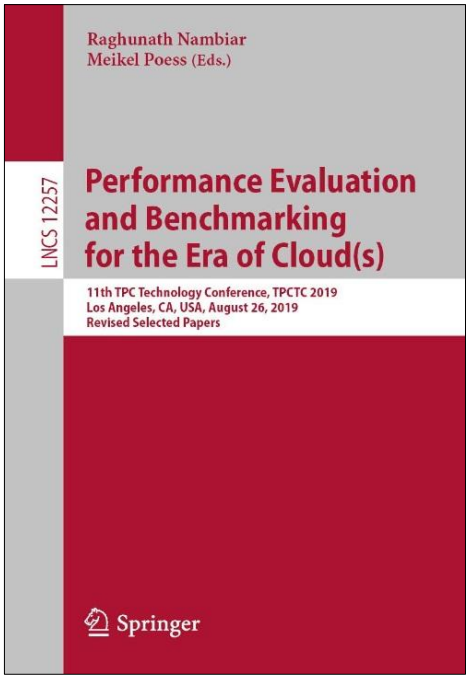
peakmarks

Oracle Configuration and Database Load

February 2025



peakmarks® presented its software at the 11th Technology Conference of the Transaction Processing Performance Council (TPC) 2019 in Los Angeles.

Copyright Information

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Performance is not everything.
But without performance, everything is worth nothing.

Introduction

Of course, every peakmarks customer can configure databases according to his needs

However, we would like to share some of our experiences from years of practice in this presentation

We use peakmarks SQL scripts for database and instance monitoring. They are located in the distribution kit ../pmk/sql directory. This directory should be part of the ORACLE_PATH environment variable

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Oracle Instance Configuration

Instance Configuration

The default instance configuration is not well suited for Oracle platform performance assessments

Adjust the instance for performance assessment

- Check memory-related configuration parameter
- Check process-related configuration parameter
- Switch off functionality like RECYCLEBIN, resource manager, administrative tasks, etc. to avoid side effects
- Use only those Oracle configuration parameters that are essential
- Avoid underscore parameters if possible

Instance Configuration

Following parameters are important

- SGA_MAX_SIZE, SGA_TARGET for driving buffer pool allocation
- CPU_COUNT for driving process configuration like number of processes, job queue processes, parallel server processes and other dependent parameters like sessions, transactions and locks (which use resources in the SGA)

Instance Configuration

peakmarks® provides several init.ora templates for different SGA sizes:

SGA target size in [GByte]	8	16	32	64	128	192
Template available ../pmk/cfg	init_8G.ora	init_16G.ora	init_32G.ora	init_64G.ora	init_128G.ora	init_192G.ora

SGA target size in [GByte]	256	384	512	768G	1'024	2'048
Template available ../pmk/cfg	init_256G.ora	init_384.ora	init_512G.ora	init_768G.ora	init_1024G.ora	Init_2048G.ora

Instance Configuration

Recommendations for memory allocation

- 60% of RAM huge pages
- 50% of RAM capacity for SGA — sga_max_size, sga_target

Recommendations for buffer pool allocation

- 7% of SGA for recycle buffer pool — db_recycle_cache_size
- 5% of SGA for memopt tables — memoptimize_pool_size (optional)
- 2% of SGA for column store — inmemory_size

Changes in Oracle license policy

- since 19.8, the usage of up to 16 Gbyte in-memory column store per CDB is free when setting INMEMORY_FORCE = BASE_LEVEL
- since 19.12, the usage of memory-optimized rowstore is supported on all Oracle platforms

Recommendations for process configuration

- PROCESSES := cpu_count x 24, min 384
- JOB_QUEUE_PROCESSES := cpu_count x 8 min 64
- PARALLEL_MAX_SERVERS := cpu_count x 8, min 128
- DML_LOCKS := cpu_count x 36, min 1024

All other process-related parameters should use default values

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Example init.ora

Example init.ora

Oracle instance configuration files for different systems can be found in the directory ../pmk/cfg

The following slides show an init.ora configuration file for a server system with

