

ORACLE 11G AUTOMATIC MEMORY MANAGEMENT

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INTRODUCTION

Oracle has introduced Automatic Shared Memory Management in Oracle 10g and thus allows automatic tuning of five important component of SGA [Shared Global Area]. Oracle 11g has introduced Automatic Memory Management which will automates SGA as well as PGA size according to your workload by dynamically transferring the memory from SGA to PGA and vice versa.

ORACLE 10G AUTOMATIC SHARED MEMEORY MANAGEMENT OVERVIEW

Starting with Oracle 9i, Oracle has made some SGA components [Shared pool, default Buffer Cache, Large Pool] as Dynamic and allows DBA to alter them without bouncing the database. The maximum size of SGA was restricted by new initialization parameter `SGA_MAX_SIZE`.

In Oracle 10g, the ASMM [Automatic Shared Memory Management] has been introduced to relieve DBAs from sizing the following five main SGA components also called auto-tuned parameter :

- | | | |
|----------------|---|-------------------------------|
| 1. Shared Pool | - | <code>SHARED_POOL_SIZE</code> |
| 2. Large Pool | - | <code>LARGE_POOL_SIZE</code> |
| 3. Java Pool | - | <code>JAVA_POOL_SIZE</code> |
| 4. DB Cache | - | <code>DB_CACHE_SIZE</code> |
| 5. Stream Pool | - | <code>STREAM_POOL_SIZE</code> |

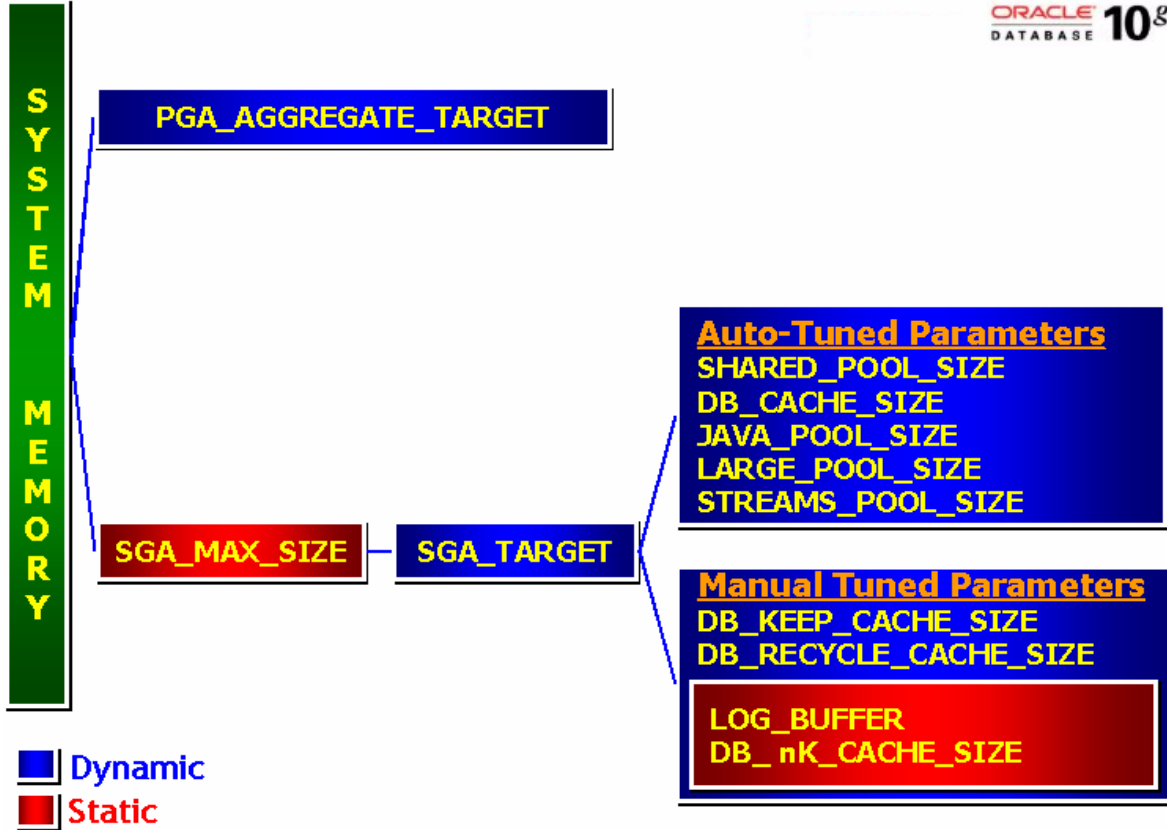
ASMM is driven by new initialization parameter `SGA_TARGET` and is managed by new background process MMAN [Memory Manager]. MMAN will take regular memory snapshots and evaluate and adjust the auto tuned parameters of SGA [as shown above] based on the database usage.

