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11 things about Oracle Database 11g Release 2

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ask Tom ORACLE

1 Do it yourself Parallelism

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Incrementally modify a table in parallel

- Used to do this manually all of the time
  - Search for ‘diy parallel’ on asktom…
  - Spent part of a chapter on ‘how to’ in Expert Oracle Database Architecture
- I split by rowid ranges
  - Split table into N equi-sized, non-overlapping chunks
  - Create a job passing in the low and high rowids for each range
  - Job would process “where rowid between :lo and :hi”
- Or by primary key ranges using NTILE()
- DBMS_PARALLEL_EXECUTE automates both approaches and makes it easy (and more functional)

Diyp.sql

Incrementally modify a table in parallel

```
ops$tkyte%ORA11GR2> create table t
  2  as
  3  select *
  4    from all objects
  5  /

Table created.

ops$tkyte%ORA11GR2> exec dbms_stats.gather_table_stats( user, 'T' );

PL/SQL procedure successfully completed.

ops$tkyte%ORA11GR2> select blocks, blocks/10 from user_tables where
  table_name = 'T';

    BLOCKS  BLOCKS/10
---------- ----------
      1044      104.4
```

Incrementally modify a table in parallel

```
ops$tkyte%ORA11GR2> create table log
  2  ( lo_rowid  rowid,
  3    hi_rowid  rowid,
  4    nrows     number,
  5    stime     timestamp,
  6    etime     timestamp
  7  )
  8  /

Table created.
```

Incrementally modify a table in parallel

```
ops$tkyte%ORA11GR2> create or replace
  2  procedure do_update( p_lo_rowid in rowid, p_hi_rowid in rowid )
  3  as
  4          l_rid rowid;
  5          l_cnt number;
  6  begin
  7          insert into log (lo_rowid,hi_rowid,stime)
  8          values (p_lo_rowid,p_hi_rowid,systimestamp)
  9          returning rowid into l_rid;
 10
 11          update t set object_name = lower(object_name)
 12           where rowid between p_lo_rowid and p_hi_rowid;
 13          l_cnt := sql%rowcount;
 14
 15          update log
 16             set etime = systimestamp,
 17                 nrows = l_cnt
 18           where rowid = l_rid;
 19  end;
 20  /
Procedure created.
```

Incrementally modify a table in parallel

```
ops$tkyte%ORA11GR2> begin
  2          dbms_parallel_execute.create_task('update t');
  3          dbms_parallel_execute.create_chunks_by_rowid
  4          ( task_name   => 'update t',
  5            table_owner => user,
  6            table_name  => 'T',
  7            by_row      => false,
  8            chunk_size  => 100);
  9  end;
 10  /
PL/SQL procedure successfully completed.

ops$tkyte%ORA11GR2> select chunk_id, status, start_rowid, end_rowid
  2    from dba_parallel_execute_chunks
  3   where task_name = 'update t'
  4  /

  CHUNK_ID STATUS               START_ROWID        END_ROWID
---------- -------------------- ------------------ ------------------
       194 UNASSIGNED           AAASTlAAEAAAAdkAAA AAASTlAAEAAAAd/CcP
       193 UNASSIGNED           AAASTlAAEAAAAcAAAA AAASTlAAEAAAAdjCcP
…
```

Incrementally modify a table in parallel

```
ops$tkyte%ORA11GR2> begin
  2          dbms_parallel_execute.run_task
  3          ( task_name      => 'update t',
  4            sql_stmt       => 'begin do_update( :start_id, :end_id ); end;',
  5            language_flag  => DBMS_SQL.NATIVE,
  6            parallel_level => 2 );
  7  end;
  8  /
PL/SQL procedure successfully completed.

ops$tkyte%ORA11GR2> select chunk_id, status, start_rowid, end_rowid
  2    from dba_parallel_execute_chunks
  3   where task_name = 'update t'
  4  /

  CHUNK_ID STATUS               START_ROWID        END_ROWID
---------- -------------------- ------------------ ------------------
       195 PROCESSED            AAASTlAAEAAAAeAAAA AAASTlAAEAAAAfjCcP
       196 PROCESSED            AAASTlAAEAAAAfkAAA AAASTlAAEAAAAf/CcP
…
```

Incrementally modify a table in parallel

```
ops$tkyte%ORA11GR2> begin
  2          dbms_parallel_execute.drop_task('update t');
  3  end;
  4  /

PL/SQL procedure successfully completed.

ops$tkyte%ORA11GR2> select chunk_id, status, start_rowid, end_rowid
  2    from dba_parallel_execute_chunks
  3   where task_name = 'update t'
  4  /

no rows selected
```

Incrementally modify a table in parallel

```
ops$tkyte%ORA11GR2> select nrows, stime, etime-stime ela from log;

     NROWS STIME                                ELA
---------- ---------------------------------- ---------------------------
      1950 07-OCT-09 11.38.38.441904 AM       +000000000 00:00:00.056220
      6747 07-OCT-09 11.38.38.499673 AM       +000000000 00:00:00.571049
      1911 07-OCT-09 11.38.39.072111 AM       +000000000 00:00:00.060847
      6662 07-OCT-09 11.38.37.364203 AM       +000000000 00:00:00.150791
      1952 07-OCT-09 11.38.37.519093 AM       +000000000 00:00:00.057181
      6920 07-OCT-09 11.38.37.577507 AM       +000000000 00:00:00.146901
      1999 07-OCT-09 11.38.37.725649 AM       +000000000 00:00:00.008060
      6997 07-OCT-09 11.38.37.734748 AM       +000000000 00:00:00.152851
…
      6663 07-OCT-09 11.38.38.069751 AM       +000000000 00:00:00.533909
      1914 07-OCT-09 11.38.38.605693 AM       +000000000 00:00:00.029193
      6653 07-OCT-09 11.38.38.635749 AM       +000000000 00:00:00.447706

32 rows selected.
```

2 Analytics are the coolest thing to happen to SQL since the keyword SELECT

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More Analytics!

- Long awaited LISTAGG
  - First did STRAGG in 9iR2 with user defined aggregates
  - Oracle Database 10g gave us a sys_connect_by_path ‘trick’
  - Oracle Database 11g Release 2 makes it ‘easy’

Analytics Rock and Roll

```
SQL> select deptno,
  2         substr(
  3         max(sys_connect_by_path(ename, '; ')),
  4         3) enames
  5    from (
  6  select deptno,
  7         ename,
  8         row_number()
  9         over
 10         (partition by deptno
 11          order by ename) rn
 12    from emp
 13         )
 14   start with rn = 1
 15  connect by prior deptno = deptno
 16      and prior rn+1 = rn
 17    group by deptno
 18    order by deptno
 19  /
```

```
DEPTNO ENAMES
---------- --------------------
        10 CLARK; KING; MILLER
        20 ADAMS; FORD; JONES;
           SCOTT; SMITH

        30 ALLEN; BLAKE;
           JAMES; MARTIN;
           TURNER; WARD
```

Analytics Rock and Roll

```
SQL> select deptno,
  2         listagg( ename, '; ' )
  3         within group
  4         (order by ename) enames
  5    from emp
  6   group by deptno
  7   order by deptno
  8  /

    DEPTNO ENAMES
---------- --------------------
        10 CLARK; KING; MILLER
        20 ADAMS; FORD; JONES;
           SCOTT; SMITH

        30 ALLEN; BLAKE;
           JAMES; MARTIN;
           TURNER; WARD
```

Analytics Rock and Roll

```
SQL> select deptno,
  2         ename,
  3         row_number()
  4         over (partition by deptno
  5               order by ename) rn,
  6         first_value(ename)
  7         over (partition by deptno
  8               order by ename) "1st ename",
  9         nth_value(ename,3)
 10         over (partition by deptno
 11               order by ename) "3rd ename",
 12         last_value(ename)
 13         over (partition by deptno
 14               order by ename
 15               rows between current row
 16               and unbounded following) "last ename"
 17    from emp
 18   order by deptno, ename
 19  /
```

Analytics Rock and Roll

```
SQL> select deptno,
  2         ename,
  3         row_number()
  4         over (partition by deptno
  5               order by ename) rn,
  6         first_value(ename)
  7         over (partition by deptno
  8               order by ename) "1st ename",
  9         nth_value(ename,3)
 10         over (partition by deptno
 11               order by ename) "3rd ename",
 12         last_value(ename)
 13         over (partition by deptno
 14               order by ename
 15               rows between current row
 16               and unbounded following) "last ename"
 17    from emp
 18   order by deptno, ename
 19  /
```

