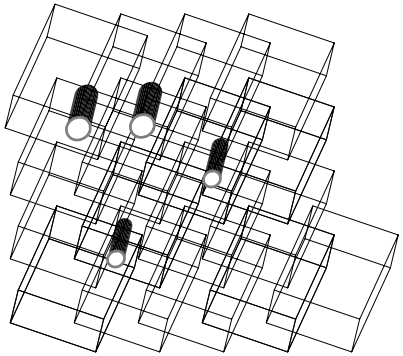

ADN

A Robust Blueprint to Performance Optimization in Multiblock Databases

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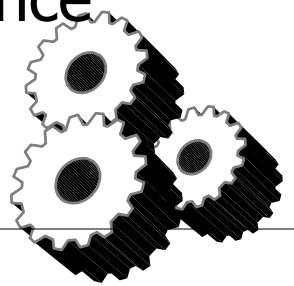
Objective

- Discuss, and present a research overview on multiblock databases.
- Emphasize an optimal performance tuning strategy for multiblock concepts and database cache utilization.
- Find the best approach to deal with any related business or technical constraints, when creating, migrating to, or transporting an Oracle multiblock database.
- Optimize utilization in data warehousing environments.

Creation Method and Strategy

- Set up the appropriate initialization parameters.
- Take advantage from using DBCA instead of manual creation, seeking custom design.
- Establish good practices when using RAID, OCFS partitioning or other special block formatting and sizing.
- If using RAC architecture, envision the effect of mapping your database files to each instance database cache.

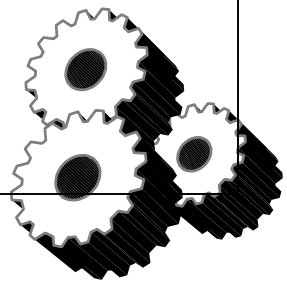


Shared vs. Dedicated Architecture

- Note that the selection of the shared or dedicated architecture database options has an enormous impact in many of the configuration parameters and connections taking place.
- When creating the database, simplify the initial networking settings.
- For instance, if utilizing the MULTIPLEXING option in the shared architecture, note that it requires Connection Manager.
- MULTIPLEXING is a qualifying argument for the DISPATCHERS parameter, and it requires integrated tuning with others qualifiers such as POOL and TICKS.

Watching for Conflicting Parameters

- Make sure that your UNDO_MANAGEMENT options are properly established.
- Do not attempt to expand on shared server options connectivity at creation time.
- Specifying certain parameters could make your database creation a conflicting one.

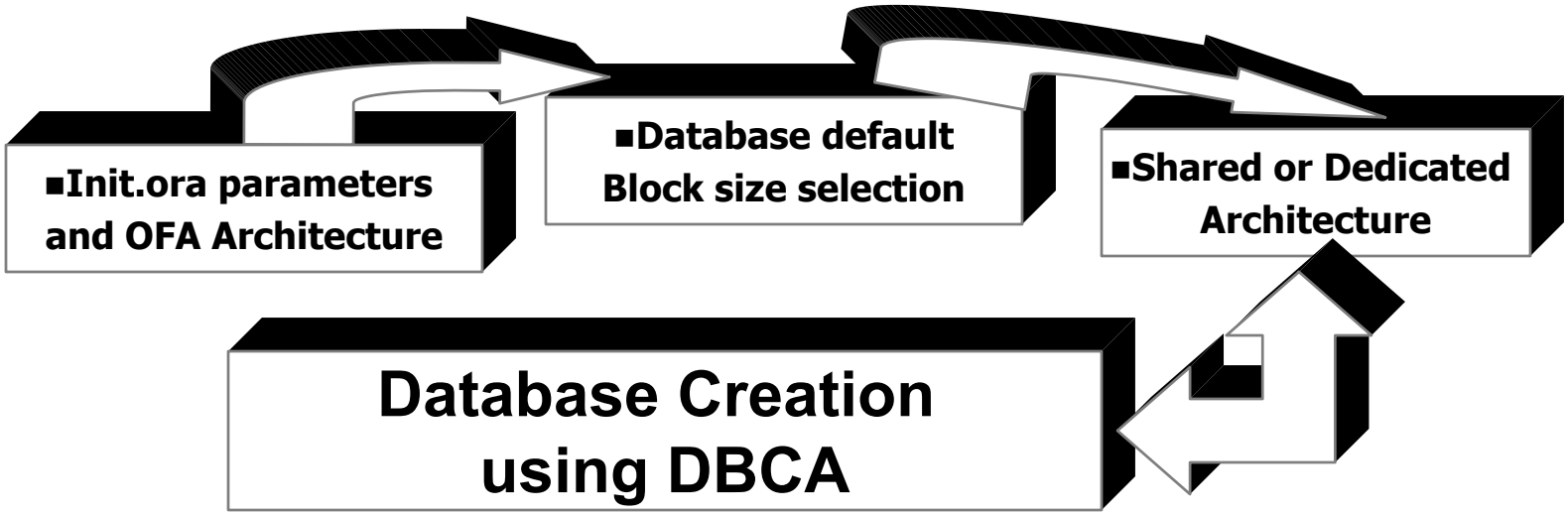


Block Size Selection

- A multiblock database can have a database default block; and
- The following db_nk_cache_size parameter matching blocks, namely:
  - A 2k block, matching the db_2k_block_cache_size
  - A 4k block, matching the db_4k_block_cache_size
  - An 8k block, matching the db_8k_block_cache_size
  - A 16k block, matching the db_16k_block_cache_size
  - A 32k block size, matching the db_32k_block_cache_size, not available in operating systems like Windows or Linux, and reserved to high-end operating systems Solaris, HP-UX, and AiX, among others.
  - Take all considerations if your OS block is very large.

Summary of Database Creation Criteria

- Choose your database database block size carefully
- Decide on a shared or dedicated server architecture
- Select the appropriate initialization parameters and OFA architecture using Oracle DBCA