If we are using ASMM and If you set non zero values to any of these auto-tuned parameter, then those values are used as minimum value by ASMM.

There are still lots of SGA components that need to be adjusted manually but take the space is deducted from the total space available for `SGA_TARGET` itself. These parameter are also called as Manual parameters as shown below

- | | | |
|---|---|---------|
| 1. <code>DB_<KEEP RECYCLE>_CACHE_SIZE</code> | - | Dynamic |
| 2. <code>DB_nK_CACHE_SIZE</code> (non default block size) | - | Static |
| 3. <code>LOG_BUFFER</code> → Cannot changed after 10g Rel 2 | - | Fixed |
| 4. Fixed SGA | - | Fixed |

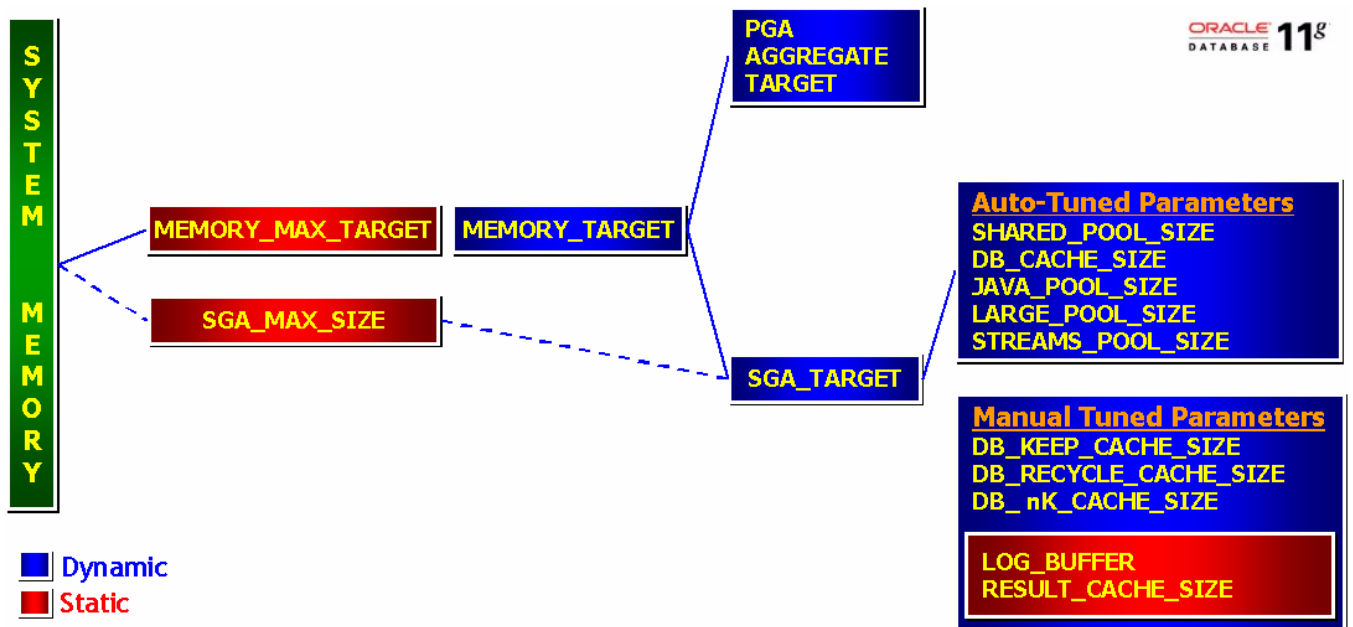
The `SGA_TARGET` will be limited by the `SGA_MAX_SIZE` value. The `SGA_MAX_SIZE` cannot be modified dynamically.