DEPTNO	ENAME	RN	1st e	3rd ena	last en
10	CLARK	1	CLARK		MILLER
	KING	2	CLARK		MILLER
	MILLER	3	CLARK	MILLER	MILLER
20	ADAMS	1	ADAMS		SMITH
	FORD	2	ADAMS		SMITH
	JONES	3	ADAMS	JONES	SMITH
	SCOTT	4	ADAMS	JONES	SMITH
	SMITH	5	ADAMS	JONES	SMITH
30	ALLEN	1	ALLEN		WARD
	BLAKE	2	ALLEN		WARD
	JAMES	3	ALLEN	JAMES	WARD
	MARTIN	4	ALLEN	JAMES	WARD
	TURNER	5	ALLEN	JAMES	WARD
	WARD	6	ALLEN	JAMES	WARD

3 Execute on a directory

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External Tables can run code now

- External tables allow for a preprocessor
  - Program is run when you SELECT from external table
  - The ‘location’ is passed to the script/executable
  - The executable does whatever it wants and writes to stdout
  - Stdout is treated as the input file
- We need a way to control who can do what
- GRANT EXECUTE ON DIRECTORY handles that

EXECUTE and PREPROCESSOR

```
ops$tkyte%ORA11GR2> CREATE or replace DIRECTORY load_dir
  2  AS '/mnt/hgfs/docs/Presentations/Seminar/11gr2'
  3  /

Directory created.

ops$tkyte%ORA11GR2> CREATE or replace DIRECTORY exec_dir
  2  AS '/mnt/hgfs/docs/Presentations/Seminar/11gr2'
  3  /

Directory created.
```

EXECUTE and PREPROCESSOR

```
ops$tkyte%ORA11GR2> CREATE TABLE EMP_ET
  2  (
  3    "EMPNO" NUMBER(4),
  4    "ENAME" VARCHAR2(10),
  5    "JOB" VARCHAR2(9),
  6    "MGR" NUMBER(4),
  7    "HIREDATE" DATE,
  8    "SAL" NUMBER(7,2),
  9    "COMM" NUMBER(7,2),
 10    "DEPTNO" NUMBER(2)
 11  )
 12  ORGANIZATION external
 13  ( TYPE oracle_loader
 14    DEFAULT DIRECTORY load_dir
 15    ACCESS PARAMETERS
 16    ( RECORDS DELIMITED BY NEWLINE
 17          preprocessor  exec_dir:'run_gunzip.sh'
 18      FIELDS TERMINATED BY "|" LDRTRIM
 19    )
 20    location ( 'emp.dat.gz')
 21  )
 22  /
Table created.
```

EXECUTE and PREPROCESSOR

```
ops$tkyte%ORA11GR2> !file emp.dat.gz
emp.dat.gz: gzip compressed data, was "emp.dat", from Unix, last
  modified: Wed Oct  7 12:48:53 2009

ops$tkyte%ORA11GR2> !cat run_gunzip.sh
#!/bin/bash

/usr/bin/gunzip -c $*

ops$tkyte%ORA11GR2> select empno, ename from emp_et where rownum <= 5;

     EMPNO ENAME
---------- ----------
      7369 SMITH
      7499 ALLEN
      7521 WARD
      7566 JONES
      7654 MARTIN
```

EXECUTE and PREPROCESSOR, interesting idea…

```
ops$tkyte%ORA11GR2> CREATE TABLE ls
  2  (
  3    line varchar2(255)
  4  )
  5  ORGANIZATION external
  6  ( TYPE oracle_loader
  7    DEFAULT DIRECTORY load_dir
  8    ACCESS PARAMETERS
  9    ( RECORDS DELIMITED BY NEWLINE
 10          preprocessor  exec_dir:'run_ls.sh'
 11      FIELDS TERMINATED BY "|" LDRTRIM
 12    )
 13    location ( 'run_ls.sh')
 14  )
 15  /

Table created.
```

EXECUTE and PREPROCESSOR, interesting idea…

```
ops$tkyte%ORA11GR2> select * from ls;

LINE
--------------------------------------------------------------------
11 things about 11gr2.ppt
diyp.sql
ebr.old.sql
ebr.sql
emp.ctl
emp.dat.gz
EMP_ET_26122.log
emp_et.sql
LS_26122.log
run_gunzip.sh
run_ls.sh

11 rows selected.
```

4 Recursive Subquery Factoring

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Recursive Subquery Factoring

- ANSI SQL replacement for connect by
- Can be
  - Easier to understand than connect by
  - Unless of course, you have been using connect by for 22 years – in which case it looks confusing

Recursive Subquery Factoring

```
ops$tkyte%ORA11GR2> with emp_data(ename,empno,mgr,l)
  2  as
  3  (select ename, empno, mgr, 1 lvl from emp where mgr is null
  4   union all
  5   select emp.ename, emp.empno, emp.mgr, ed.l+1
  6     from emp, emp_data ed
  7    where emp.mgr = ed.empno
  8  )
  9  SEARCH DEPTH FIRST BY ename SET order_by
 10  select l,
 11         lpad('*',2*l,'*')||ename nm
 12    from emp_data
 13   order by order_by
 14  /
```

Recursive Subquery Factoring

```
         L NM
---------- --------------------
         1 **KING
         2 ****BLAKE
         3 ******ALLEN
         3 ******JAMES
         3 ******MARTIN
         3 ******TURNER
         3 ******WARD
         2 ****CLARK
         3 ******MILLER
         2 ****JONES
         3 ******FORD
         4 ********SMITH
         3 ******SCOTT
         4 ********ADAMS

14 rows selected.
```

Recursive Subquery Factoring

```
ops$tkyte%ORA11GR2> with data(r)
  2  as
  3  (select 1 r from dual
  4   union all
  5   select r+1 from data where r < 5
  6  )
  7  select r, sysdate+r
  8    from data;

         R SYSDATE+R
---------- ---------
         1 08-OCT-09
         2 09-OCT-09
         3 10-OCT-09
         4 11-OCT-09
         5 12-OCT-09
```

Recursive Subquery Factoring

- ANSI SQL replacement for connect by
- Can be
  - Easier to understand than connect by
  - Unless of course, you have been using connect by for 22 years – in which case it looks confusing
  - Used to solve Sudoku puzzles!

5 Improved Time Travel

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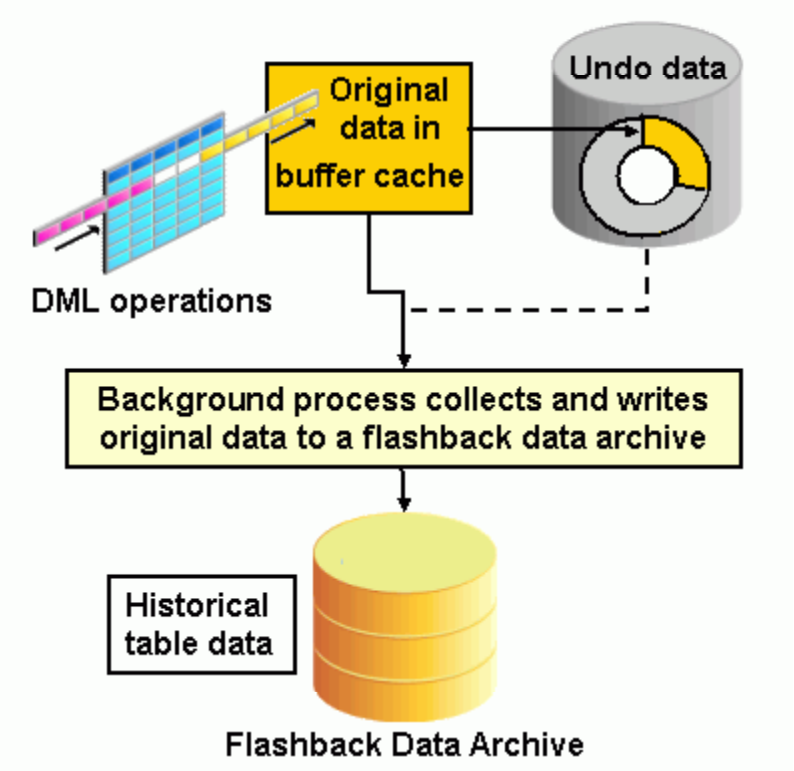
Improved Time Travel

- Flashback Data Archive
  - Query data as of 5 days, 5 weeks, 5 months, 5 years – whatever – in the past
  - http://www.oracle.com/technology/oramag/oracle/08-jul/o48totalrecall.html
    - Article by Jonathan Gennick on this feature for more info
- How does it work…

How Does Flashback Data Archive Work?