- CPU_COUNT = 256
- SGA_MAX_SIZE = 1024G

Example init.ora

Server with CPU_COUNT = 256 and SGA_MAX_SIZE = 1024G

```
# ------------------------------------------------------------------------------------------------
#   Copyright © 2016 - 2025, peakmarks Ltd. All rights reserved.           support@peakmarks.com
# ------------------------------------------------------------------------------------------------
#
#   Config File....:    init_1024G.ora template for Oracle 23ai
#
#   Release........:    01-Jan-2025, MDR
#
#   Description....:    Oracle configuration parameter template file for CDB database
#                       with Oracle SGA size of 1024 GByte
#
#   Notes..........:    . two parameters are important for setting up the instance and determine
#                         many other parameters in this script
#
#                         CPU_COUNT    = 256
#                         SGA_MAX_SIZE = 1024G
#
#                       . use at least 4 GByte SGA per cpu (thread) for optimal results
#                       . use following command to reset a configuration parameter to its default
#                         value
#
#                         SQL>  ALTER SYSTEM RESET <parameter> SCOPE=SPILE SID='*';
#
#                       . to get the maximum number of data files from CREATE DATABASE command,
#                         check with following SQL statement
#
#                         SQL>  SELECT records_total
#                           2     FROM v$controlfile_record_section
#                           3    WHERE type = 'DATAFILE'
#
#                       . the usage of up to three user-created pluggable databases is free
#                       . since 19.8, the usage of up to 16 Gbyte in-memory column store per CDB
#                         is free when setting INMEMORY_FORCE = BASE_LEVEL
#                       . since 19.12, the usage of memory-optimized rowstore is supported on
#                         all Oracle environments
```

Example init.ora

Server with CPU_COUNT = 256 and SGA_MAX_SIZE = 1024G

```
# ---------------------------------------------------------------------------------------------
#   section 1:  basic database parameters
# ---------------------------------------------------------------------------------------------

db_name                         =   ORA23AI          # max 8 characters
db_block_size                   =   8192             # database block size in [Byte]

recyclebin                      =   off

global_names                    =   false

# ---------------------------------------------------------------------------------------------
#   section 2:  process configuration
#
#               Oracle process parameter need resources and may become a performance bottleneck
#               in very large configurations (> 512 threads); therefore, we try to use as low
#               parameters as possible
#
#               the peakmarks recommendations for process configuration are
#
#               . processes                (cpu_count x 24), min  384
#               . job_queue_processes      (cpu_count x  8), min   64
#               . parallel_max_servers     (cpu_count x  8), min  128
#               . dml_locks                (cpu_count x 36), min 1024
# ---------------------------------------------------------------------------------------------

cpu_count                       =   256

processes                       =   6144
job_queue_processes             =   2048
parallel_min_servers            =   0
parallel_max_servers            =   2048
dml_locks                       =   9216
```

Example init.ora

Server with CPU_COUNT = 256 and SGA_MAX_SIZE = 1024G

```
# ------------------------------------------------------------------------------------------
#   section 3:  buffer cache configuration
#
#               the peakmarks recommendations for buffer cache configuration are
#               in percentage of SGA_MAX_SIZE; please note, that Oracle does not shrink or
#               increase memoptimize_pool_size automatically, its fixed. the memory optimized
#               pool is used for fast look-up (workload TP-LOOKUP, table type MTAB). fast ingest
#               (workload DL-STREAM, table type MTMP) uses the large pool. the MTAB and MTMP
#               tables need 200 MByte (DBSIZE < 1 TByte) or 400 MByte (DBSIZE >= 1 TByte).
#
#               . db_recycle_cache_size   min  7.0%
#               . memoptimize_pool_size   min  5.0%, min   1 GByte, max 25 GByte (= 25600M)
#               . inmemory_size           min  2.0%, min 192 MByte
#               . log_buffer              min  1.0%, max 512 MByte
# ------------------------------------------------------------------------------------------

sga_max_size                    =   1024G
sga_target                      =   1024G

db_recycle_cache_size           =   73400M
#memoptimize_pool_size          =   25600M
inmemory_size                   =   20971M
inmemory_optimized_arithmetic   =   enable          # not all cpus support this feature

log_buffer                      =   512M

use_large_pages                 =   only            # not necessarily available
                                                    # on virtual servers

# ------------------------------------------------------------------------------------------
#   section 4:  parallel sql processing
# ------------------------------------------------------------------------------------------

parallel_degree_policy          =   manual          # switch off auto DOP
parallel_force_local            =   true            # use local instance only
parallel_min_percent            =   100
```