ORACLE 11G AUTOMATIC MEMEORY MANAGEMENT

In order to implement Automatic Memory management, you need to set a new initialization parameter (MEMORY_TARGET). This parameter all Oracle to automatically tune your instance memor by redistributing memory between SGA (System Global Area) and PGA (Program Global Area). MEMORY_TARGET parameter is dynamic and can be increased to maximum memory size specified by new initialization parameter, MEMORY_MAX_TARGET.

Even Oracle can manage your memory based on your non-zero value of MEMORY_TARGET, but still you can set some lower bound values for various caches below which database will not auto-tune that memory component.



MEMORY_TARGET W.R.T SGA_TARGET AND PGA_AGGREGATE_TARGET

Here we will check the various scenarios when MEMORY_TARGET is set to zero or non-zero values

1. When MEMORY_TARGET > 0
2. When MEMORY_TARGET = 0 [Default] or not set

SCENARIO 1 : WHEN MEMORY_TARGET > 0

1. If you also set SGA_TARGET as well as PGA_AGGREGATE_TARGET, then
 - These values are considered as minimum values.
 - $MEMORY_TARGET > (MEMORY_TARGET + SGA_TARGET)$ else you will get an error **ORA-00838: Specified value of MEMORY_TARGET is too small, needs to be at least xxxM**
 - If MEMORY_MAX_TARGET is also set, then MEMORY_TARGET can take the sum of values of SGA_TARGET and PGA_AGGREGATE_TARGET to MEMORY_MAX_TARGET.
 - If MEMORY_MAX_TARGET is not set then it will default to MEMORY_TARGET
2. If only SGA_TARGET is set but not the PGA_AGGREGATE_TARGET then
 - PGA_AGGREGATE_TARGET will be initialized to $(MEMORY_TARGET - SGA_TARGET)$.
 - Database instance continue to auto-tunes both SGA_TARGET and PGA_AGGREGATE_TARGET.
3. If only PGA_AGGREGATE_TARGET is set but not the SGA_TARGET then
 - SGA_TARGET will be initialized to $\min(MEMORY_TARGET - PGA_AGGREGATE_TARGET, SGA_MAX_SIZE [if set])$.
 - Database instance continue to auto-tunes both SGA_TARGET and PGA_AGGREGATE_TARGET.
4. If both SGA_TARGET as well as PGA_AGGREGATE_TARGET are not set then
 - SGA_TARGET will be initialized to $\text{Min} [(60 * MEMORY_TARGET) / 100, SGA_MAX_SIZE (if set)]$
 - PGA_AGGREGATE_TARGET will be initialized to $\text{Max} [(40 * MEMORY_TARGET) / 100, MEMORY_TARGET - SGA_MAX_SIZE (if Set)]$
5. If MEMORY_MAX_TARGET is not set, then it will default to MEMORY_TARGET

SCENARIO 2 : WHEN MEMORY_TARGET IS NOT SET OR SET TO 0 [ZERO-DEFAULT VALUE]

