构建高性能MySQL之索引

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慢SQL引发的思考

```sql
SELECT  presentid, count(*) AS cnt, sum(amount) AS amount
  FROM presentorders
 WHERE 1 = 1
   AND ((presentid IN ('772378151', '772378704')) OR amount > 0)
   AND STATUS = '1'
   AND ctime >= '2015-08-28'
   AND ctime < '2015-08-29'
 GROUP BY presentid
HAVING cnt >= '2'
 ORDER BY cnt DESC;
```

```
PRIMARY KEY (`id`),
KEY `idx_presentid_ctime` (`presentid`,`ctime`),
KEY `idx_patientid_ctime` (`patientid`,`ctime`),
KEY `idx_spaceid_ctime` (`spaceid`,`ctime`),
KEY `idx_spaceid_patientid` (`spaceid`,`patientid`),
KEY `idx_ptime_space` (`ptime`,`spaceid`),
KEY `idx_userid` (`userid`),
KEY `idx_contractid` (`contractid`),
KEY `idx_space_present` (`spaceid`,`presentid`)
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	presentorders	index	idx_presentid_ctime,idx_space_present	idx_presentid_ctime	8	NULL	1293646	Using where; Using temporary; Using filesort

```
mysql> SELECT presentid, count(*) AS cnt, sum(amount) AS amount   FROM presentorders  WHERE 1 = 1    AND ((presentid
IN ('772378151', '772378704')) OR amount > 0)     AND STATUS = '1'     AND ctime >= '2015-08-28'     AND ctime < '2015-0
8-29'   GROUP BY presentid HAVING cnt >= '2'   ORDER BY cnt DESC;
+------------+-----+---------+
| presentid  | cnt | amount  |
+------------+-----+---------+
| 3210338199 | 266 |  266.00 |
| 3210336341 | 111 |  111.00 |
| 3210353495 | 100 | 1000.00 |
| 3210350260 |  66 |  660.00 |
| 3216496931 |  32 |   32.00 |
| 3210376439 |  28 |  840.00 |
| 3210381066 |  27 |  810.00 |
| 3128226885 |  26 | 2600.00 |
| 3097882366 |  15 | 1500.00 |
| 3216506320 |  14 |  140.00 |
| 3210329315 |  12 |   12.00 |
| 3210348087 |   9 |   90.00 |
| 2254312142 |   6 |    6.00 |
| 3216509041 |   5 |  150.00 |
| 3132705573 |   3 |    3.00 |
|  699322060 |   3 |   60.00 |
|  699322045 |   2 |   40.00 |
|  800871576 |   2 |   60.00 |
| 1004130974 |   2 |   20.00 |
| 2254329894 |   2 |   60.00 |
| 3210371155 |   2 |   60.00 |
| 3097644213 |   2 |  200.00 |
+------------+-----+---------+
22 rows in set (3.61 sec)
```

```
mysql> select count(*) from presentorders where presentid in ('772378151','772378704');
+----------+
| count(*) |
+----------+
|      349 |
+----------+
1 row in set (0.00 sec)

mysql> select count(*) from  presentorders where ctime >= '2015-08-28'
    ->     AND ctime < '2015-08-29';
+----------+
| count(*) |
+----------+
|     2115 |
+----------+
1 row in set (0.01 sec)
```

```
mysql> SELECT presentid, count(*) AS cnt, sum(amount) AS amount   FROM presentorders   WHERE 1 = 1    AND ((presentid
IN ('772378151', '772378704')) OR amount > 0)    AND STATUS = '1'    AND ctime >= '2015-08-28'    AND ctime < '2015-
8-29'   GROUP BY presentid HAVING cnt >= '2'   ORDER BY cnt DESC;
+------------+-----+---------+
| presentid  | cnt | amount  |
+------------+-----+---------+
| 3210338199 | 266 |  266.00 |
| 3210336341 | 111 |  111.00 |
| 3210353495 | 100 | 1000.00 |
| 3210350260 |  66 |  660.00 |
| 3216496931 |  32 |   32.00 |
| 3210376439 |  28 |  840.00 |
| 3210381066 |  27 |  810.00 |
| 3128226885 |  26 | 2600.00 |
| 3097882366 |  15 | 1500.00 |
| 3216506320 |  14 |  140.00 |
| 3210329315 |  12 |   12.00 |
| 3210348087 |   9 |   90.00 |
| 2254312142 |   6 |    6.00 |
| 3216509041 |   5 |  150.00 |
|  699322060 |   3 |   60.00 |
| 3132705573 |   3 |    3.00 |
|  800871576 |   2 |   60.00 |
| 2254329894 |   2 |   60.00 |
| 3210371155 |   2 |   60.00 |
| 1004130974 |   2 |   20.00 |
|  699322045 |   2 |   40.00 |
| 3097644213 |   2 |  200.00 |
+------------+-----+---------+
22 rows in set (0.01 sec)
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	presentorders	range	idx_presentid_ctime,idx_space_present,idx_c	idx_c	4	NULL	2113	Using index condition; Using where; Using temporary; Using filesort

```
1 row in set (0.00 sec)
```