The Database Creation Script

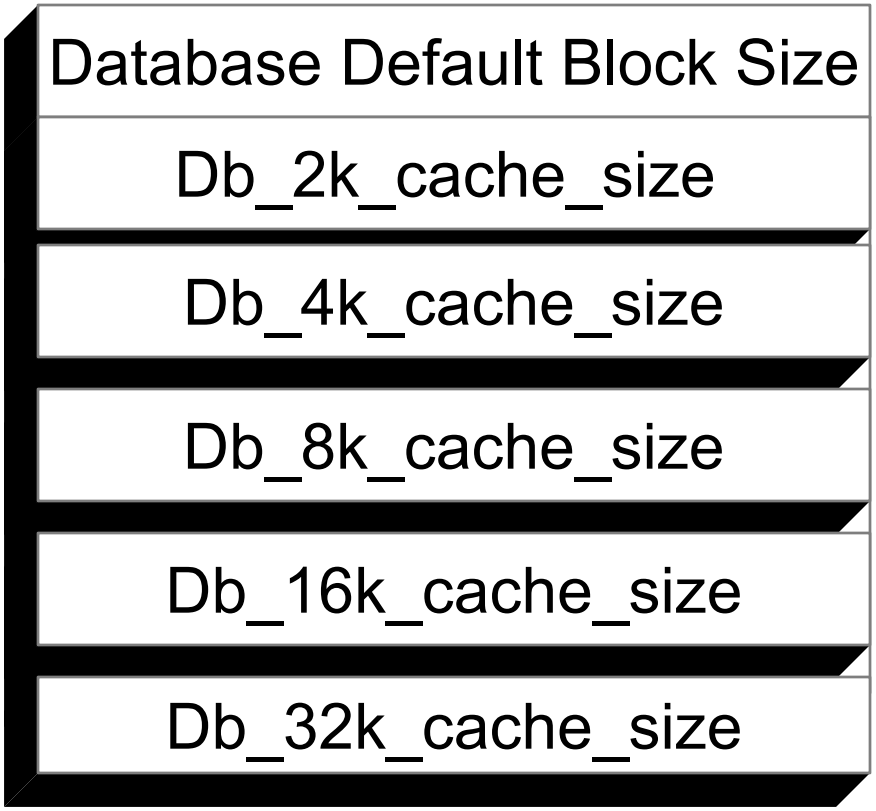
```
CREATE DATABASE adnp1
  CONTROLFILE REUSE
  LOGFILE
    GROUP 1 ('/export/home/oracle/oralogs/adnp1/logs/adnp1_redo01a.log',
       '/export/home/oracle/oradata/adnp1/logs/adnp1_redo01b.log') SIZE 500M,
    GROUP 2 ('/export/home/oracle/oralogs/adnp1/logs/adnp1_redo01a.log',
         '/export/home/oracle/oradata/adnp1/logs/adnp1_redo02b.log'
           ) SIZE 500M
  MAXLOGFILES 255
  MAXLOGHISTORY 12144
  MAXDATAFILES 1244
  MAXINSTANCES 12
  ARCHIVELOG
  CHARACTER SET AL32UTF8
  NATIONAL CHARACTER SET AL16UTF16
  DATAFILE
    '/export/home/oracle/orasys/adnp1/datasys/adnp1_system_01.dbf' size 500m
    AUTOEXTEND ON
    NEXT 100M MAXSIZE UNLIMITED
  DEFAULT TEMPORARY TABLESPACE temp tempfile
    '/export/home/oracle/oratemp/adnp1/temp/adnp1_temp_01.dbf' size 4000m
  UNDO TABLESPACE undotbs1 datafile
    '/export/home/oracle/oraundo/adnp1/undo/adnp1_undotbs1_01.dbf' size 16000m
  SET TIME_ZONE = '-05:00';
```

Setting the db_nk_cache_size

- For the set of new db_*n*k_cache_size parameters, you need to bounce the database each time.
- Then you are able to adjust this cache accordingly, if need be, using the
  ALTER SYSTEM set db_*n*k_cache_size = <cache_size_value>;
- If your default database block size is 8k, there is no need to specify a db_8k_cache_size parameter .

Possible Block Sizes in an Oracle Database

- The Database default block size range varies depending on the operating system and the format utilized.
- 32k blocks are not currently supported by Linux or Windows Operating Systems.



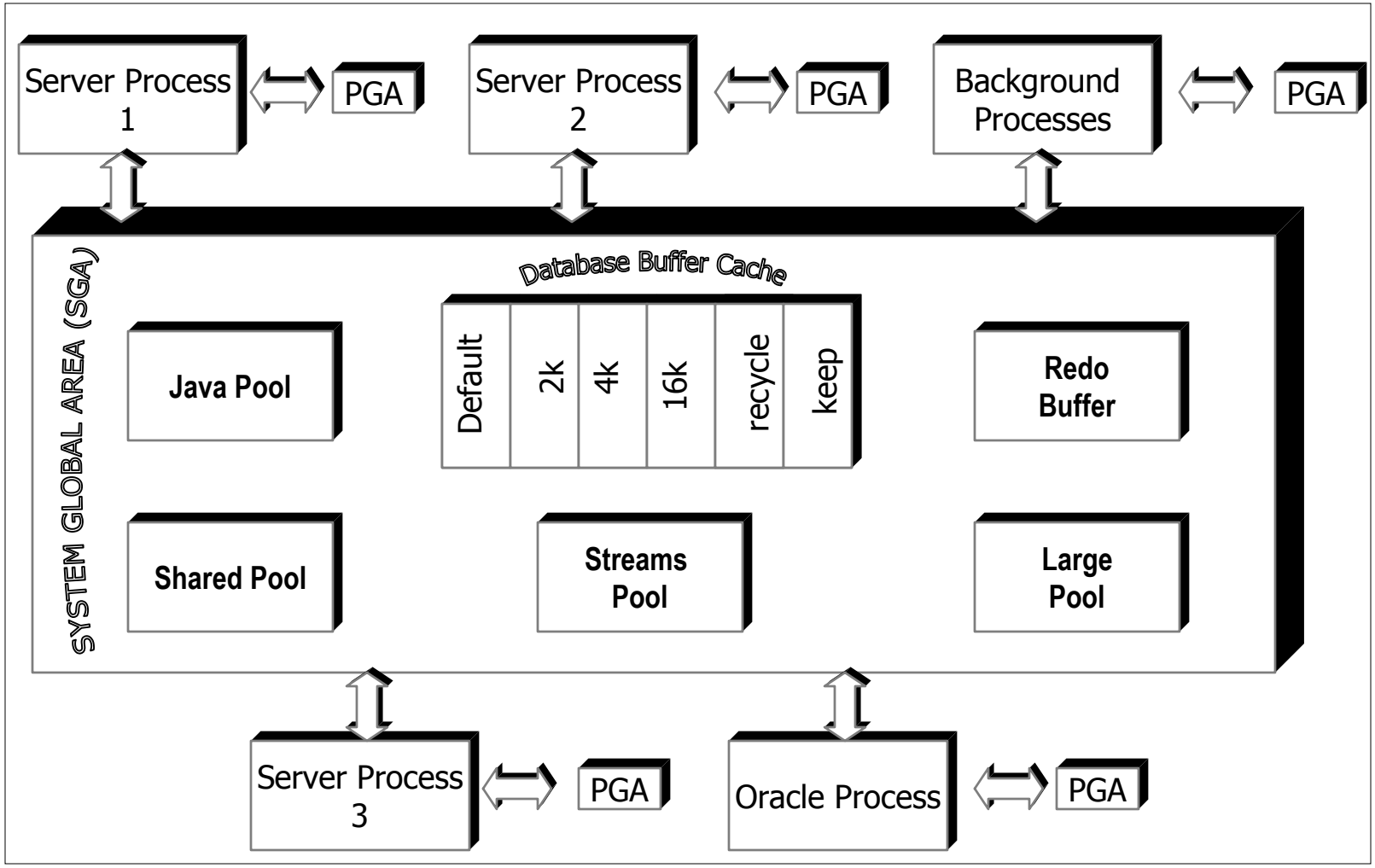
Bouncing your Database to setup specific db_nk_cache_size parameters

- When the DBA first bounces the database for cache reconfiguration, they have their best time to first add the different cache sizes that will match the different tablespace block sizes, not equal to the database default block size. The process limits to the following steps:
- Before restarting the database instance, type in the db_nk_cache_size parameters in the init.ora parameter file. Values need to be consistent with the number and size of cached tables (and associated structures) matching this block size.
- Restart your database instance specifying the modified parameter file.

Bouncing your Database to setup specific db_nk_cache_size parameters (continued)

- Use the CREATE TABLESPACE command to create new tablespaces with the appropriate block size matching those specific block sizes set in the init.ora parameter. The BLOCKSIZE clause is required.
- Create new objects in each tablespace with a different block size.
- Create a server parameter file (*spfile*) from your initialization parameter file.