1. If only SGA_TARGET is set but not the PGA_AGGREGATE_TARGET then
 - SGA components (Shared pool, Buffer Cache, Java pool, Large Pool, Stream Pool) are auto tuned but SGA_TARGET itself is not increased or decreased automatically
 - PGA_AGGREGATE_TARGET is auto-tuned independent if whether it is explicitly set or not. Its initial value depends on the size of SGA_TARGET setting
2. If SGA_TARGET is not set then
 - SGA components (Shared pool, Buffer Cache, Java pool, Large Pool, Stream Pool) are not auto tuned their values are set explicitly as in Oracle 10g.
3. If SGA_MAX_SIZE is not set then it will default to MEMORY_MAX_TARGET
4. If MEMORY_MAX_TARGET is set then you can dynamically change the MEMORY_TARGET to a non-zero value, provided it does not exceed the value of MEMORY_MAX_TARGET
5. If MEMORY_MAX_TARGET is not set, then you can not use Oracle 11g Automatic memory management.

MONITORING AND TUNING AUTOMATIC MEMORY MANAGEMENT

We can Monitor and Tune Oracle 11g AMM using

1. Oracle Enterprise Manager
2. Oracle Views with SQLPlus

MONITOR AND TUNE AMM USING EM DATABASE CONSOLE

Step 1 : Logon to Oracle 11g Enterprise Manager Database Console

Specify the Username and password and click **LOGIN** to Continue

ORACLE Enterprise Manager 11g Database Control

Login

Login to Database:orcl

* User Name

* Password

Connect As ▼

Login

Login

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Step 2 : Click on [Server](#) on the Home Page Tab as shown below in RED outline

Logged in As SYS

Database Instance: orcl

- [Home](#)
- [Performance](#)
- [Availability](#)
- [Server](#)**
- [Schema](#)
- [Data Movement](#)
- [Software and Support](#)

Latest Data Collected From Target **Jul 30, 2007 4:51:36 I**

General



[Shutdown](#) [Black Out](#)

Status [Up](#)
 Up Since **Jul 30, 2007 4:08:56 PM GMT**
 Instance Name **orcl**
 Version **11.1.0.3.1**
 Host [gcr1](#)
 Listener [LISTENER_gcr1](#)

[View All Properties](#)

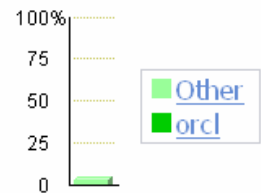
Health Meter



3 [Incidents](#)
6 [Alerts](#)

[Health History](#)

Host CPU



Load [1627389952.00](#)

Step 3 : Select [Memory Parameters](#) under Database Configuration. On the [Memory Parameters](#) page, you can [enable](#) or [disable](#) the Oracle 11g Automatic Memory Management as shown below in RED outline. You can also click on [ADVICE](#) button to get the advice

ORACLE Enterprise Manager 11g Database Control

Database Instance: orcl

Home Performance Availability **Server** Schema Data Movement Software and Support

Storage Database Configuration Oracle Scheduler

- Control Files
- Tablespaces
- Temporary Tablespace Groups
- Datafiles
- Rollback Segments
- Redo Log Groups
- Archive Logs

- Memory Parameters**
- Undo Management
- All Initialization Parameters
- Database Feature Usage

- Jobs
- Chains
- Schedules
- Programs
- Job Classes
- Windows
- Window Groups
- Global Attributes
- Automated Maintenance Tasks

ORACLE Enterprise Manager 11g Database Control

Database Instance: orcl >

Memory Parameters

Automatic Memory Management **Enabled** (Disable) Page Refreshed July 30, 2007 5:00:16 PM GMT (Refresh)

Total Memory Size (MB) 2048 (Advice) (Show SQL) (Revert) (Apply)

Allocation History

This chart shows the history of the components of the Memory.