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type
presentorders	0	PRIMARY	1	id	A	1294095	NULL	NULL		BTREE
presentorders	1	idx_presentid_ctime	1	presentid	A	510	NULL	NULL		BTREE
presentorders	1	idx_presentid_ctime	2	ctime	A	1294095	NULL	NULL		BTREE

```
mysql> select distinct a.userid as userid
    ->                     from doctoroutlines a
    ->                     inner join tab_DiseaseDoctor b on b.fld_DoctorId = a.doctorid and b.fld_DiseaseDoctorGoodVoteCount >0
    ->                     where b.fld_DiseaseId = '27'
    ->                      and a.userid not in ('93546','42395','945963')order by b.fld_DiseaseDoctorRank desc limit 1;
+--------+
| userid |
+--------+
| 421234 |
+--------+
1 row in set (1.03 sec)
```

```
+-------+-------+--------------------------+---------+---------------------+------+------------------------------+
| table | type  | key                      | key_len | ref                 | rows | Extra                        |
+-------+-------+--------------------------+---------+---------------------+------+------------------------------+
| b     | index | fld_DiseaseDoctorRank    | 4       | NULL                | 218  | Using where; Using temporary |
| a     | ref   | doctorid_index           | 4       | db_Hdf.b.fld_DoctorId |  1  | Using where                  |
+-------+-------+--------------------------+---------+---------------------+------+------------------------------+
```

```
doctoroutlines  KEY `doctorid_index` (`doctorid`)
tab_DiseaseDoctor KEY `fld_DiseaseDoctorRank` (`fld_DiseaseDoctorRank`)
tab_DiseaseDoctor KEY `fld_DiseaseId` (`fld_DiseaseId`)
```

```
mysql> create index idx_c on tab_DiseaseDoctor(fld_DiseaseId,fld_DiseaseDoctorRank);
mysql> select distinct a.userid as userid
    ->                     from doctoroutlines a
    ->                     inner join tab_DiseaseDoctor b on b.fld_DoctorId = a.doctorid and b.fld_DiseaseDoctorGoodVoteCount >0
    ->                     where b.fld_DiseaseId = '27'
    ->                      and a.userid not in ('93546','42395','945963')order by b.fld_DiseaseDoctorRank desc limit 1;
+--------+
| userid |
+--------+
| 421234 |
+--------+
1 row in set (0.02 sec)
```

table	type		key	key_len	ref	rows	Extra
b	ref		idx_c	4	const	2523	Using where; Using temporary
a	ref		doctorid_index	4	db_Hdf.b.fld_DoctorId	1	Using where

```
mysql> select distinct a.userid as userid
    ->     from doctoroutlines a,
    ->         (select b.fld_DoctorId
    ->             from tab_DiseaseDoctor b
    ->            where b.fld_DiseaseId = '27'
    ->            order by b.fld_DiseaseDoctorRank desc) c
    ->   where a.doctorid = c.fld_DoctorId
    ->     and a.userid not in ('93546', '42395', '945963') limit 1;
+--------+
| userid |
+--------+
| 421234 |
+--------+
1 row in set (0.01 sec)
```