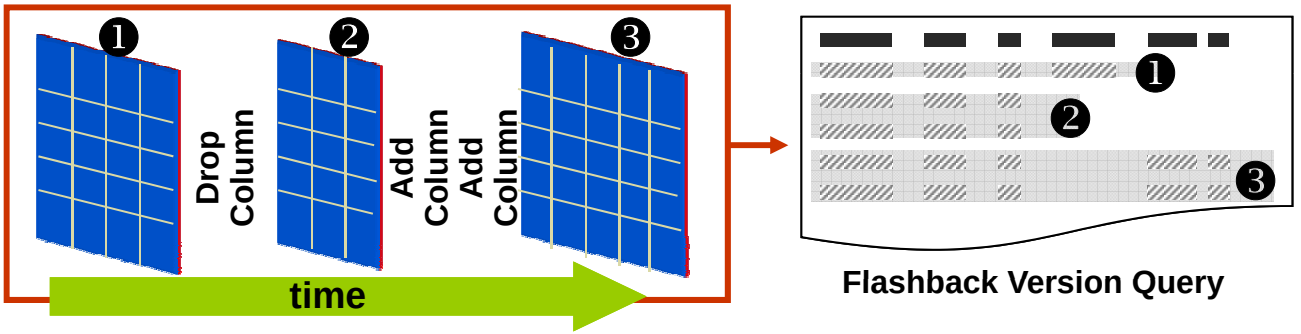
- Primary source for history is the undo data
- History is stored in automatically created history tables inside the archive
- Transactions and its undo records on tracked tables marked for archival
  - Undo records not recycled until history is archived
- History is captured asynchronously by new background process (fbda)
  - Default capture interval is 5 minutes
  - Capture interval is self-tuned based on system activities
  - Process tries to maximize undo data reads from buffer cache for better performance
  - INSERTs do not generate history records



Oracle Database 11g Release

Total Recall Schema Evolution Support

- Alter base table – history table automatically adjusts
  - Drop, Rename, Modify Column
  - Drop, Truncate Partition
  - Rename, Truncate Table
- Flashback query supported across DDL changes



- Complex DDL changes (e.g. table split) accommodated
  - Associate/Diassociate history table via DBMS_FLASHBACK_ARCHIVE package

6 You've got Mail

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File Watchers

- As files arrive in some directory
  - An event is generated
  - And your code can be invoked to deal with it…

File Watchers

```
ops$tkyte%ORA11GR2> begin
  2    dbms_scheduler.create_credential(
  3       credential_name => 'watch_credential',
  4       username        => 'tkyte',
  5       password        => ‘foobar');
  6  end;
  7  /

PL/SQL procedure successfully completed.
```

File Watchers

```
ops$tkyte%ORA11GR2> create or replace directory MY_FILES as
  '/home/tkyte/files'
  2  /

Directory created.

ops$tkyte%ORA11GR2> create table files
  2  (
  3     file_name varchar2(100),
  4     loaded timestamp,
  5     contents  clob
  6  );

Table created.
```

File Watchers

```
ops$tkyte%ORA11GR2> create or replace procedure process_files
  2  (p_payload in sys.scheduler_filewatcher_result)
  3  is
  4      l_clob clob;
  5      l_bfile bfile;
  6  begin
  7      insert into files
  8      (loaded, file_name, contents )
  9      values (p_payload.file_timestamp,
 10       p_payload.directory_path || '/' || p_payload.actual_file_name,
 11       empty_clob()
 12      ) returning contents into l_clob;
 13
 14      l_bfile := bfilename( 'MY_FILES', p_payload.actual_file_name );
 15      dbms_lob.fileopen( l_bfile );
 16      dbms_lob.loadfromfile( l_clob, l_bfile, dbms_lob.getlength(l_bfile) );
 17      dbms_lob.fileclose( l_bfile );
 18  end;
 19  /

Procedure created.
```

File Watchers

```
ops$tkyte%ORA11GR2> begin
  2    dbms_scheduler.create_program(
  3      program_name        => 'file_watcher',
  4      program_type        => 'stored_procedure',
  5      program_action      => 'Process_Files',
  6      number_of_arguments => 1,
  7      enabled             => false);
  8    dbms_scheduler.define_metadata_argument(
  9      program_name        => 'file_watcher',
 10      metadata_attribute  => 'event_message',
 11      argument_position   => 1);
 12    dbms_scheduler.enable('file_watcher');
 13  end;
 14  /

PL/SQL procedure successfully completed.
```

File Watchers

```
ops$tkyte%ORA11GR2> begin
  2    dbms_scheduler.create_file_watcher(
  3      file_watcher_name => 'my_file_watcher',
  4      directory_path    => '/home/tkyte/files',
  5      file_name         => '*',
  6      credential_name   => 'watch_credential',
  7      destination       => null,
  8      enabled           => false);
  9  end;
 10  /

PL/SQL procedure successfully completed.
```

File Watchers

```
ops$tkyte%ORA11GR2> begin
  2    dbms_scheduler.create_job(
  3      job_name        => 'my_file_job',
  4      program_name    => 'file_watcher',
  5      event_condition => 'tab.user_data.file_size > 10',
  6      queue_spec      => 'my_file_watcher',
  7      auto_drop       => false,
  8      enabled         => false);
 10  end;
 11  /

PL/SQL procedure successfully completed.
ops$tkyte%ORA11GR2> exec
  dbms_scheduler.enable('my_file_watcher,my_file_job');

PL/SQL procedure successfully completed.
```

File Watchers

```
ops$tkyte%ORA11GR2> select * from files;

FILE_NAME                      LOADED                            CONTENTS
------------------------------ --------------------------------- ---------------
/home/tkyte/files/file4.txt    07-OCT-09 07.37.22.000000 PM      hello world, ho
                                                                 w are you
                                                                 hello world, ho
                                                                 w are you
                                                                 hello world, ho
                                                                 w are you
                                                                 hello world, ho
                                                                 w are you
```

7 Deferred Segment Creation

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Deferred Segment Creation

- Segments (tables, indexes, etc) normally allocate an initial extent
- They might be small, but they exist
- If you do something “small” (or fast) over and over a lot – it gets “big” (or slow)
- Many third party applications create thousands of tables
  - And then use 100 of them
- Deferred segment creation allows us to put off initial extent allocation until the first row is put into a segment.

Deferred Segment Creation

```
SQL> alter session set
  2  deferred_segment_creation=false;
Session altered.

SQL> create table t1
  2  ( x int
  3    constraint t1_pk
  4    primary key,
  5    y int
  6    constraint t1_y
  7    unique,
  8    z clob
  9  )
 10  lob( z )
 11  store as t1_z_lob
 12  (index t1_z_lobidx);
Table created.
```

```
SQL> select segment_name,
  2         extent_id,
  3         bytes
  4    from user_extents
  5   order by segment_name;

SEGMENT_NAM  EXTENT_ID      BYTES
----------- ---------- ----------
T1                   0      65536
T1_PK                0      65536
T1_Y                 0      65536
T1_Z_LOB             0      65536
T1_Z_LOBIDX          0      65536
```

Deferred Segment Creation

```
SQL> alter session set
  2  deferred_segment_creation=true;
Session altered.

SQL> create table t2
  2  ( x int
  3    constraint t2_pk
  4    primary key,
  5    y int
  6    constraint t2_y
  7    unique,
  8    z clob
  9  )
 10  lob( z )
 11  store as t2_z_lob
 12  (index t2_z_lobidx);
Table created.
```

No Change!

```
SQL> select segment_name,
  2         extent_id,
  3         bytes
  4    from user_extents
  5   order by segment_name;

SEGMENT_NAM  EXTENT_ID      BYTES
----------- ---------- ----------
T1                   0      65536
T1_PK                0      65536
T1_Y                 0      65536
T1_Z_LOB             0      65536
T1_Z_LOBIDX          0      65536
```

Deferred Segment Creation

```
SQL> insert into t2 values ( 1, 2, 'hello world' );
1 row created.

SQL> select segment_name,
  2         extent_id,
  3         bytes
  4    from user_extents
  5   order by segment_name;

SEGMENT_NAM  EXTENT_ID      BYTES
----------- ---------- ----------
T1                   0      65536
T1_PK                0      65536
T1_Y                 0      65536
T1_Z_LOB             0      65536
T1_Z_LOBIDX          0      65536
T2                   0      65536
T2_PK                0      65536
T2_Y                 0      65536
T2_Z_LOB             0      65536
T2_Z_LOBIDX          0      65536
10 rows selected.
```