Time	SGA (MB)	PGA (MB)
4:38	2000	200
4:40	2000	200
4:45	2000	200
4:50	2000	200
4:55	2000	200
5:00	2000	200

Step 4 : On the Memory Parameters Page, you can see the SGA details as shown below in RED

Database Instance: orcl >

Memory Parameters

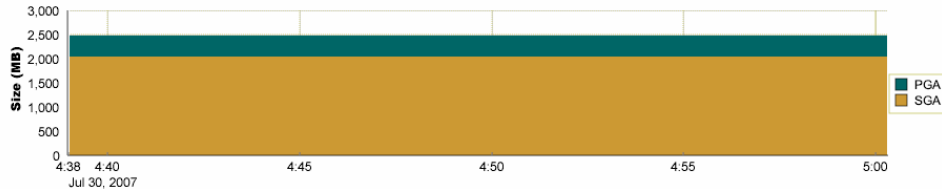
Automatic Memory Management **Enabled**

Page Refreshed July 30, 2007 5:00:16 PM GMT

Total Memory Size (MB)

Allocation History

This chart shows the history of the components of the Memory.



Maximum Memory Size

The Maximum Memory Size specifies the maximum memory that the database may allocate. If you specify the Maximum Memory Size, you can later dynamically change the Total Memory Size above (provided Total Memory Size does not exceed the Maximum Memory Size).

Maximum Memory Size* (MB)

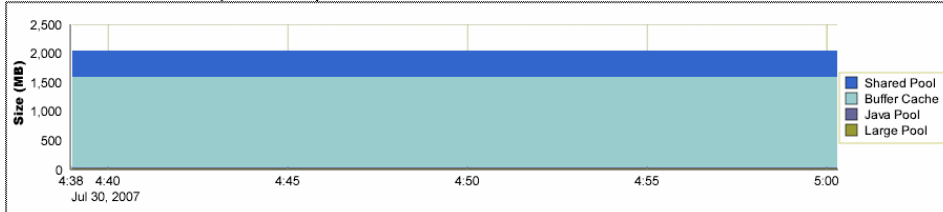
The database must be restarted before any changes to this value take effect.

SGA [PGA](#)

The System Global Area (SGA) is a group of shared memory structures that contains data and control information for one Oracle database. The SGA is allocated in memory when an Oracle database instance is started.

Allocation History

This chart shows the history of the components of the SGA.

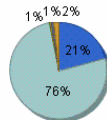


Current Allocation

Automatic Shared Memory Management **Enabled**

Total SGA Size (MB) **2048**

SGA Component	Current Allocation (MB)
Shared Pool	432
Buffer Cache	1552
Large Pool	16
Java Pool	16
Other	32



Shared Pool	(21.1%)
Buffer Cache	(75.8%)
Large Pool	(0.8%)
Java Pool	(0.8%)
Other	(1.6%)

Step 5 : On the Memory Parameters Page, you can see the PGA details as shown below in RED. To get more details about the PGA usage, click on PGC Memory Usage Details as shown in Red and you can get complete graphical representation of the usage.

ORACLE Enterprise Manager 11g Database Control

Database Instance: orcl >

Memory Parameters

Automatic Memory Management **Enabled** Page Refreshed July 30, 2007 5:00:16 PM GMT

Total Memory Size (MB)

Allocation History

This chart shows the history of the components of the Memory.

Maximum Memory Size

The Maximum Memory Size specifies the maximum memory that the database may allocate. If you specify the Maximum Memory Size, you can later dynamically change the Total Memory Size above (provided Total Memory Size does not exceed the Maximum Memory Size).

Maximum Memory Size* (MB)

The database must be restarted before any changes to this value take effect.

[SGA](#) **PGA**

The Program Global Area (PGA) is a memory buffer that contains data and control information for a server process. A PGA is created by Oracle when a server process is started.

Aggregate PGA Target (B)

Current PGA Allocated (KB) **126745**

Maximum PGA Allocated (KB) **162329** (since startup)

Cache Hit Percentage (%) **100**

Oracle Enterprise Manager (SYS) - PGA Memory Usage Details - Windows Int...