SGA and Cache Perspective



CREATING A TABLESPACE WITH NON-DEFAULT BLOCKSIZE. EXAMPLE 1.

```
CREATE TABLESPACE INDX DATAFILE
  'E:\ORACLE\ORADATA\PORTAL\INDX01.DBF' SIZE 25M
       AUTOEXTEND ON NEXT 1280K MAXSIZE 33554416K
LOGGING
ONLINE
PERMANENT
EXTENT MANAGEMENT LOCAL AUTOALLOCATE
BLOCKSIZE 16K
SEGMENT SPACE MANAGEMENT AUTO;
```

CREATING A TABLESPACE WITH NON-DEFAULT BLOCKSIZE. EXAMPLE 2.

```
CREATE TABLESPACE DIAGRAM_TABLES DATAFILE
  '/oradata/portaldb/portal_diagtab_01.dbf' SIZE 1320K
       AUTOEXTEND OFF
LOGGING
ONLINE
PERMANENT
EXTENT MANAGEMENT LOCAL UNIFORM SIZE 128K
BLOCKSIZE 32K
SEGMENT SPACE MANAGEMENT MANUAL;
```

SPECIAL REMARKS

- The EXTENT MANAGEMENT LOCAL with SEGMENT SPACE MANAGEMENT AUTO can provide the best performance options in most cases.
- In Some cases, it is better to utilize a LOCAL UNIFORM extent management approach with a required explicit value, since autoallocation of blocks can lead to these issues, such as when creating tables with CREATE TABLE AS SELECT quite often.

TUNING THE DATABASE BUFFER CACHE

- Because performance tuning has greatly evolved, utilizing UTLBSAT/UTLESTAT and subsequently the stats$waitstat table.
- STATSPACK utilizes the PERFSTAT schema and involves both SQL and PL/SQL scripts than can achieve better tuning results. Other recommended tuning strategies such as utilizing Oracle Enterprise Manager (OEM) Tools, like Oracle Expert, Index Analyzer, and Capacity Planner.
- OEM directly provides a set of instance performance visualization from the Instance Manager, as a result it is possible to utilize the Oracle Cache Advisories.
- Automatic Database Diagnostic Monitor (ADDM) and Automatic Workload Repository (AWR) for total autocontrol of the database server tuning.

MULTIBLOCK CACHE IN A STATSPACK REPORT

spMBZRep.LST - Notepad

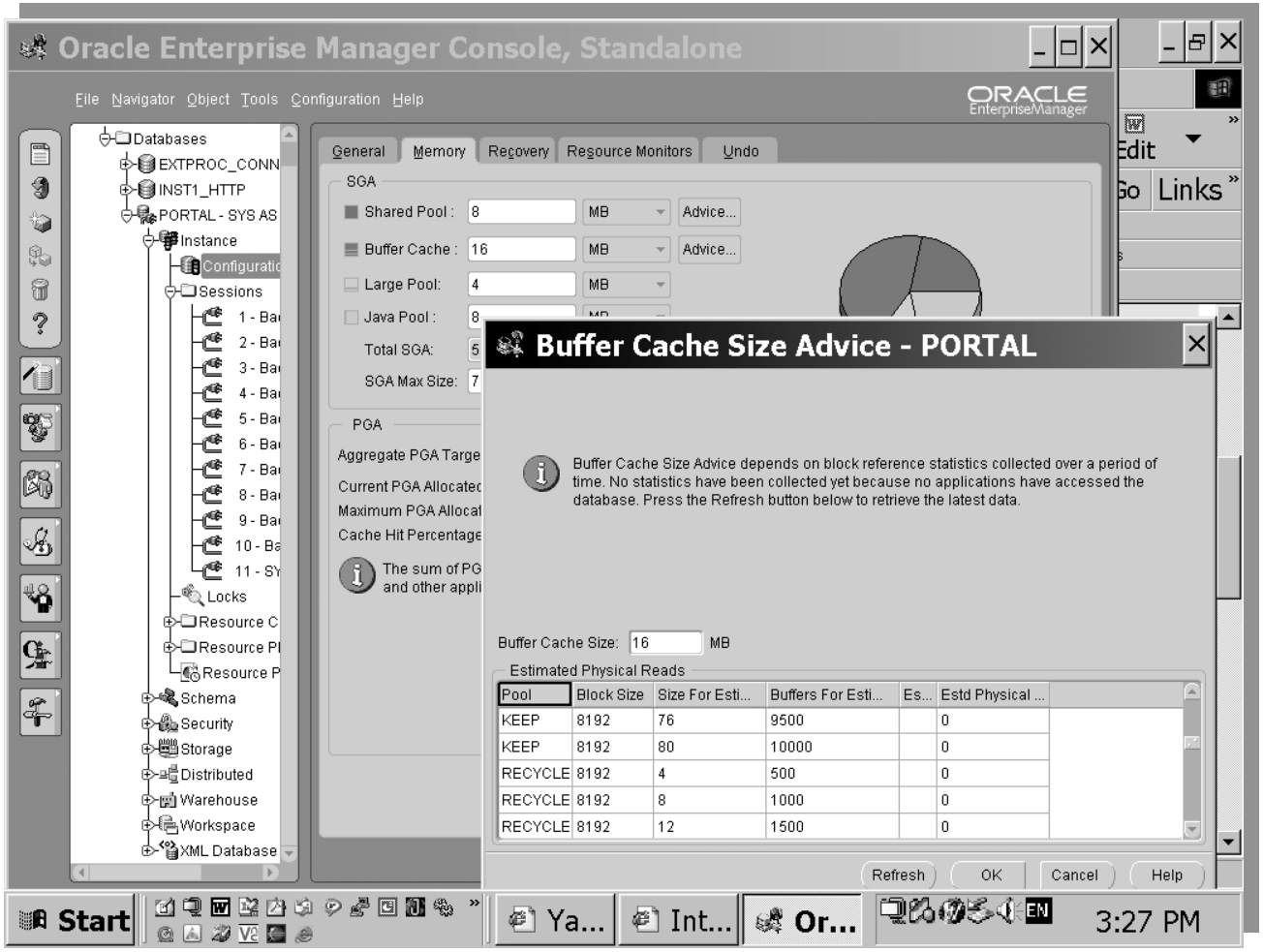
File Edit Format View Help

```
TS_STATSPACK              G:\ORACLE\PRODUCT\10.1.0\ORADATA\ADNDBA\TS_STATSPACK
          65           28           61          160          441

TEMP                      G:\ORACLE\PRODUCT\10.1.0\ORADATA\ADNDBA\TEMP01.DBF
           0            0            0            0            2

          ------------------------------------------------------------
Buffer Pool Statistics  DB/Inst: ADNDBA/adndba  Snaps: 13-16
-> Standard block size Pools  D: default,  K: keep,  R: recycle
-> Default Pools for other block sizes: 2k, 4k, 8k, 16k, 32k

                                                          Free Writ     Buffer
     Number of Pool         Buffer     Physical    Physical Buff Comp       Busy
P      Buffers Hit%           Gets        Reads      Writes Wait Wait      Waits
--- ---------- ---- -------------- ------------ ----------- ---- ---- ----------
D        1,002   93        304,067       21,064       2,983    0    0          4
4k       1,964  100              4            0           0    0    0          0
16k      5,060  100              4            0           0    0    0          0
          ------------------------------------------------------------

Instance Recovery Stats  DB/Inst: ADNDBA/adndba  Snaps: 13-16
-> B: Begin snapshot,  E: End snapshot

  Targt Estd                                     Log File  Log Ckpt    Log Ckpt
  MTTR  MTTR    Recovery    Actual     Target      Size     Timeout    Interval
   (s)   (s)    Estd IOs  Redo Blks Redo Blks Redo Blks  Redo Blks  Redo Blks
- ----- ----- ---------- --------- --------- ---------- --------- ------------
B     0    48         47      6285     18432      18432
E     0    49        186     19484     18432      18432
          ------------------------------------------------------------

Buffer Pool Advisory  DB/Inst: ADNDBA/adndba  End Snap: 16
-> Only rows with estimated physical reads >0 are displayed
-> ordered by Block Size, Buffers For Estimate

                                    Est
                                   Phys      Estimated                    Est
   Size for  Size      Buffers    Read     Phys Reads     Est Phys % dbtime
```