table	type	key	key_len	ref	rows	Extra
\<derived2\>	ALL	NULL	NULL	NULL	2523	Using temporary
a	ref	doctorid_index	4	c.fld_DoctorId	1	Using where
b	ref	fld_DiseaseId	4	const	2523	Using where; Using filesort

```
+--------+---------+----------------------------+---------+----------------+------+----------------------------------------+
| table  | type    | key                        | key_len | ref            | rows | Extra                                  |
+--------+---------+----------------------------+---------+----------------+------+----------------------------------------+
| d      | range   | ix_spaceid_hosttype_status | 4       | NULL           | 580  | Using index condition; Using where     |
| e      | eq_ref  | ix_marks_ref               | 4       | flow_avatar.d.id | 1  | Using where                            |
+--------+---------+----------------------------+---------+----------------+------+----------------------------------------+
```

```
mysql> select count(*) from doctorpatientrefs d where d.userid <> '1293826'
    ->     and d.status not in ('1', '3') and d.spaceid in ('2498157',
    ->                          '697669779',
    ->                          '546515',
    ->                          '1967854',
    ->                          '104831',
    ->                          '295212',
    ->                          '41600074',
    ->                          '2941372',
    ->                          '2921923',
    ->                          '1887133856');
+----------+
| count(*) |
+----------+
|   121661 |
+----------+
```

```
mysql>     select count(*) from  flowcontentmarks e where e.status = 'AUDIT'
    ->     and e.mark in ('LEVEL_2', 'LEVEL_3');
+----------+
| count(*) |
+----------+
|    27236 |
+----------+
```

```
mysql> select d.id as id
    ->                     from flowcontentmarks e STRAIGHT_JOIN  doctorpatientrefs d
    ->                       on d.id = e.doctorpatientrefid
    ->                     where d.userid <> '1293826'
    ->                       and d.status not in ('1', '3')
    ->                       and e.status = 'AUDIT'
    ->                       and e.mark in ('LEVEL_2', 'LEVEL_3')
    ->                       and d.spaceid in ('2498157',
    ->                                         '697669779',
    ->                                         '546515',
    ->                                         '1967854',
    ->                                         '104831',
    ->                                         '295212',
    ->                                         '41600074',
    ->                                         '2941372',
    ->                                         '2921923',
    ->                                         '1887133856');
```

```
| 2368780644 |
| 2385524207 |
| 2390058401 |
| 2390433464 |
| 2534292811 |
| 2868079996 |
+------------+
61 rows in set (0.21 sec)
```

第二章：索引基础理论与数据结构
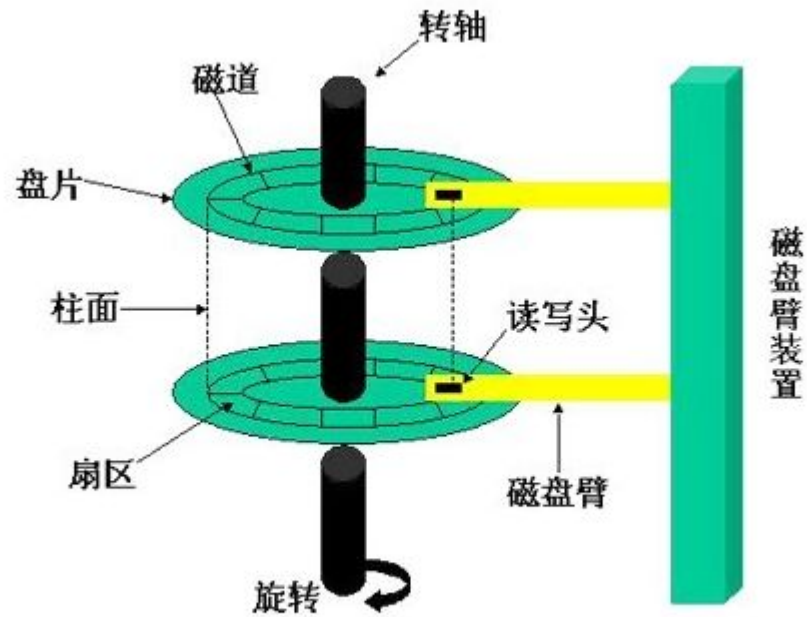
seek time   5ms
latency time   1/120/2 = 4.17ms
transmission time 0.1

