOMM 等. "WF on LDPC Matrix" 3GPP TSG RAN WG1 Meeting #88 R1-1703xxx, 2017年 2月 17日 (2017 - 02 - 17), 第1-4页	1-30	X	SAMSUNG. "Consideration on LDPC Proto-Matrix Design" 3GPP TSG RAN WG1 #88 R1-1703000, 2017年 2月 17日 (2017 - 02 - 17), 第1-3节	1-30	X	KT CORP. "Number of LDPC codes in NR" 3GPP TSG RAN WG1 Meeting #88 R1-1703210, 2017年 2月 17日 (2017 - 02 - 17), 第1-3节	1-30	X	3GPP. "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on New Radio (NR) Access Technology (Release 14)" 3GPP TR 38.912 V1.0.0 (2017-03), 2017年 3月 31日 (2017 - 03 - 31), 第8.2.1.5.1节	1-30	A	CN 102035556 A (香港理工大学) 2011年 4月 27日 (2011 - 04 - 27) 全文	1-30
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A	CN 102035556 A (香港理工大学) 2011年 4月 27日 (2011 - 04 - 27) 全文	1-30																		
☐ 其余文件在C栏的续页中列出。 ☒ 见同族专利附件。																				
* 引用文件的具体类型: "A" 认为不特别相关的表示了现有技术一般状态的文件 "E" 在国际申请日的当天或之后公布的在先申请或专利 "L" 可能对优先权要求构成怀疑的文件, 或为确定另一篇引用文件的公布日而引用的或者因其他特殊理由而引用的文件 (如具体说明的) "O" 涉及口头公开、使用、展览或其他方式公开的文件 "P" 公布日先于国际申请日但迟于所要求的优先权日的文件 "T" 在申请日或优先权日之后公布, 与申请不相抵触, 但为了理解发明之理论或原理的在后文件 "X" 特别相关的文件, 单独考虑该文件, 认定要求保护的发明不是新颖的或不具有创造性 "Y" 特别相关的文件, 当该文件与另一篇或者多篇该类文件结合并且这种结合对于本领域技术人员为显而易见时, 要求保护的发明不具有创造性 "&" 同族专利的文件																				
国际检索实际完成的日期 2018年 1月 28日		国际检索报告邮寄日期 2018年 2月 9日																		
ISA/CN的名称和邮寄地址 中华人民共和国国家知识产权局 (ISA/CN) 中国北京市海淀区蓟门桥西土城路6号 100088 传真号 (86-10) 62019451		授权官员 董立波 电话号码 (86-10) 53961431																		

国际申请号
PCT/CN2017/087073

检索报告引用的专利文件	公布日 (年/月/日)	同族专利	公布日 (年/月/日)
CN 102035556 A	2011年 4月 27日	US 2011083052 A1	2011年 4月 7日