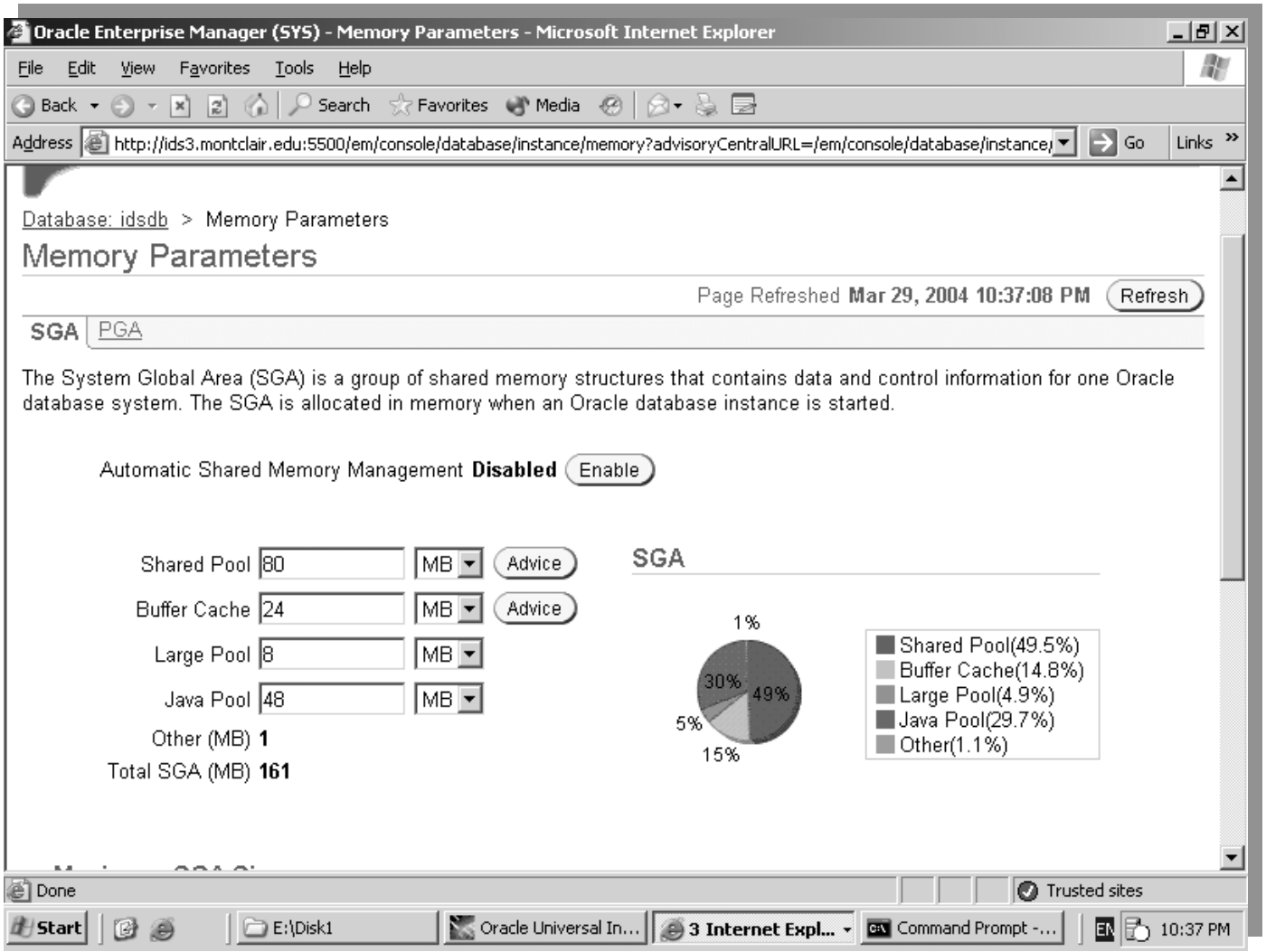
CACHE ADVISORIES AND MEMORY STRUCTURES OPTIMIZATION

- Oracle Cache Advisories allow DBAs to make decisions on how to dynamically adjust certain memory structures such as the database buffer cache, the shared pool and consequently the System Global Area (SGA) actual target (SGA_TARGET).
- By utilizing the Cache Advisory available in the Instance Manager, thresholds for each buffer cache can be visualized from a chart view. Similarly, the DBA can query the V$DB_CACHE_ADVICE[1] view, which displays estimated physical read factors and buffers used for estimate as the main source to establish the best cache size value
- [1] The DB_CACHE_ADVICE initialization parameter needs to be set to either ON or READY.

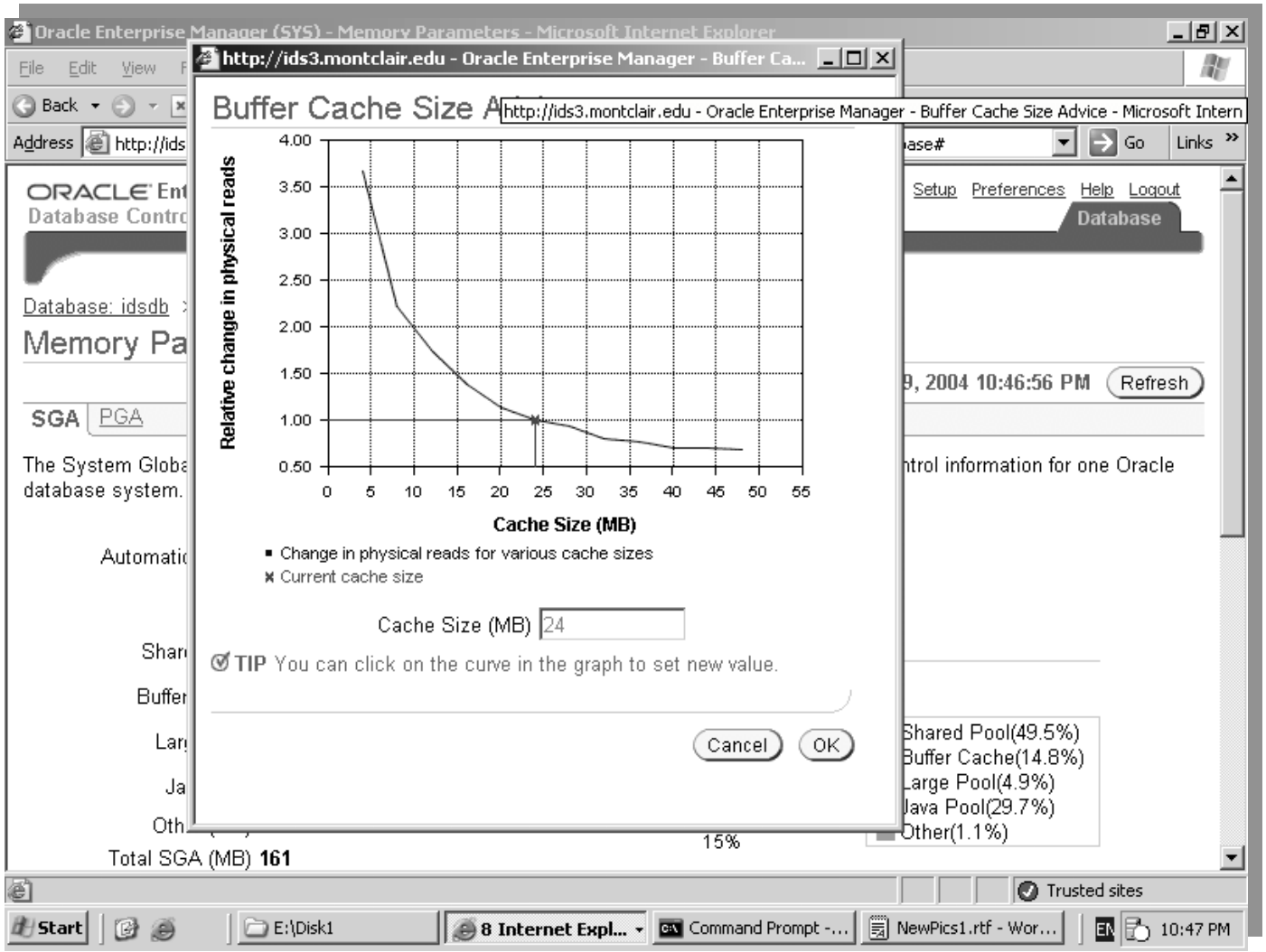
ORACLE9i DATABASE CACHE ADVISORY PERSPECTIVE