binary search
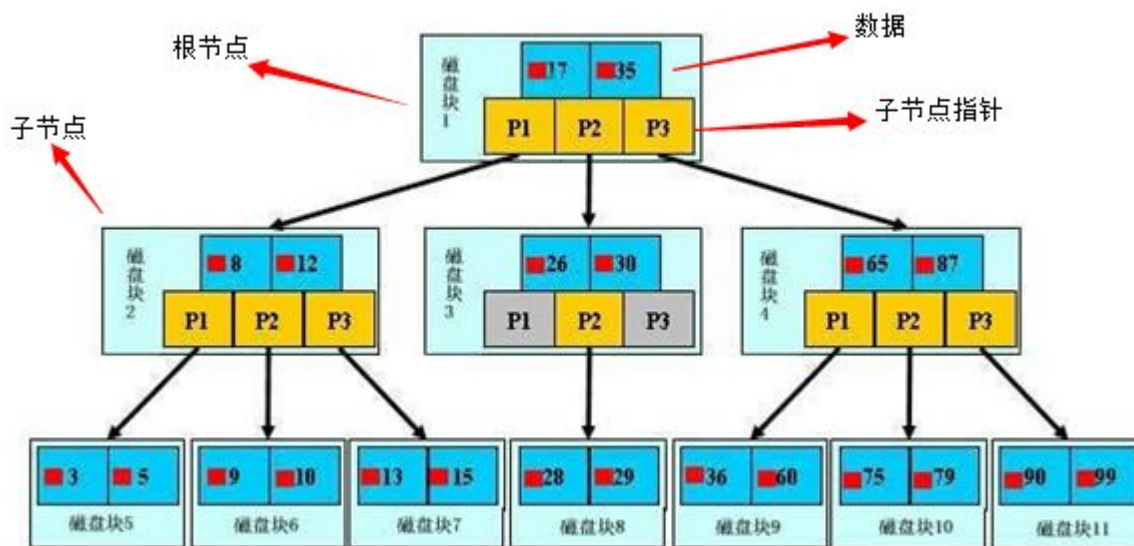
B-Tree

B+Tree
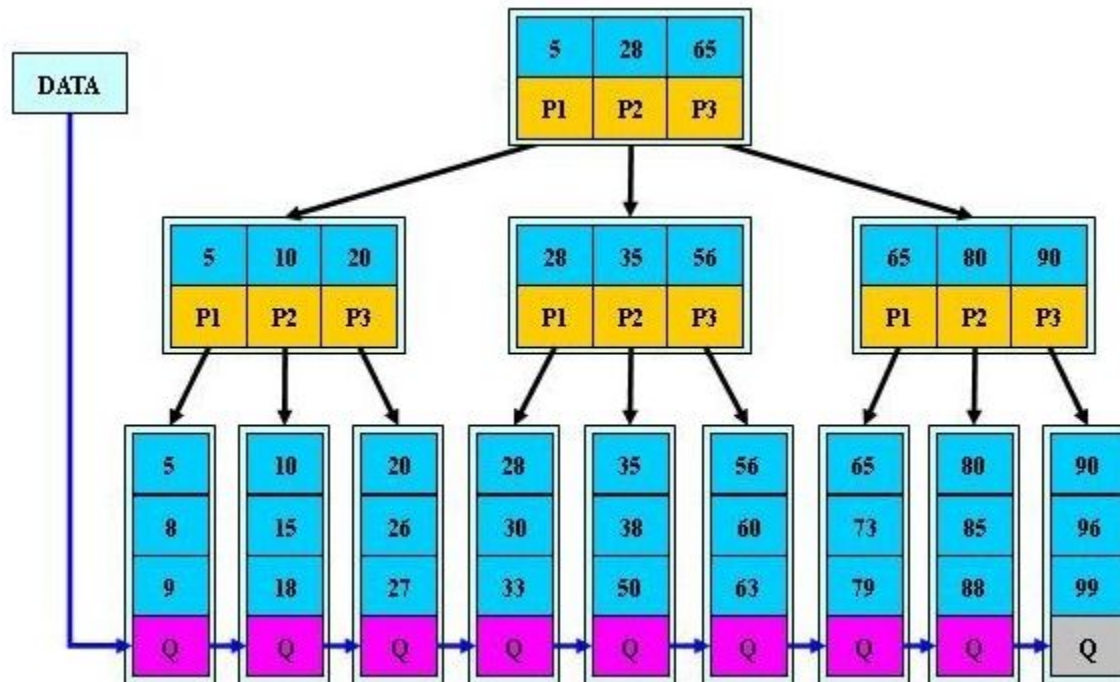
Select ...
From Customer A, Orders B
Where A.Cust_Id = B.Cust_Id
  And A.Cust_Id = 3975;