8 Flash Cache

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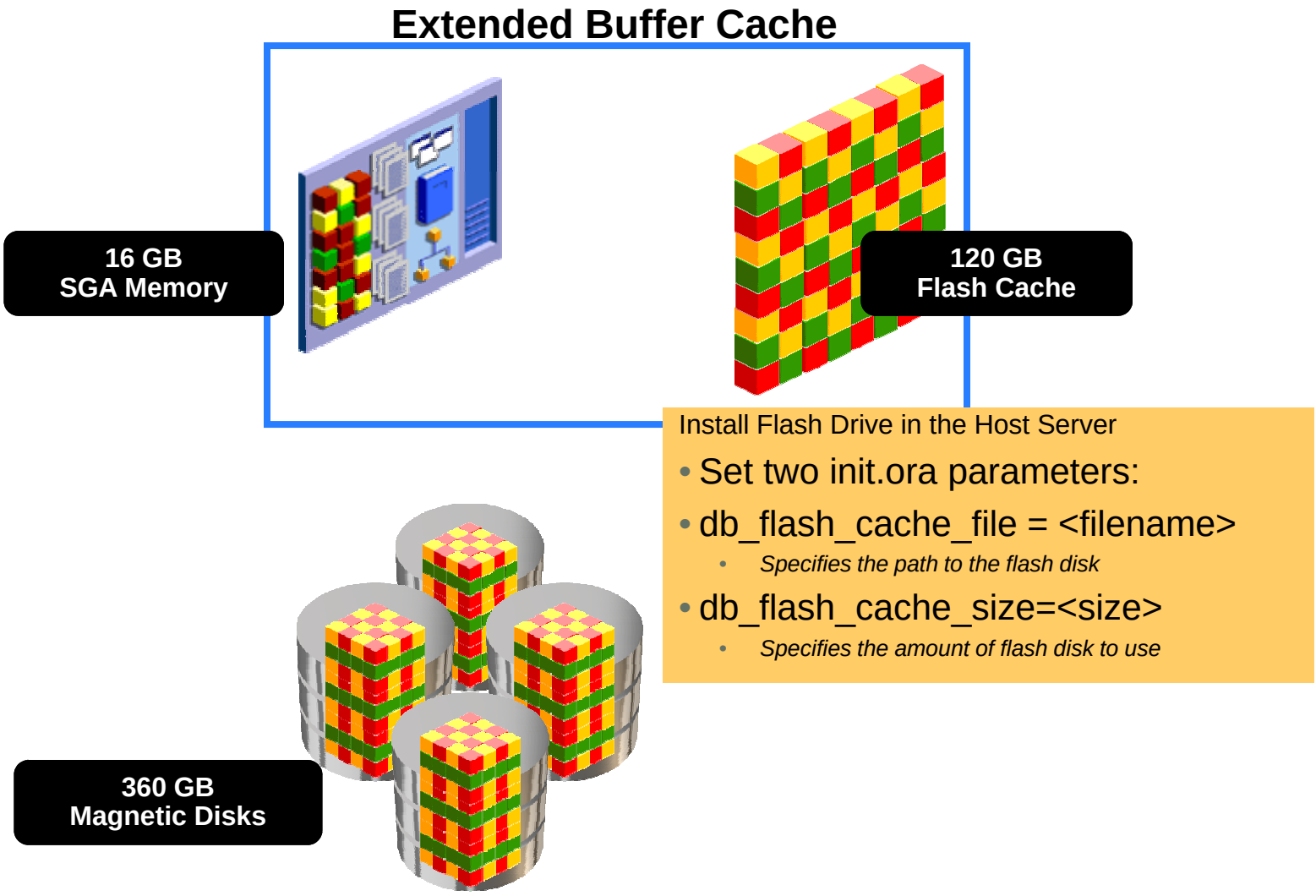
Oracle Database 11g Release 2

Reduce I/O bandwidth requirement with Flash Cache

- A transparent extension of the database buffer cache using solid-state disk (SSD) technology
  - SSD acts as a Level 2 cache (SGA is Level 1)
    - Faster than disk (100x faster for reads)
    - Cheaper than memory ($50 per gigabyte)
    - Large capacity (hundreds of gigabytes per flash disk)
- Fewer drives and better performance
  - For I/O throughput, users often use hundreds of drives today
  - Flash enables I/O throughput without all the drives
  - Large jobs complete faster

Flash Cache

How it works

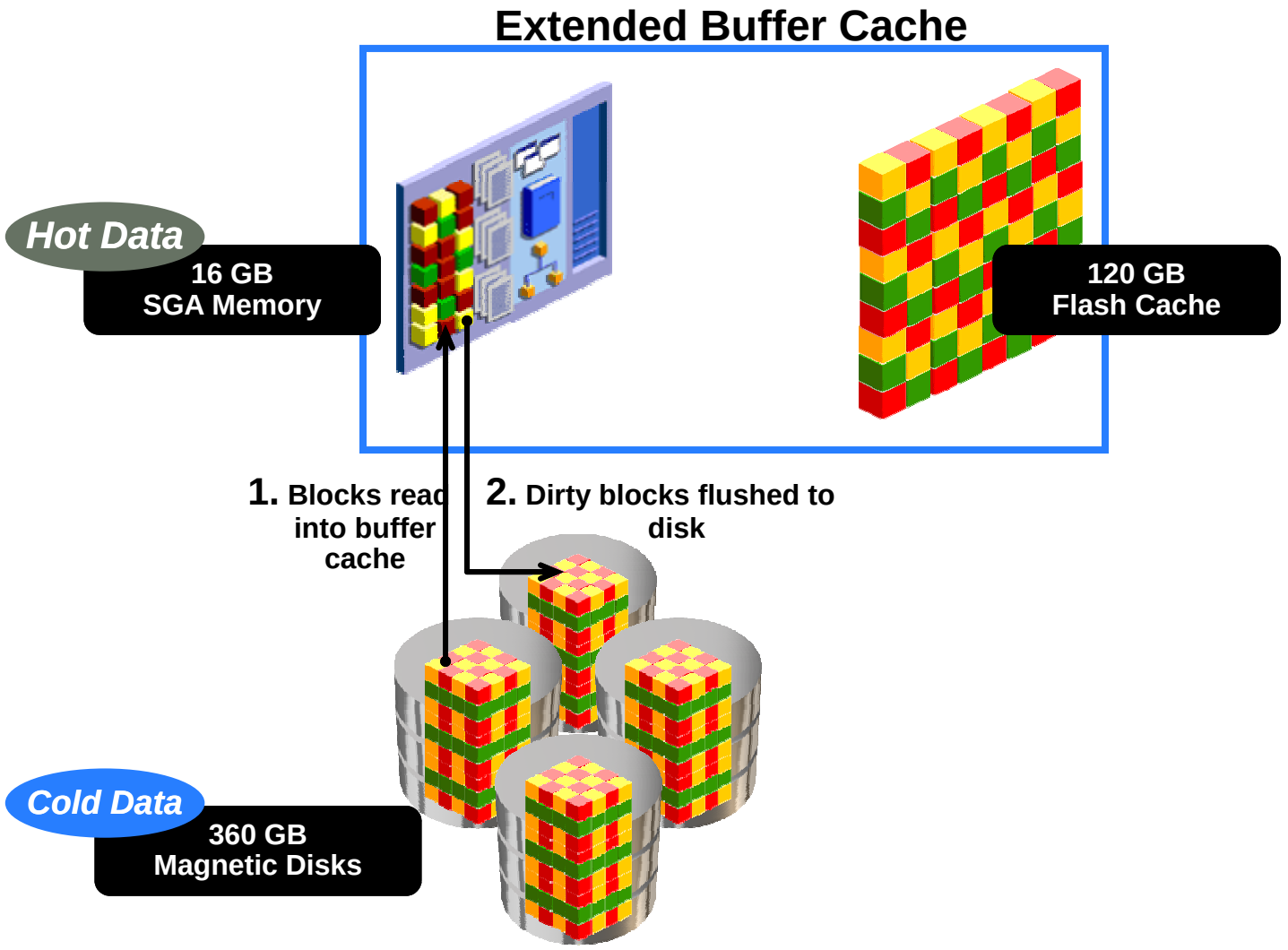


Install Flash Drive in the Host Server

- Set two init.ora parameters:
- db_flash_cache_file = <filename>
  - *Specifies the path to the flash disk*
- db_flash_cache_size=<size>
  - *Specifies the amount of flash disk to use*