Example init.ora

Server with CPU_COUNT = 256 and SGA_MAX_SIZE = 1024G

```
# ------------------------------------------------------------------------------------------
#   section 5:  enable fast-starting checkpointing to eliminate i/o spikes
# ------------------------------------------------------------------------------------------

log_checkpoint_timeout          =   0
fast_start_mttr_target          =   60

# ------------------------------------------------------------------------------------------
#   section 6:  file management
# ------------------------------------------------------------------------------------------

filesystemio_options            =   setall            # direct + async I/O for file systems

db_create_file_dest             =   +DATA
db_create_online_log_dest_1     =   +RECO

# ------------------------------------------------------------------------------------------
#   section 7:  REDO and UNDO
# ------------------------------------------------------------------------------------------

undo_tablespace                 =   undotbs1
undo_retention                  =   0
temp_undo_enabled               =   true

# ------------------------------------------------------------------------------------------
#   section 8:  resource manager
# ------------------------------------------------------------------------------------------

resource_limit                  =   false
resource_manager_plan           =   'FORCE:'

# ------------------------------------------------------------------------------------------
#   end-of-file                                                          www.peakmarks.com
# ------------------------------------------------------------------------------------------
```

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peakmarks® Command pmk.set_instance

peakmarks® Command pmk.set_instance

The manual configuration of Oracle init.ora parameters can be a time-consuming and error-prone task

peakmarks offers a command that optimizes all necessary Oracle instance configuration parameters for a performance assessment based on the peakmarks configuration parameters CPUCOUNT and DBCACHE

The commands to change the configuration are stored in the scripts in the ../pmk/tmp directory

- alter_cdb.sql to change the root CDB configuration parameter
- alter_pdb.sql to change the PDB peakmarks database configuration parameter

Check current peakmarks configuration parameter

```
BENCH@PMK SQL> @show_peakmarks

Thu 09-Jan-2025 20:43:33

peakmarks Configuration Parameters
----------------------------------

Run.........:
Parameter...:

Database....:  PMK               Oracle......:  19.25.0
Instance....:  ORA19C1           Build.......:  250201
RAC nodes...:  2                 Platform....:  twx01dbadm01.lab.tw.

     peakmarks
 Run Parameter       Value                          Remark                                                                    Last change
---- --------------- ------------------------------ ------------------------------------------------------------------------- -----------------
   0 AWRFORMAT       BOTH                           format of Oracle AWR reports: NONE, TEXT, HTML, BOTH                      09-JAN-2025 20:24
     CPUCOUNT        96                             number of logical CPUs: 2 ... 2048 per instance                           09-JAN-2025 20:24
     DBCACHE         382                            size of database buffer cache in [GByte]: 8 ... 32768 per instance        09-JAN-2025 20:24
     DBSIZE          8192                           size of peakmarks database in [GByte]: 64 ... 65536 per instance          09-JAN-2025 20:43
     FLASHCACHE      KEEP                           database or Exadata flash cache usage: NONE, DEFAULT, KEEP                09-JAN-2025 20:43
     LOADER          24                             number of peakmarks loader processes: 4 ... 128 per instance              09-JAN-2025 20:43
     PLATFORM        peakmarks Ref System           platform description, mixed case supported, max. 32 character             09-JAN-2025 20:41
     RUNTIME         3                              runtime target in [min]: 1 ... 720                                        09-JAN-2025 20:24

8 rows selected.

There are some rules for changing the peakmarks configuration parameters
. Increase values in following sequence: DBSIZE, DBCACHE, CPUCOUNT, LOADER and INCREMENT
. Decrease values in following sequence: INCREMENT, LOADER, CPUCOUNT, DBCACHE and DBSIZE

BENCH@PMK SQL>
```

Executing the pmk.set_instance command

```
BENCH@PMK SQL> exec pmk.set_instance

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--------------------------------------------------------------------------------
Release.....................: 10.3
Build.......................: 250201

peakmarks command...........: pmk.set_instance

../tmp/alter_cdb.sql script...: completed.
../tmp/alter_pdb.sql script...: completed.

peakmarks pmk.set_instance....: completed.

PL/SQL procedure successfully completed.

BENCH@PMK SQL>
```