PGA Memory Usage Details

Legend: Optimal executions One pass executions Multipass executions

Chart should show: Execution percentages Number of Execution

Show memory usage details for PGA target: MB

MONITOR AND TUNE AMM USING ORACLE V\$VIEWS

The dynamic performance view **V\$MEMORY_DYNAMIC_COMPONENTS** shows the current sizes of all dynamically tuned memory components, including the total sizes of the SGA and instance PGA

```
SQL> select component, current_size, min_size, max_size
       from V$MEMORY_DYNAMIC_COMPONENTS;
```

COMPONENT	CURRENT_SIZE	MIN_SIZE	MAX_SIZE
shared pool	452984832	452984832	452984832
large pool	16777216	0	16777216
java pool	16777216	16777216	16777216
streams pool	0	0	0
SGA Target	2147483648	2147483648	2147483648
DEFAULT buffer cache	1627389952	1627389952	1627389952
KEEP buffer cache	0	0	0
RECYCLE buffer cache	0	0	0
DEFAULT 2K buffer cache	0	0	0
DEFAULT 4K buffer cache	0	0	0
DEFAULT 8K buffer cache	0	0	0
DEFAULT 16K buffer cache	0	0	0
DEFAULT 32K buffer cache	0	0	0
Shared IO Pool	67108864	67108864	67108864
PGA Target	436207616	436207616	436207616
ASM Buffer Cache	0	0	0

16 rows selected.

The view **V\$MEMORY_RESIZE_OPS** has the circular history of last 800 SGA resize requests

```
SQL> select component, parameter, initial_size, target_size, final_size,
        status, start_time, end_time
from V$MEMORY_RESIZE_OPS;
```

COMPONENT	PARAMETER	INITIAL_SIZE	TARGET_SIZE	FINAL_SIZE	STATUS	START_TIM	END_TIME
SGA Target	sga_target	0	2147483648	2147483648	COMPLETE	30-JUL-07	30-JUL-07
DEFAULT 4K buffer cache	db_4k_cache_size	0	0	0	COMPLETE	30-JUL-07	30-JUL-07
java pool	java_pool_size	0	16777216	16777216	COMPLETE	30-JUL-07	30-JUL-07
ASM Buffer Cache	db_cache_size	0	0	0	COMPLETE	30-JUL-07	30-JUL-07
DEFAULT 2K buffer cache	db_2k_cache_size	0	0	0	COMPLETE	30-JUL-07	30-JUL-07
DEFAULT buffer cache	db_cache_size	1644167168	1627389952	1627389952	COMPLETE	30-JUL-07	30-JUL-07
DEFAULT buffer cache	db_cache_size	0	1627389952	1627389952	COMPLETE	30-JUL-07	30-JUL-07
DEFAULT buffer cache	db_cache_size	1644167168	1627389952	1627389952	COMPLETE	30-JUL-07	30-JUL-07
DEFAULT 8K buffer cache	db_8k_cache_size	0	0	0	COMPLETE	30-JUL-07	30-JUL-07
shared pool	shared_pool_size	0	452984832	452984832	COMPLETE	30-JUL-07	30-JUL-07
streams pool	streams_pool_size	0	0	0	COMPLETE	30-JUL-07	30-JUL-07
large pool	large_pool_size	0	16777216	16777216	COMPLETE	30-JUL-07	30-JUL-07
large pool	large_pool_size	0	16777216	16777216	COMPLETE	30-JUL-07	30-JUL-07
DEFAULT 16K buffer cache	db_16k_cache_size	0	0	0	COMPLETE	30-JUL-07	30-JUL-07
PGA Target	pga_aggregate_target	0	0	0	COMPLETE	30-JUL-07	30-JUL-07
DEFAULT 32K buffer cache	db_32k_cache_size	0	0	0	COMPLETE	30-JUL-07	30-JUL-07
KEEP buffer cache	db_keep_cache_size	0	0	0	COMPLETE	30-JUL-07	30-JUL-07
RECYCLE buffer cache	db_recycle_cache_size	0	0	0	COMPLETE	30-JUL-07	30-JUL-07

The view **V\$MEMORY_TARGET_ADVICE** provides tuning advice for the MEMORY_TARGET initialization parameter.