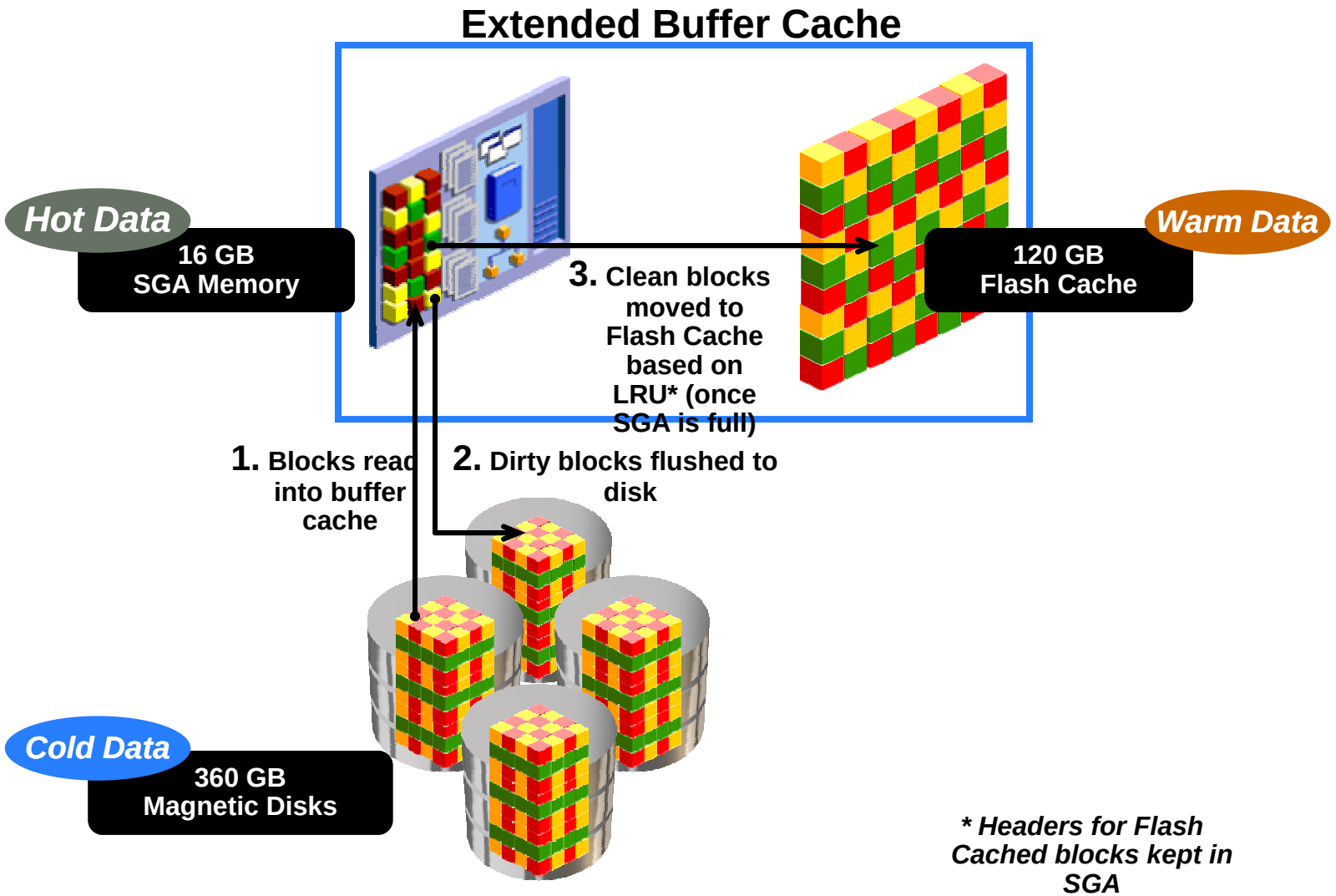
Flash Cache

How it works



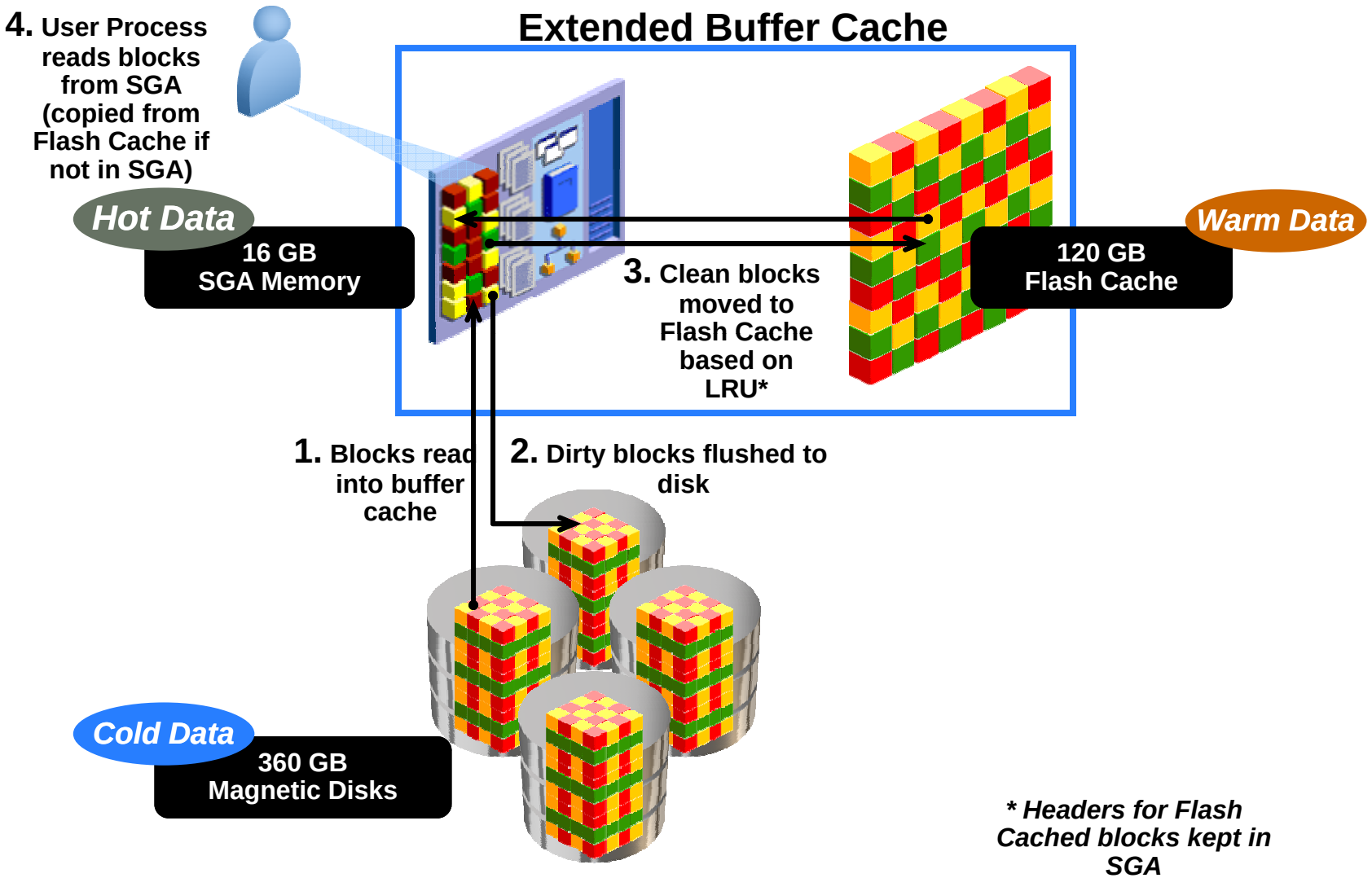
Flash Cache

How it works



** Headers for Flash Cached blocks kept in SGA*

Flash Cache



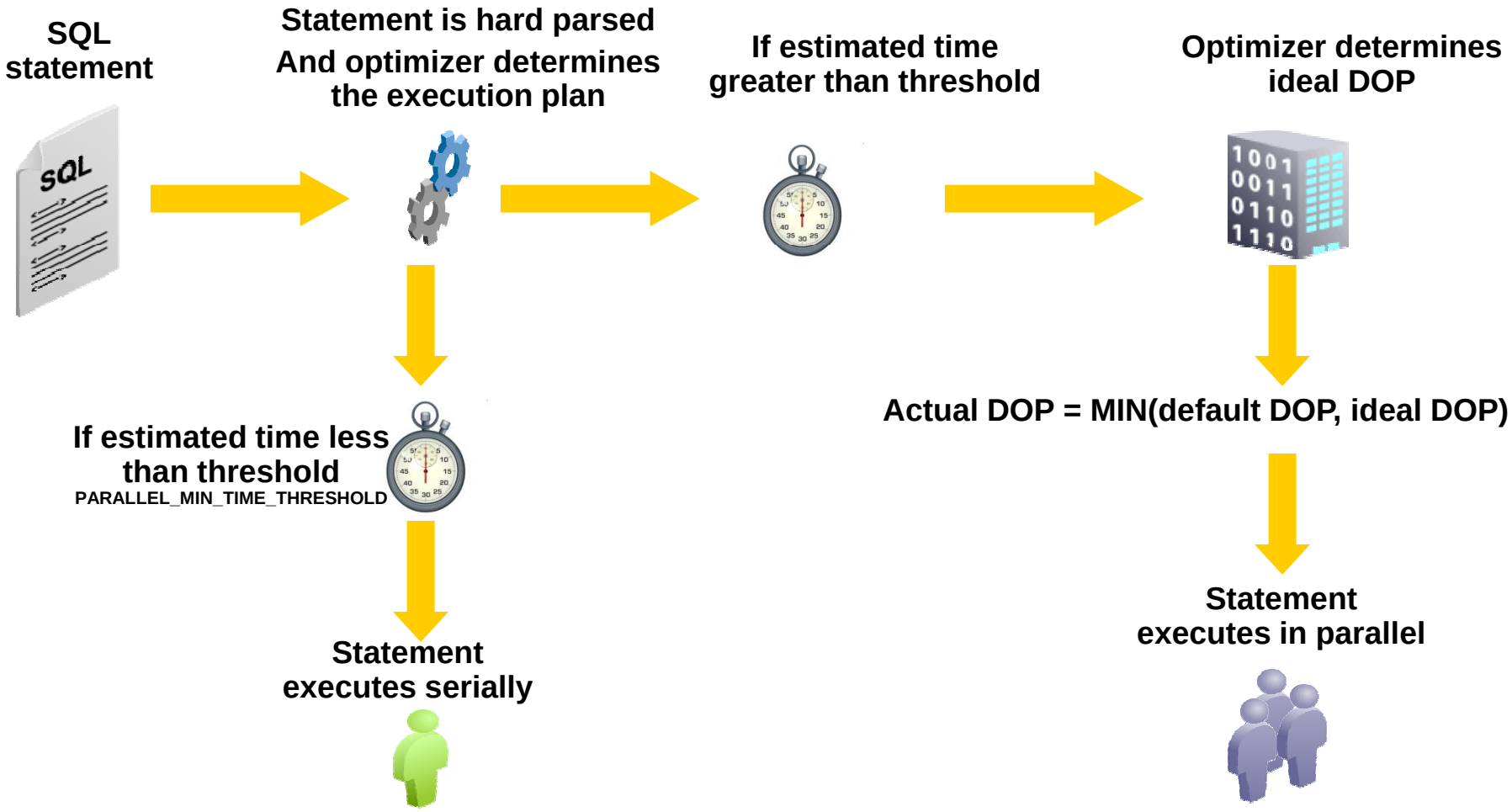
** Headers for Flash Cached blocks kept in SGA*