Contents of the scripts

alter_cdb.sql

```
CREATE PFILE = '/acfs01/pmk/tmp/init.ora' FROM SPFILE;
SET ECHO ON;
ALTER SYSTEM SET noncdb_compatible = true SCOPE = spfile SID = '*';
ALTER SYSTEM SET global_names = false SCOPE = spfile SID = '*';
ALTER SYSTEM SET parallel_degree_policy = manual SCOPE = spfile SID = '*';
ALTER SYSTEM SET parallel_force_local = true SCOPE = spfile SID = '*';
ALTER SYSTEM SET parallel_min_percent = 100 SCOPE = spfile SID = '*';
ALTER SYSTEM SET log_checkpoint_timeout = 0 SCOPE = spfile SID = '*';
ALTER SYSTEM SET fast_start_mttr_target = 60 SCOPE = spfile SID = '*';
ALTER SYSTEM SET filesystemio_options = setall SCOPE = spfile SID = '*';
. . .
```

alter_pdb.sql

```
SET ECHO ON;
ALTER SYSTEM SET plsql_code_type = native SCOPE = spfile SID = '*';
ALTER SYSTEM SET global_names = false SCOPE = spfile SID = '*';
ALTER SYSTEM SET parallel_degree_policy = manual SCOPE = spfile SID = '*';
ALTER SYSTEM SET parallel_force_local = true SCOPE = spfile SID = '*';
ALTER SYSTEM SET undo_retention = 0 SCOPE = spfile SID = '*';
ALTER SYSTEM SET recyclebin = off SCOPE = spfile SID = '*';
ALTER SYSTEM SET resource_limit = false SCOPE = spfile SID = '*';
ALTER SYSTEM SET resource_manager_plan = 'force:' SCOPE = spfile SID = '*’;
. . .
```

Applying the script alter_cdb.sql

```
$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Thu Jan 9 20:45:48 2025
Version 19.25.0.0.0

Copyright (c) 1982, 2024, Oracle.  All rights reserved.

Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.25.0.0.0

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----------------------------------------

SYS@ORA19C1 SQL> @alter_cdb
```

Restart all instances to make all changes effective

Applying the script alter_pdb.sql

```
$ sqlplus bench/bench@PMK

SQL*Plus: Release 19.0.0.0.0 - Production on Thu Jan 9 20:47:10 2025
Version 19.25.0.0.0

Copyright (c) 1982, 2024, Oracle.  All rights reserved.

Last Successful login time: Thu Jan 09 2025 20:44:58 +01:00

Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.25.0.0.0

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BENCH@PMK SQL> @alter_pdb
```

Restart all instances to make all changes effective

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peakmarks® Command pmk.load_pdb

peakmarks® Command pmk.load_pdb

The peakmarks command **pmk.load_pdb** starts several processes in parallel (peakmarks configuration parameter LOADER) to generate and load all data of the peakmarks database (pdb)

The database load process is highly scalable and achieves a load rate of more than 8 TByte per hour on high-performance systems

☛ If a crash occurs during a peakmarks **database load**, for whatever reason, you must purge the peakmarks database (SQL> exec pmk.purge_pdb) and reload it

☛ If a crash occurs during a **peakmarks run**, for whatever reason, the peakmarks data model remains consistent and recovers itself without any delay

Executing the pmk.load_pdb command

```
BENCH@PMK SQL> exec pmk.load_pdb

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--------------------------------------------------------------------------------
Release.....................: 10.3
Build.......................: 250201

peakmarks command...........: pmk.load_pdb

Load peakmarks database.....: 24 loader configured.
Load peakmarks database run...: 1 registered.
Load peakmarks database run...: 1 completed in 81.41 min; 0 Oracle errors; 0 peakmarks errors.

Cache sizes and table capacities
--------------------------------

Size of all CTAB tables.....:          6.000 GByte
Size of all DTAB tables.....:      2,327.500 GByte
Size of db buffer cache(s)....:        310.000 GByte
Size of all ITAB.C04 columns..:          1.431 GByte
Size of column store(s).....:          8.000 GByte
Size of all MTAB tables.....:          9.000 GByte
Size of mem opt pool(s).....:         19.500 GByte

PL/SQL procedure successfully completed.

BENCH@PMK SQL>
```

Performance of peakmarks database load - parallelism scales

```
Thu 09-Jan-2025 16:01:30

Load Performance of peakmarks Database
--------------------------------------

Run.........:
DB size.....:

Database....:  PMK               Oracle......:  19.25.0
Instance....:  ORA19C1           Build.......:  250201
RAC nodes...:  1                 Platform....:  twx01dbadm01.lab.tw.
```