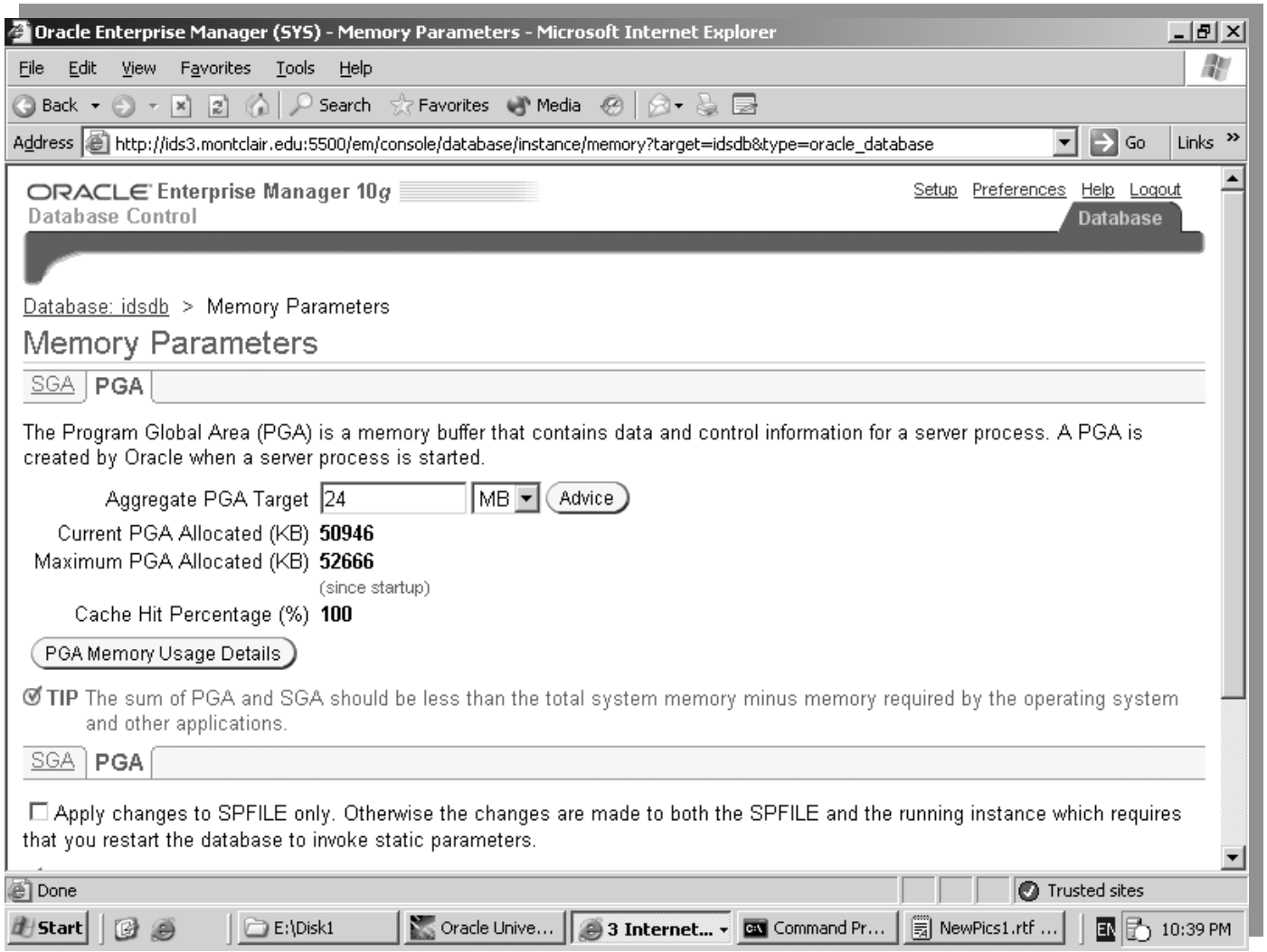
ORACLE10g SGA GRAPHICAL VIEW



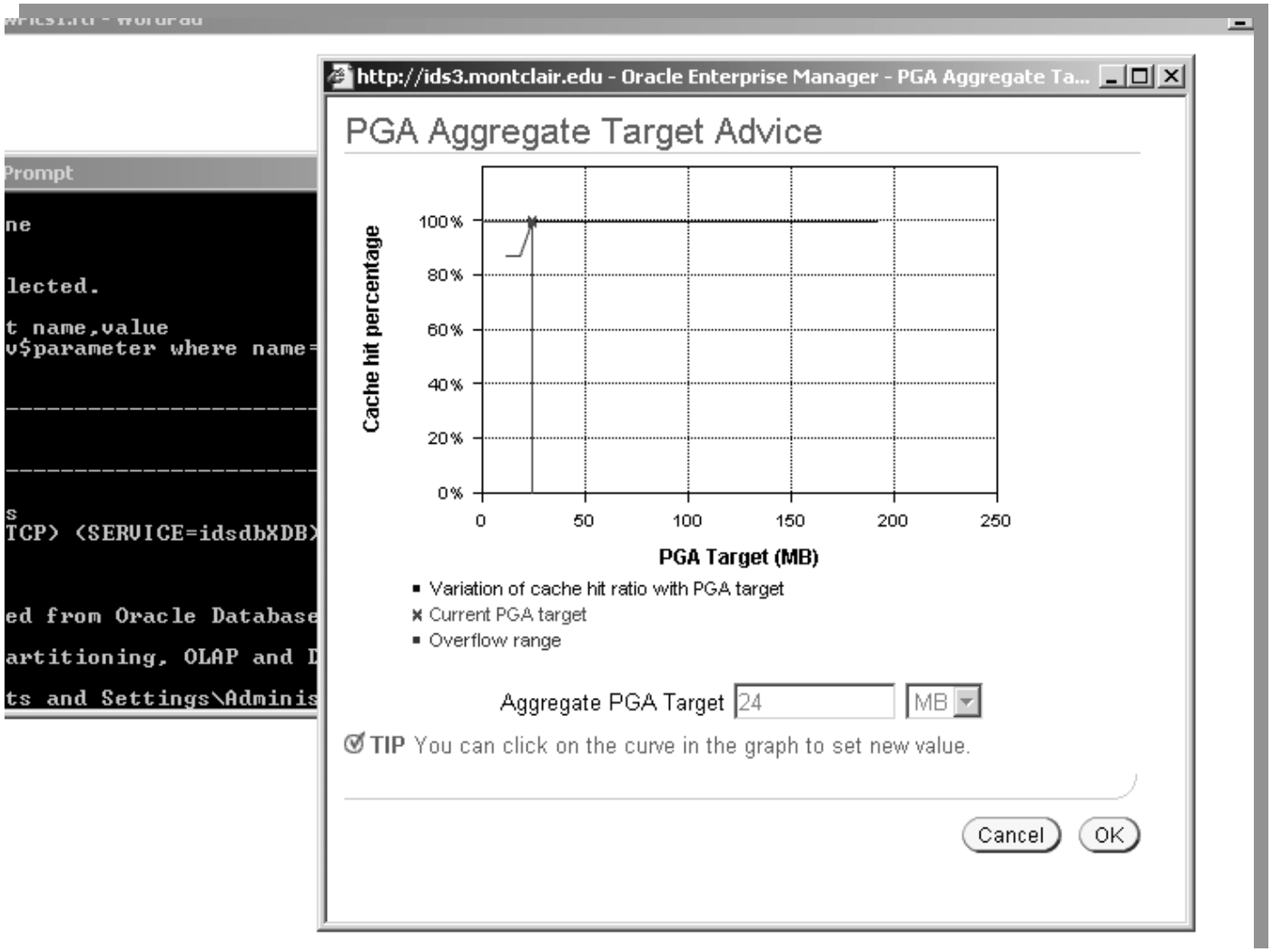
ORACLE10g DATABASE CACHE ADVISORY VIEW



ORACLE10g PGA VIEW



ORACLE10g PGA AGGREGATE TARGET ADVICE



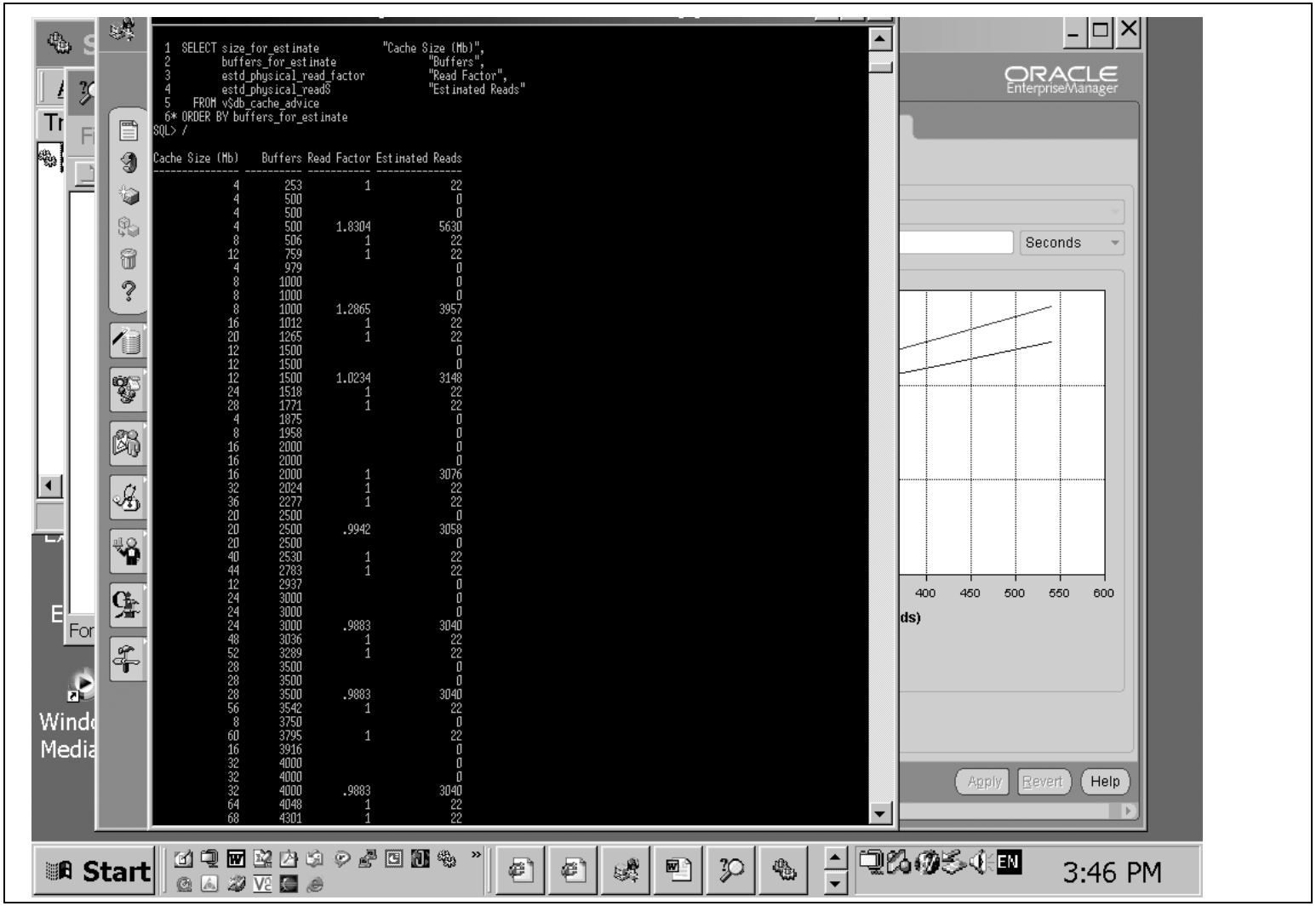
SOME CRITICAL CONCEPTS

- The SGA dynamic allocation unit is the granule. The size of the granule depends on the estimated size of the SGA. If the SGA is less than 128MB, then a granule is 4MB. If the SGA is larger than 128MB, then the granule is 16MB.
- The minimum number of granules allocated at startup is one for the buffer cache, one for the shared pool and one for the fixed SGA, which includes redo buffers. So according to these requirements the minimum configurable SGA is 3 granules or at least 12MB.

SOME CRITICAL CONCEPTS (continued)

- When the value of the recommended cache size is recognized from the Cache Advisory, the DBA can change it dynamically by using the ALTER SYSTEM SET DB_CACHE_SIZE <value>; command line.
- At that moment, it is really not recommended to set that value in the init.ora parameter and bounce the database instance, since the restarted instance could actually lead to a change in the total SGA size with a larger unexpected value, and subsequently to inconsistent tuning.
- This is particularly true in multiblock databases, when the db_recycle_cache_size and the db_keep_cache_size initialization parameters are set in the init.ora parameter file together with other db_nk_cache_size parameters.