9 Parallel Improved

ORACLE

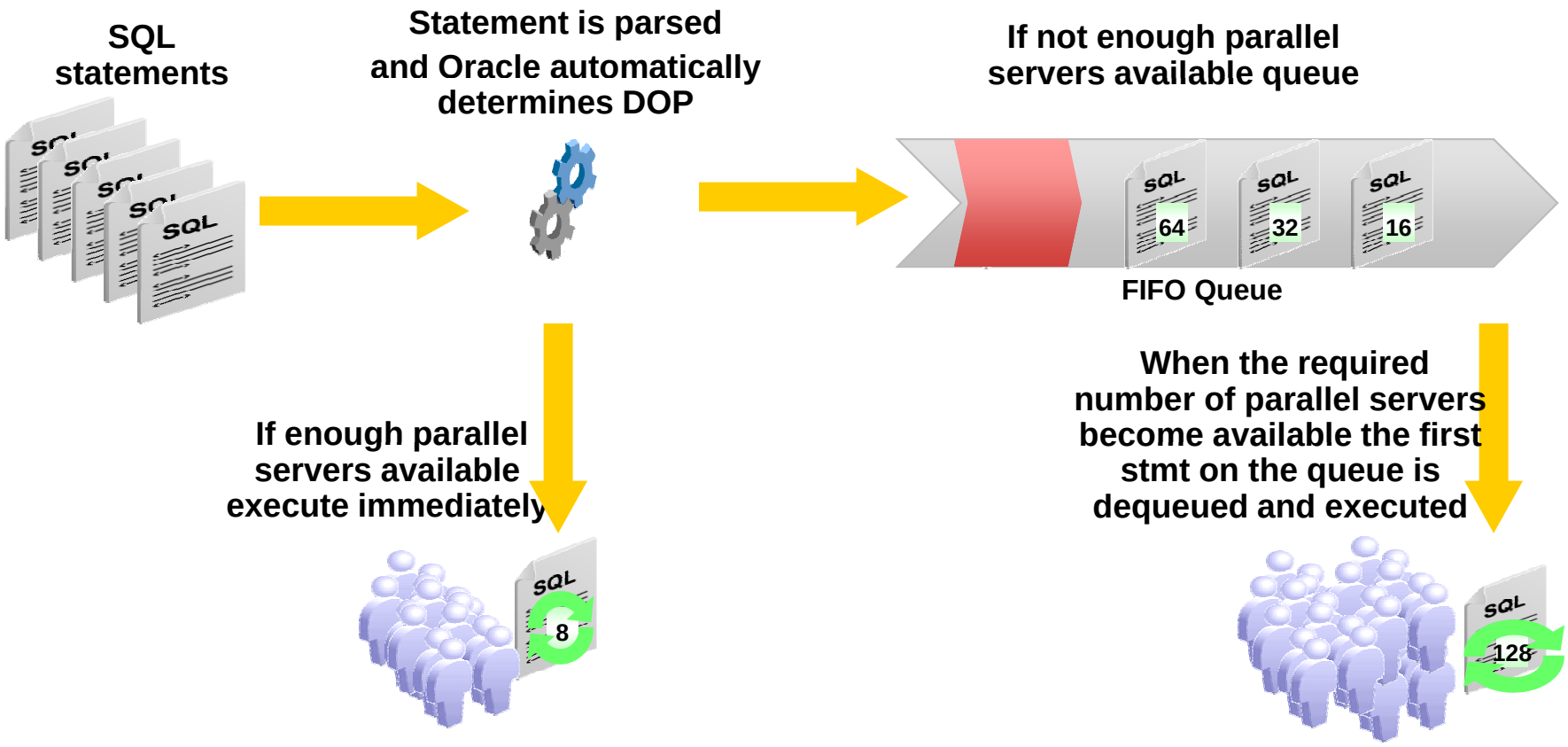
Automated Degree of Parallelism

How it works



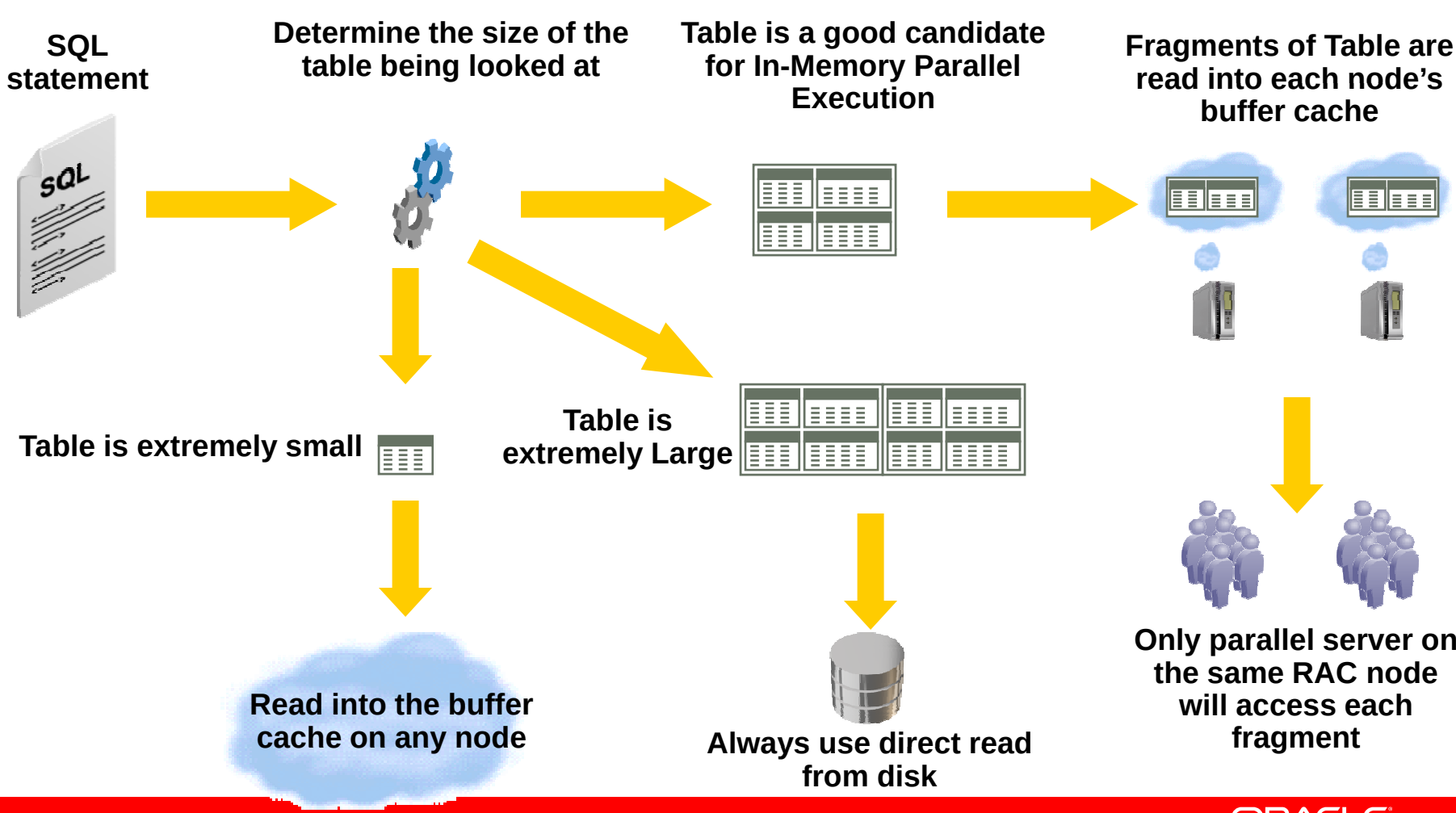
Parallel Statement Queuing

How it works



In-Memory Parallel Execution

How it works



10 Edition-based Redefinition

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Yes, this is here twice

But only because

It is the *killer feature*

Of Oracle Database 11g Release 2

It is worth 2 features

10+Edition-based Redefinition!