使用一个 HASH 集群

散列函数

I/O

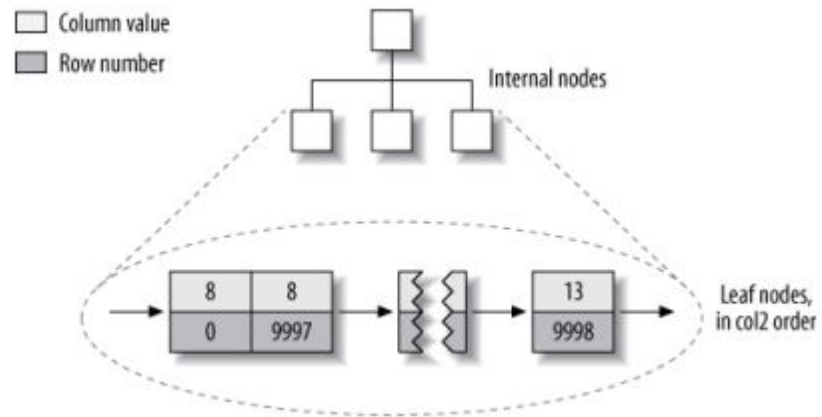| HASH键	集群键	数据

使用 B 树索引

I/O

B 树索引

树枝块

I/O

树枝块

I/O

树枝块

表

数据块
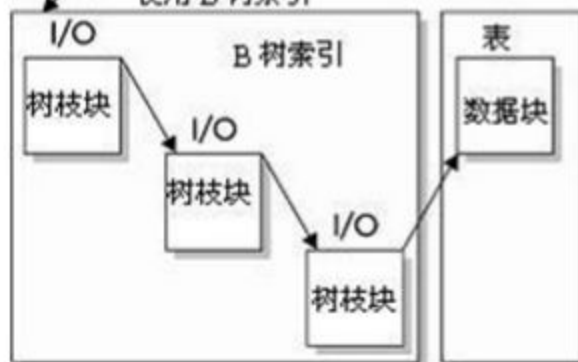
理解InnoDB索引与MyISAM索引

MyISAM

INNODB

INNODB

Primary key

Secondary key

Row Row Row Row

Key + PK cols Key + PK cols Key + PK cols Key + PK cols
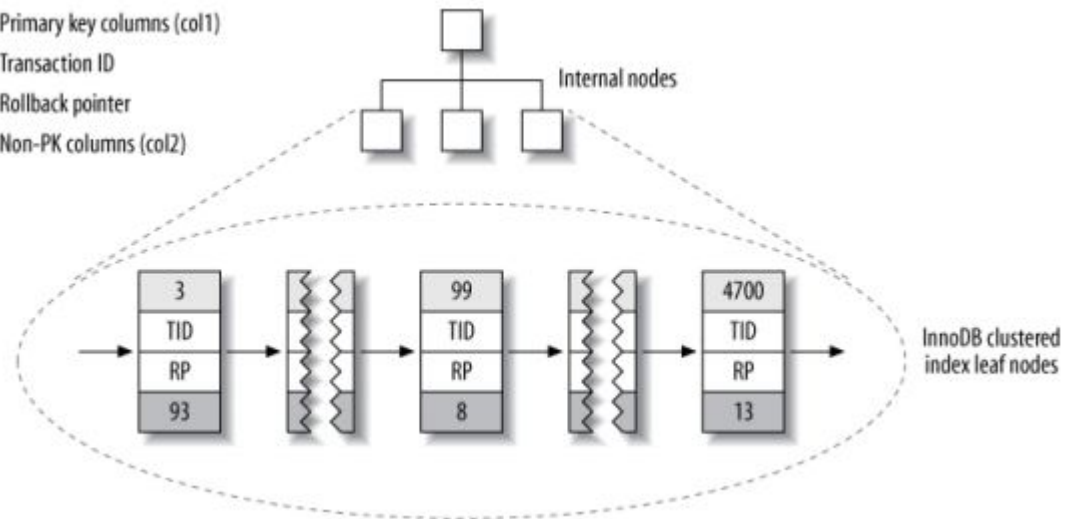
InnoDB (clustered) table layout