QUERYING THE CACHE ADVISORY VIEWS



```
1  SELECT size_for_estimate          "Cache Size (Mb)",
2         buffers_for_estimate       "Buffers",
3         estd_physical_read_factor  "Read Factor",
4         estd_physical_reads        "Estimated Reads"
5    FROM v$db_cache_advice
6* ORDER BY buffers_for_estimate
SQL> /

Cache Size (Mb)    Buffers Read Factor Estimated Reads
--------------- ---------- ----------- ---------------
              4        253           1              22
              4        500                           0
              4        500                           0
              4        500      1.8304            5630
              8        506           1              22
             12        759           1              22
              4        979                           0
              8       1000                           0
              8       1000                           0
              8       1000      1.2865            3957
             16       1012           1              22
             20       1265           1              22
             12       1500                           0
             12       1500                           0
             12       1500      1.0234            3148
             24       1518           1              22
             28       1771           1              22
              4       1875                           0
              8       1958                           0
             16       2000                           0
             16       2000                           0
             16       2000           1            3076
             32       2024           1              22
             36       2277           1              22
             20       2500                           0
             20       2500       .9942            3058
             20       2500                           0
             40       2530           1              22
             44       2783           1              22
             12       2937                           0
             24       3000                           0
             24       3000                           0
             24       3000       .9883            3040
             48       3036           1              22
             52       3289           1              22
             28       3500                           0
             28       3500                           0
             28       3500       .9883            3040
             56       3542           1              22
              8       3750                           0
             60       3795           1              22
             16       3916                           0
             32       4000                           0
             32       4000                           0
             32       4000       .9883            3040
             64       4048           1              22
             68       4301           1              22
```

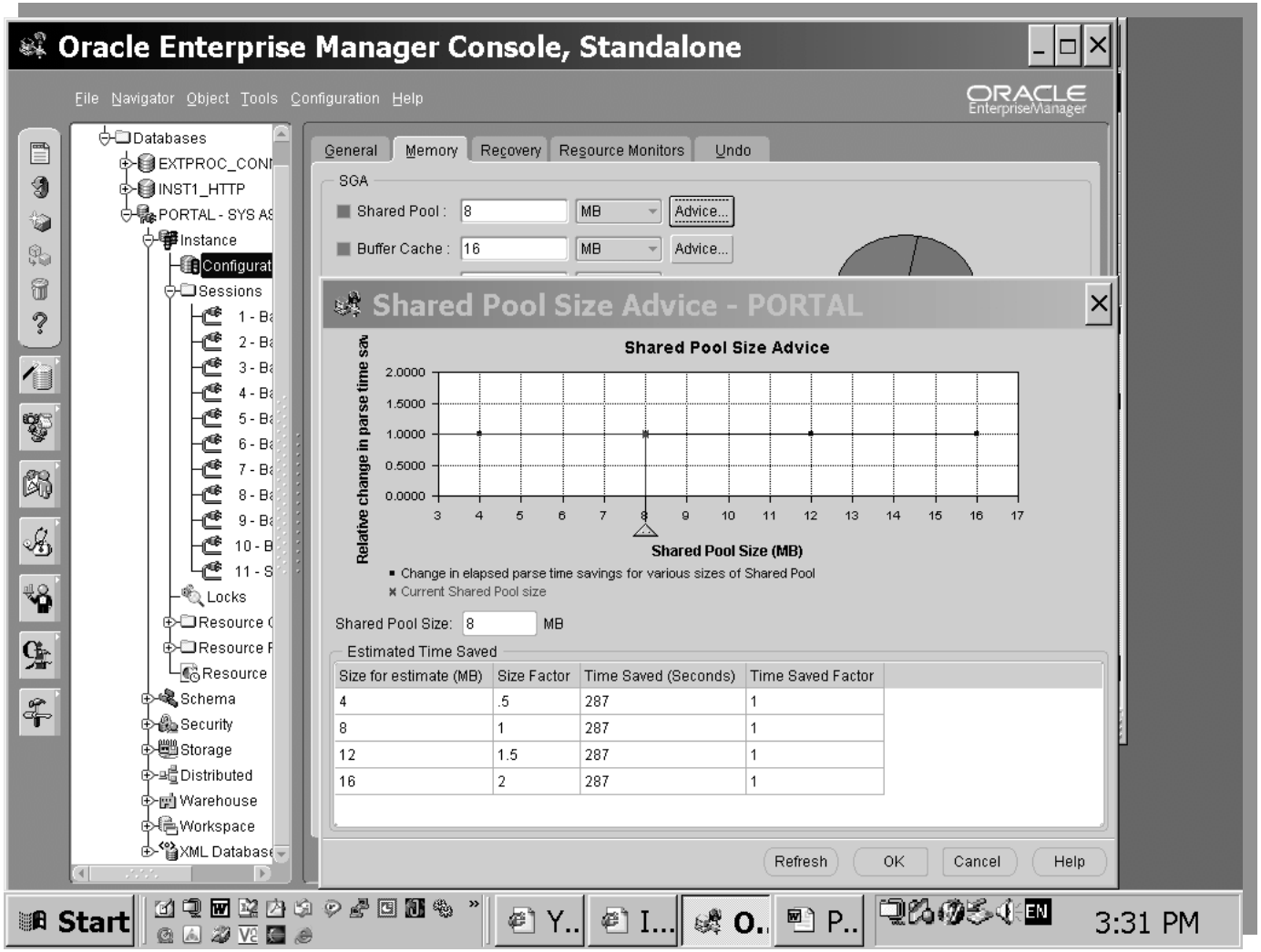
RECYCLE BUFFER POOL ISSUES

- It is possible to configure a RECYCLE buffer pool for blocks pertaining to segments that you do not want to remain in memory.
- The RECYCLE pool is good for segments that are scanned rarely or are not referenced frequently

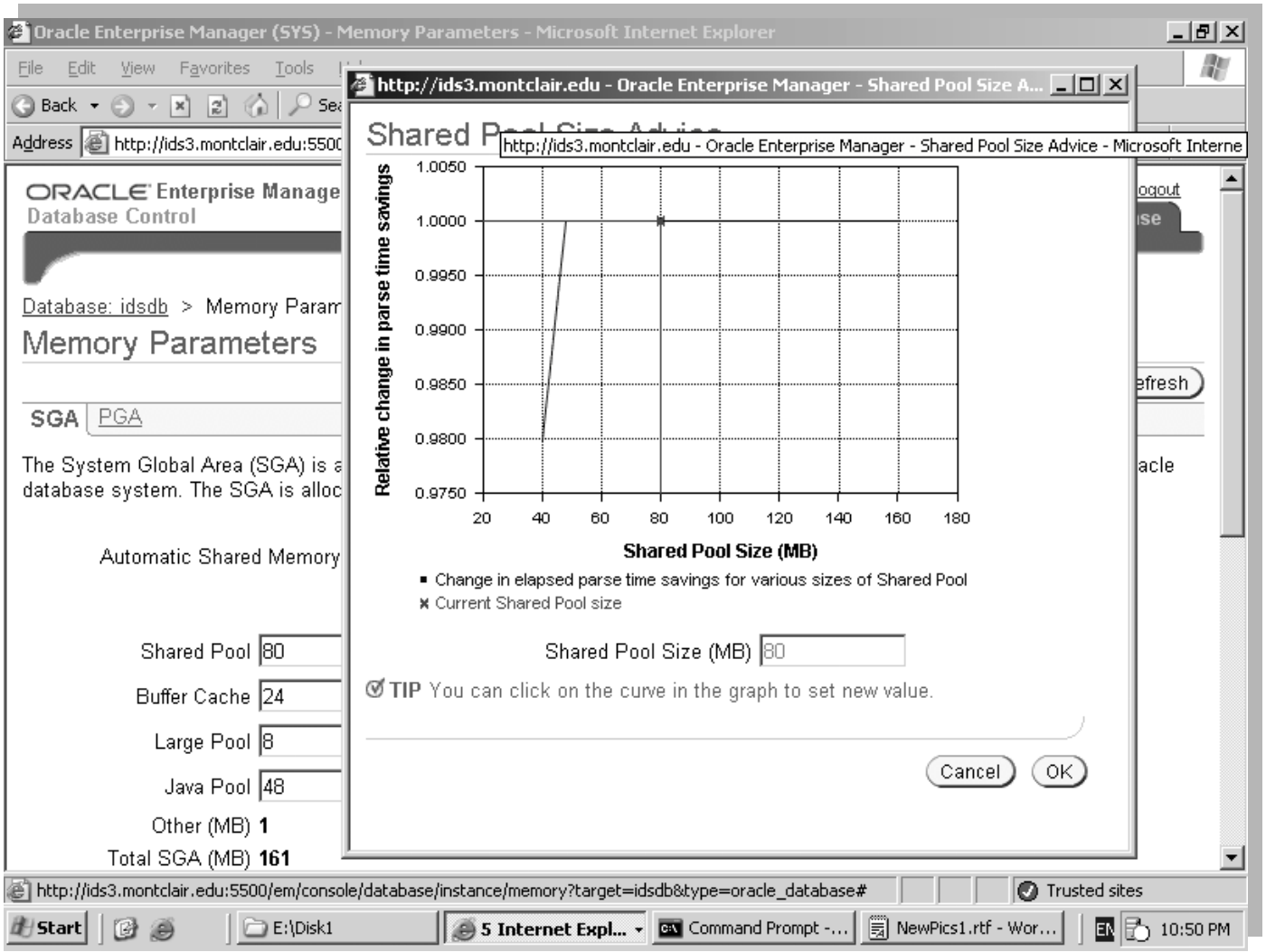
MINING THE DATA DICTIONARY TO ATTAIN THE BEST PERFORMANCE TUNING