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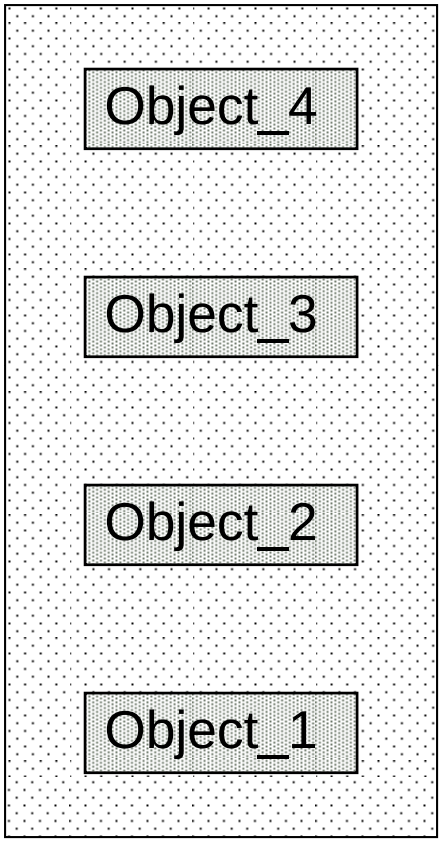
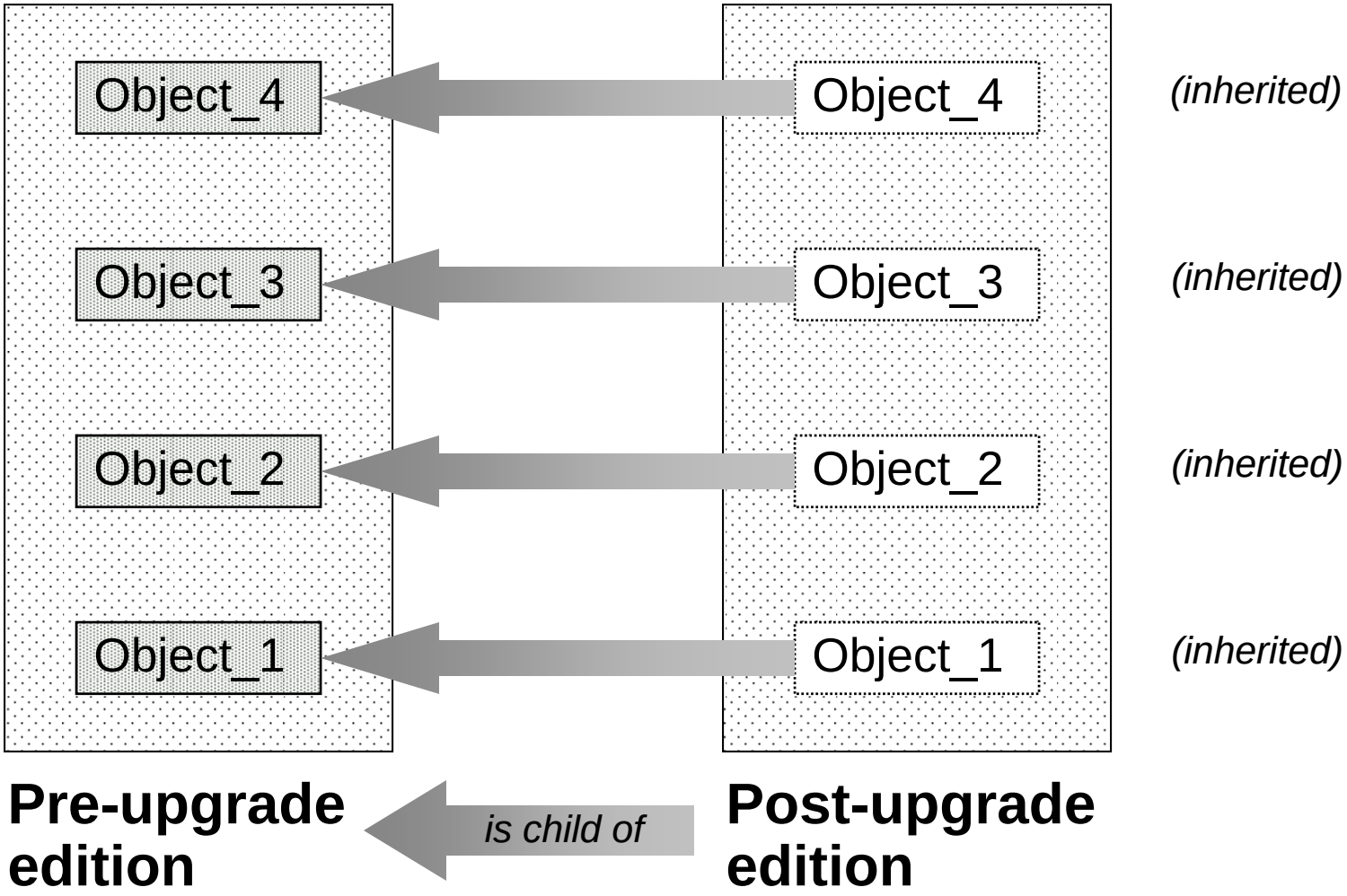
Editions & object visibility