Primary key

Secondary key

Row Row Row Row
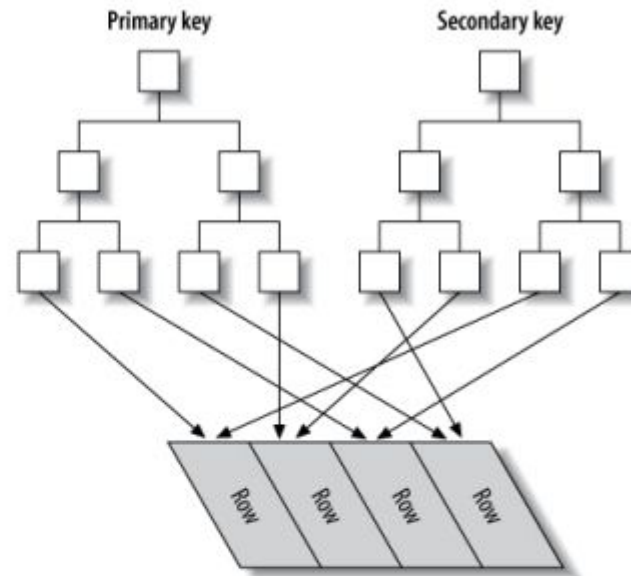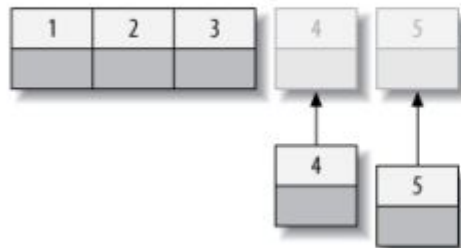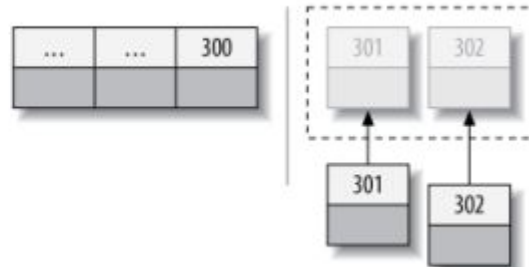
MyISAM (nonclustered) table layout

Sequential insertion into the page: each new record is inserted after the previous one

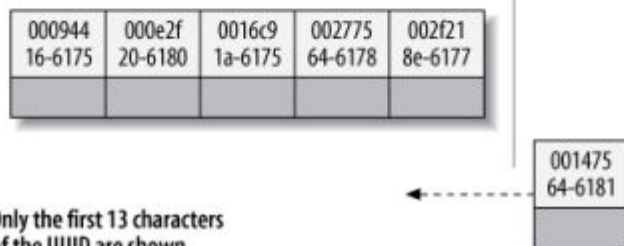| 1	2	3	4	5

4

5

When the page is full, insertion continues in a new page

...	...	300

301	302

301

302

Inserting UUIDs: new records may be inserted between previously inserted records, forcing them to be moved

000944 16-6175	0016c9 1a-6175	002f21 8e-6177

002775 64-6178

000e2f 20-6180
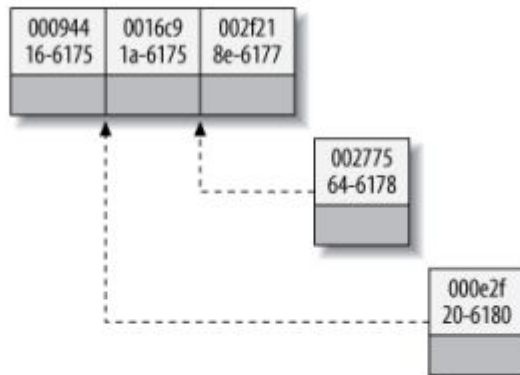
Pages that were filled and flushed to disk may have to be read again

000944 16-6175	000e2f 20-6180	0016c9 1a-6175	002775 64-6178	002f21 8e-6177

001475 64-6181

*Only the first 13 characters of the UUID are shown

Table	Rows	Time (sec)	Index size (MB)
userinfo	1,000,000	137	342
userinfo_uuid	1,000,000	180	544
userinfo	3,000,000	1233	1036
userinfo_uuid	3,000,000	4525	1707

End

Thank
you

系统是由每一个细节组成