- Similarly, diagnosing freelist contention can take place by inspecting the following views:
- V$WAITSTAT: Query COUNT and TIME for the segment header CLASS.
- V$SYSTEM_EVENT: Query TOTAL_WAITS for the EVENT buffer busy.
- V$SESSION_WAIT: Fir server process wait events, need to join with DBA_SEGMENTS accordingly
- DBA_SEGMENTS: Used to determine the name of the segment waited on in V$SESSION_WAIT.

ORACLE9*i* DATABASE SHARED POOL CACHE ADVISORY



ORACLE10g DATABASE SHARED POOL CACHE ADVISORY



CERTAIN CONSTRAINTS

- Besides, the SGA_TARGET parameter could be increased up to the value specified for the SGA_MAX_SIZE, or otherwise reduced. If the DBA reduces the value of SGA_TARGET, the system identifies one or more automatically tuned components to release memory. The DBA can reduce SGA_TARGET until one or more automatically tuned components reach their minimum size.
- Oracle Database determines the minimum allowable value for SGA_TARGET taking into account several factors, including values set for the automatically sized components, manually sized components that use SGA_TARGET space, and number of CPUs. The change in the amount of physical memory consumed when SGA_TARGET is modified depends on the operating system.

JAVA POOL: MONITORING AND SIZING

- Oracle's Java Virtual Machine (JVM) known rather by Oracle EJE uses memory from both the shared pool and the java pool. It uses about 8k for each loaded class, for which a minimum of 50MB is recommended for enhanced production performance. In dedicated servers the java pool memory utilizes the shared part of each Java class used per session, which can average 4K to 8k for each class.
- The per-session Java state of each session is stored in the UGA within the Program Global Area (PGA) rather than in the Java pool within the SGA. Similarly, the shared server uses Java pool memory for the shared part of each Java class used for the per-session state of each session. So, it is easy to estimate and monitor the Java pool by querying V$SGASTAT.
- Object locking and deadlocking situations can be established by querying the dba_blockers and dba_waiters views or by visualizing and zooming into Oracle Lock Manager from OEM's Oracle Instance Manager.

UNDO AND TEMPORARY TABLESPACE ISSUES

- Use at least two undo tablespaces, particularly, at peak production time or in the event of a major application upgrade, large load or import task.
- This cooperates with the current undo_retention policy and the associated retention guarantee (10g), if any.
- The key idea is to be able to switch from the undo tablespace when 80% full.
- This is particularly true if a parameter such as _*DISABLE*_LOGGING is set to speed up an Import utility process and minimize redo logging activity, if an approach such as ORAPEPI, or alike, is eventually used.
- **Use ALTER SYSTEM SET UNDO_TABLESPACE <undo_tablespace_name>;**
- Two temporary tablespaces are also recommended in most scenarios, and a related strategy to control and leverage them a peak aggregation, sorting or indexing time.

PHYSICAL DATABASE ISSUES: TUNING THE DESIGN

- Map Tables to different block size tablespaces. Thus, for data warehouse environments perform better in tablespaces with larger block size, OLTP driven databases in smaller block size, independently from the pureness or wholeness of the architecture and approach themselves, such as when using Heterogeneous Systems and/or diverse consumer groups perspectives.
- Likewise, the author recommends utilizing larger blocksize tablespace to accommodate tables involving CLOB, BLOB, BFILE, XMLTYPE, and the majority of large user- defined object domains.
- Do not ignore table compression and partitioning options.
- Derive Business Rules to associate objects to block sizes.

ADVANCED REPLICATION AND STREAM ISSUES

- Underlying object components, such replicating a partition table using a local index, since invalidation of this objects may lead to a time consuming rebuilding process.
- Envision, design, and implement a strategy that can contemplate not only tuning a the first replication stage, but also the systematic periodic replicating job processes whose intensiveness needs to be carefully measured and planned for.
- Storage Area Network/Network Attached Storage (SAN/NAS) channel
- Database image vs. Business Continuity Volume (BCV) Approaches
- Database Version Issues

PARTITIONING ON A DIFFERENT BLOCK SIZE

```
CREATE INDEX DBAMBA.IDX$CUSTOMER$STATE
ON DBAMBA.CUSTOMER (STATE)
PARALLEL 4 TABLESPACE INDX
INITRANS 2 MAXTRANS 255 ONLINE
COMPUTE STATISTICS
REVERSE GLOBAL PARTITION BY RANGE (STATE)
(PARTITION IDX$CUSTOMER$STATE_P1 VALUES LESS THAN ('DE' )
TABLESPACE DATAPAR1,
 PARTITION IDX$CUSTOMER$STATE_P2 VALUES LESS THAN ('IA' )
TABLESPACE DATAPAR2,
 PARTITION IDX$CUSTOMER$STATE_P3 VALUES LESS THAN ('NY' )
TABLESPACE DATAPAR3,
 PARTITION IDX$CUSTOMER$STATE_P4 VALUES LESS THAN (MAXVALUE)
TABLESPACE DATAPAR4);
```

CONCLUDING REMARKS

- Multiblock databases represent a very useful database architecture technology that can nuance with and encompass other technologies such as Data Warehousing, shared database architecture, Oracle Advanced Replication, and Streams, Table Compression, and allow a DBA to best make use of Oracle's LOBs, Object-Orientation and related user-defined data types technologies altogether.
- The dimensions and possibilities where multiblock databases can have a great impact are countless, including highly increased index performance
- Finally, the issues discussed in this paper are the outcome of a comprehensive research in this topic, with practical application in rather VLDB raging the area of 8 to 10TB of data.
- Therefore, they can certainly account as a blueprint for most industries and applications utilizing multiblock databases, particularly VLDB, in integration with other Oracle key leading technologies as presented.

CONCLUDING REMARKS

- **Technical Areas of Application**