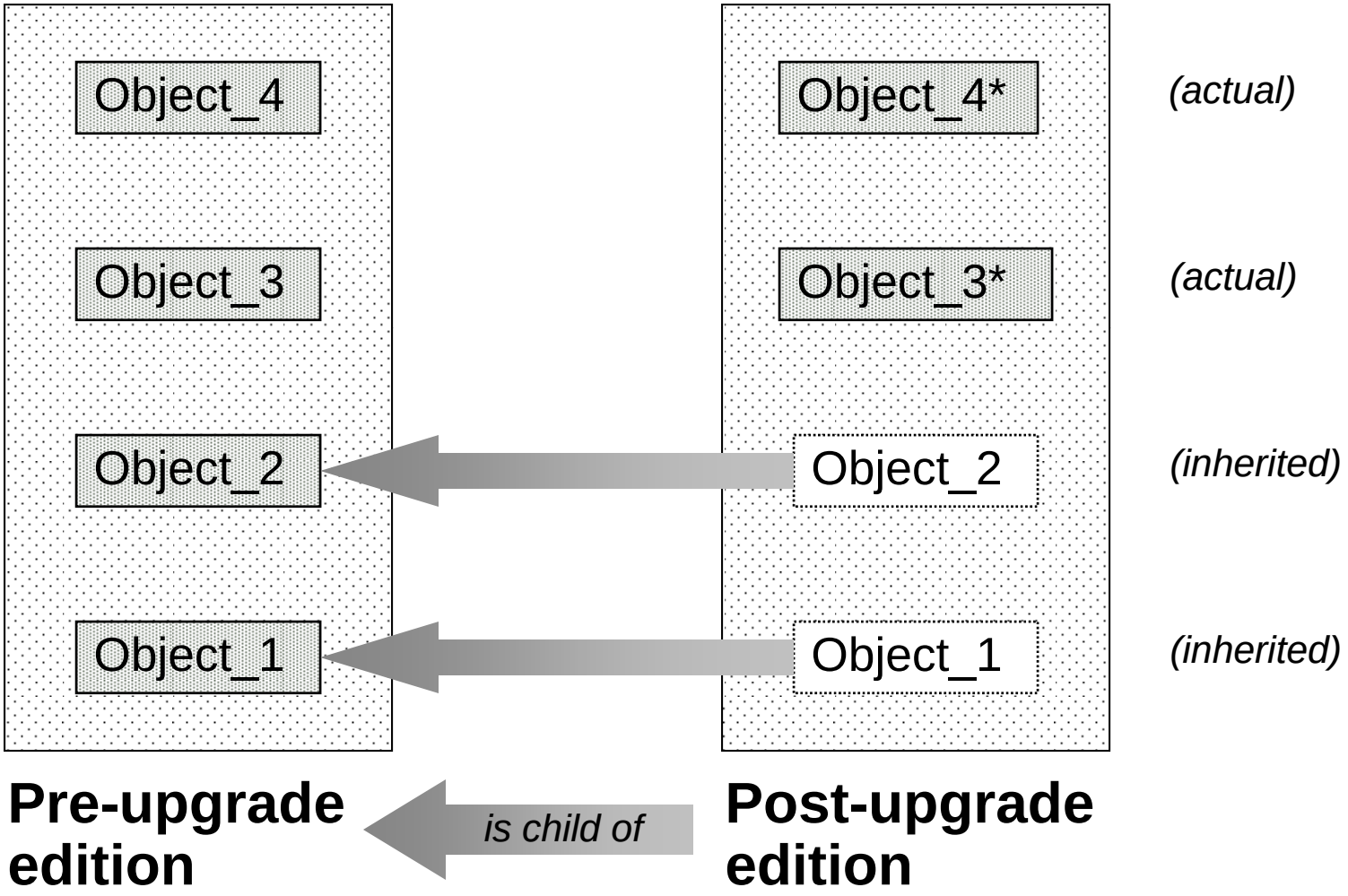


Pre-upgrade edition

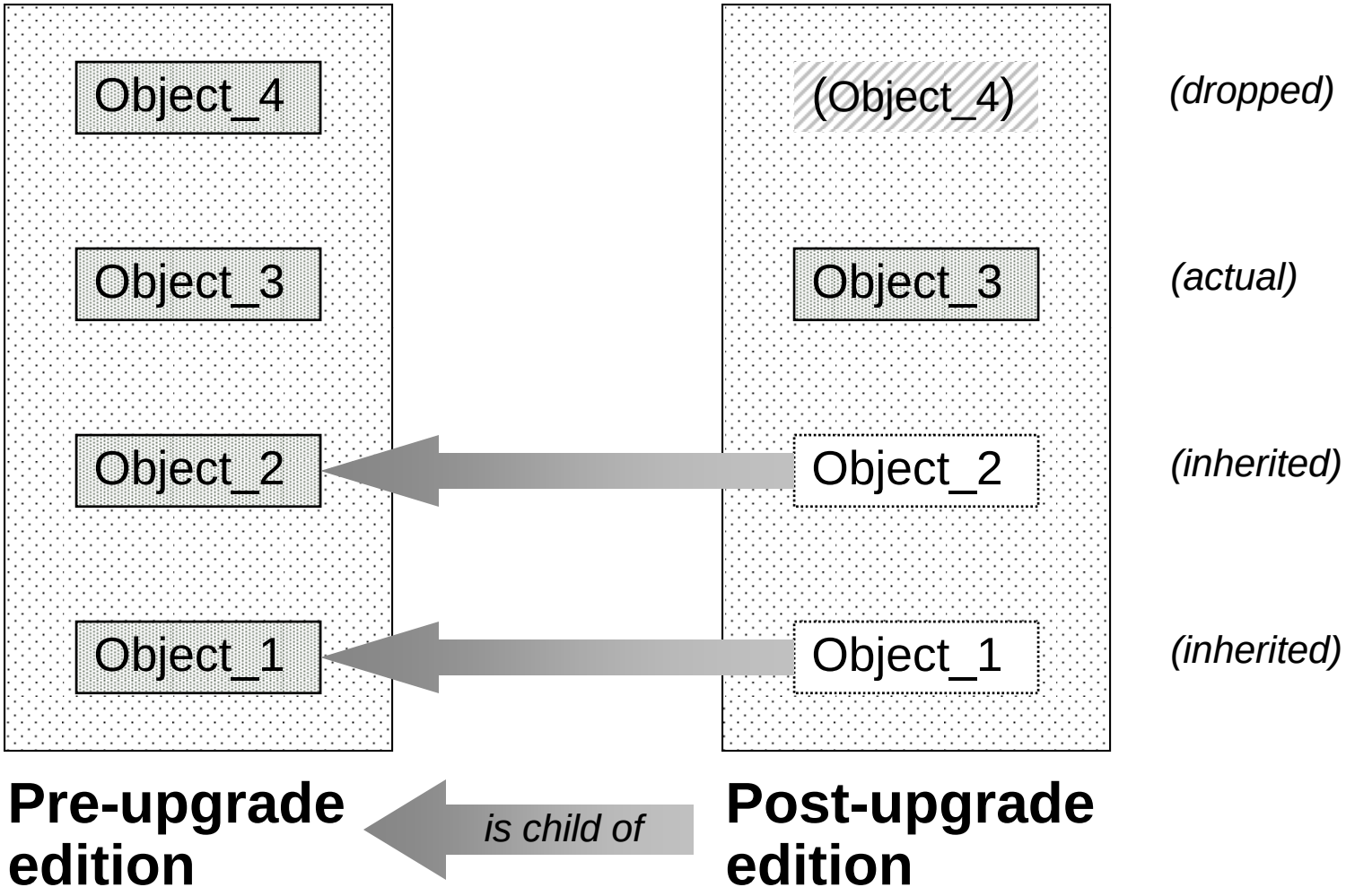
Editions & object visibility

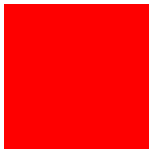


Editions & object visibility



Editions & object visibility





DEMONSTRATION

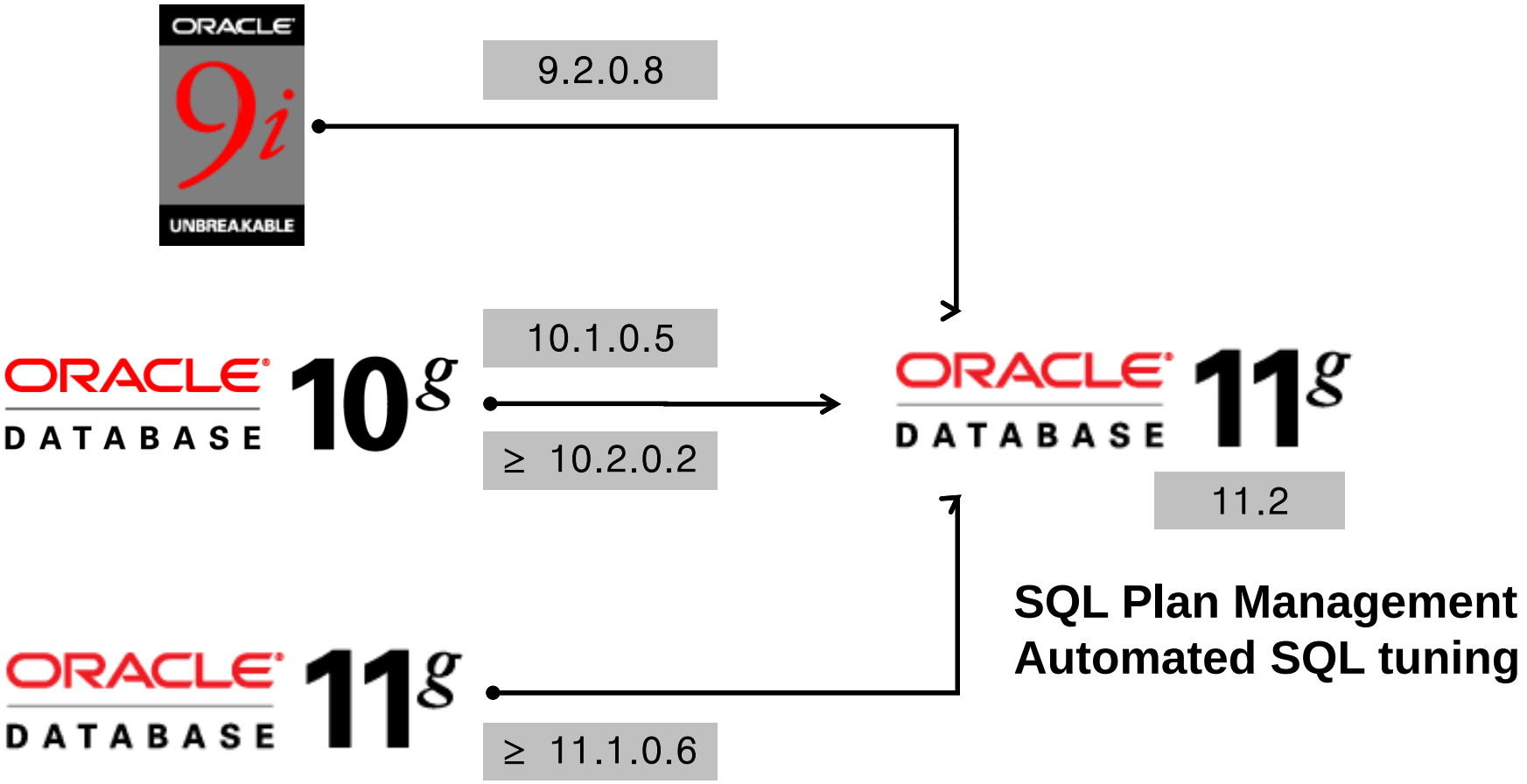
Edition-based Redefinition

ebr.sql

How to get there

What are my upgrade paths?

Predictable performance post-upgrade



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