Run	Database size [GByte]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	#prc DBWR	#prc LGWR	Completed check points	Phys reads total [MBps]	Phys writes total [MBps]	REDO data [MBps]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Loaded rows peakmarks database	Elapsed time [min]
3	1,024	1	4	6	5	1	94	0	12	9	125	158	1,369	154	93.39	99.98	49.10	1,152,006,000	45
4	1,024	1	6	9	7	1	91	0	12	9	124	229	2,030	219	93.23	100.00	48.14	1,152,006,000	31
5	1,024	1	8	12	10	1	88	0	12	9	120	296	2,501	283	93.18	100.00	48.30	1,152,006,000	24
6	1,024	1	12	17	14	2	83	0	12	9	116	406	3,335	379	92.97	100.00	47.64	1,152,006,000	18
7	1,024	1	16	21	17	2	79	0	12	9	115	475	3,938	445	92.83	100.00	47.30	1,152,006,000	15
8	1,024	1	20	26	21	3	74	0	12	9	112	544	4,540	508	92.85	100.00	46.59	1,152,006,000	14
9	1,024	1	24	29	23	4	71	0	12	9	110	571	4,837	533	92.66	100.00	44.71	1,152,006,000	13
10	1,024	1	28	32	26	4	68	0	12	9	109	598	5,048	558	92.64	100.00	42.59	1,152,006,000	12

```
8 rows selected.

BENCH@PMK SQL>
```

Performance of peakmarks database load

```
Thu 09-Jan-2025 16:01:30

Load Performance of peakmarks Database
--------------------------------------

Run.........:
DB size.....:

Database....:  PMK               Oracle......:  19.25.0
Instance....:  ORA19C1           Build.......:  250201
RAC nodes...:  1                 Platform....:  twx01dbadm01.lab.tw.
```

Run	Database size [GByte]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	#prc DBWR	#prc LGWR	Completed check points	Phys reads total [MBps]	Phys writes total [MBps]	REDO data [MBps]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Loaded rows peakmarks database	Elapsed time [min]
14	2,048	2	8	7	5	1	93	0	24	18	245	524	2,350	262	93.32	100.00	48.05	2,304,012,000	52
15	4,096	2	32	24	19	3	76	0	24	18	270	1,499	7,165	690	90.04	99.99	45.95	2,602,012,000	24
16	8,192	2	48	26	21	3	74	0	24	18	664	1,437	7,494	788	92.79	100.00	47.37	6,758,012,000	53
17	12,288	2	48	27	22	4	73	0	24	18	1,084	1,476	7,792	857	98.43	100.00	48.42	11,226,012,000	79
18	16,384	2	48	28	23	3	72	0	24	18	1,344	1,544	8,051	838	99.02	100.00	47.00	13,502,012,000	98
20	32,768	2	48	29	24	3	71	0	24	18	3,709	1,786	8,106	959	96.08	100.00	49.28	38,862,012,000	242

```
6 rows selected.

BENCH@PMK SQL>
```

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peakmarks® Command pmk.purge_pdb

peakmarks® Command pmk.purge_pdb

The peakmarks command **pmk.purge_pdb** purges data of the peakmarks database (pdb)

Only the tablespaces with the peakmarks data will be deleted

All other information in the peakmarks repository remains

Executing the pmk.purge_pdb command

```
BENCH@PMK SQL> exec pmk.purge_pdb;

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--------------------------------------------------------------------------------
Release.....................: 10.3
Build.......................: 250201

peakmarks command...........: pmk.purge_pdb

peakmarks pmk.purge_pdb.....: completed.

PL/SQL procedure successfully completed.

BENCH@PMK SQL>
```

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Summary of Scripts and Commands

Summary of scripts and commands

Scripts to set up peakmarks® database

SQL> exec pmk.set_instance

SQL> exec pmk.load_pdb

SQL> exec pmk.purge_pdb

Scripts to report the performance of peakmarks® database load

SQL> @kpm_loadpdb

Scripts to report database and instance configuration

SQL> @dbs.sql

SQL> @dbf.sql

SQL> @rlg.sql

SQL> @rlf.sql

SQL> @tbs.sql

SQL> @tbs_capa.sql

peakmarks Mission

Identify Key Performance Metrics for Oracle Database Platforms.

On-Premises and in the Cloud.

For Quality Assurance, Evaluations, and Capacity Planning.