A Customer Case Study of Oracle Rdb Database Consolidation

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Overview

Early last year, SIAER, a long-time Italian OpenVMS customer, began investigating the feasibility of a project to consolidate server, storage, software applications, and Rdb databases along with the renewal of its network IT infrastructure. In order to provide the customer with the proof of concept that the global consolidation was possible with the technology architecture we proposed, HP invited SIAER to the OpenVMS Solution Center in Nashua, NH, to test its applications and database in a new environment, representing a significant subset of the global consolidation.

After the visit, SIAER reported success from its tests and great benefits from Oracle Rdb's Row Cache technology. SIAER provided us with an exhaustive report of the trials and tests performed. This article details the experiences of this customer in making use of an OpenVMS cluster and Rdb's Row Cache feature to achieve great improvements in performance after the consolidation process. This article is another positive result of the HP and SIAER partnership.

Company Overview

S.I.A.E.R — Sistema Informativo Aziende Emilia Romagna (Information System of Emilia Romagna Companies) — is a company founded in 1981 (SIAER scarl, Via Malavolti, 5, 41100 Modena, Italy www.siaer.it). It has 60 employees and approximately 20 independent consultants. It plans and develops software applications for financial and administrative functions of companies (payroll, financial accounting, management control, business relations with local and public government, bank, commercial institution, and others) in an integrated environment of services, which provides a high level of efficiency and achieves a solid and wide database of craftsmanship and small-medium business companies. SIAER works in a B2B environment and currently serves 15 associations (provinces), mostly based in north central Italy; those associations belong to CNA, a primary trade association agency (www.cna.it - www.er.cna.it).

SIAER customers, in turn, provide services to approximately 80,000 firms and employ more than 3,000 operators at local agencies (provinces). Furthermore, SIAER recently implemented SIR, Sportello Istruttore di Rete, which allows users to interact within local and central administrations;

moreover, it put "On-line Services" in place for its customers that allow companies to access web-based applications of the current integrated environment of services. SIAER developed a software application for benchmarking services for Ecipar Emilia Romagna and started the implementation of EKO (Ecipar Knowledge Organization), an ERP system for global management of educational services.

In 2001, SIAER, with the contribution of a major Italian telecommunication carrier, built one of the wider broadband networks in Italy. In January 2003, with the HP and TelecomItalia partnership, SIAER started the implementation of the IT infrastructure renewal project: near its main office in Modena, SIAER built the Data Center where all hardware infrastructure and software applications were brought together through a process of server, storage, database and application consolidation. During 2003, SIAER will provide its customers with desktop management service and will assume the shape of one of the most important ASP (Application Service Provider) in Italy.

SIAER's President is Mr. Giorgio Allari; SIAER CEO is Mr. Lauro Venturi.

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The Server Consolidation Project: “Golem” — The Middleware to Support Applications

From the functional point of view, all services supplied by SIAER work together; SiDist, a middleware component developed in-house, provides the overall integration. SiDist, based on a semantic model, maps object representation, consistency rules, and logic of the distributed model on a wide number of approximately 200 Rdb/Oracle databases: SiDist manages the distributed model based on a partial data replication. The project to consolidate hardware infrastructure and software applications required changing the SiDist distributed model to a centralized model: the Golem.

Introduction

To evaluate the feasibility of the server consolidation project, we conducted performance and workload benchmark tests on an OpenVMS AlphaServer cluster (2 x ES45) at the OpenVMS Solution Center in Nashua, NH (USA).

> This testing was part of a wider collaboration with OpenVMS Engineering started in March 2002 when the SIAER CEO visited Nashua. Italian sales and technical account managers later provided a preliminary global outsourcing proposal in response to SIAER’s request. This document and the related results of the benchmark testing were prerequisites for a successful server consolidation.

The scope of the benchmark testing was to:

- Validate configuration and structural changes to the main application program (SiDist) and to the Rdb database
- Check and validate the new environment (Golem) with an up-to-date hardware and software system architecture
- Verify concurrent access to the unique Rdb consolidated database by a large number of users.

Systems and storage were available between July 8th and August 16th. Prior to July 28 we used systems for experiments, unofficial tests, and preparing scripts and test data. We performed official tests between July 29th and August 16th when SIAER personnel were available.

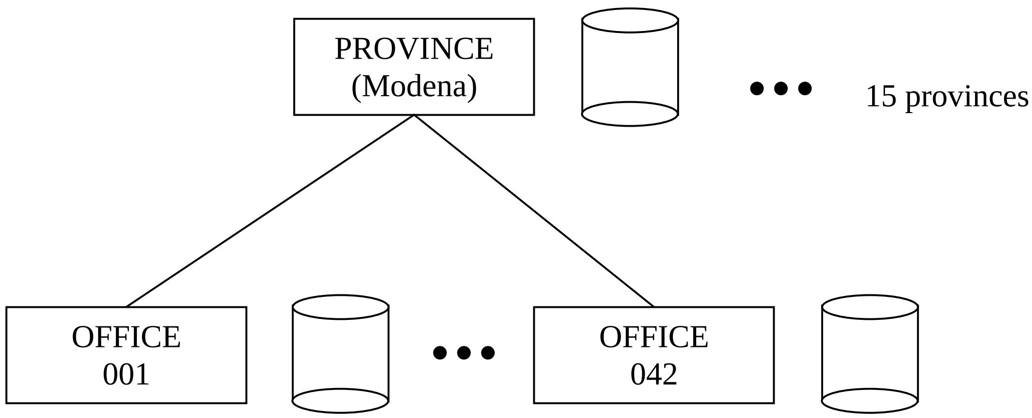
This document contains two sections and an Appendix:

- The first section describes the benchmark setup, preparation, and results
- The second section describes the tests performed, system tools, system architecture, data collections, and results. The contents of this section are fundamental to planning the future Golem implementation.
- The Appendix gives details of each test.

Benchmark Setup and Preparation

The Environment

The driving force behind this test was the server consolidation project that SIAER planned for 2003. The current configuration is as follows:



Currently, each location has a system and a database running locally; the software application, SiDist, manages data replication and coherence. The future configuration will be located in the "Datacenter," where a single system will handle the workload of all the offices and the main province office; the consolidation project foresees a single database instance called "Golem".

In the current configuration, we have multiple databases with three kinds of data:

- GLOBAL: shared between province and office and between offices (the percentage of sharing between offices is around 10% — 336 tables)
- LOCAL: each record in these tables is exclusively owned by one office; local data exists also in the province office (228 tables)
- BROADCAST: the same data is everywhere (147 tables)

Golem will consolidate all the data on a single database. This change leads to the "Visibility problem"! Golem solves the problem by introducing a table, called the "Visibility table", which correlates the user with the data that can be viewed; this table allows more than one user to view the same data. In the actual design, a single visibility table is used to manage the visibility for a set of related tables; currently 17 tables are used to manage visibility for 336 global tables.

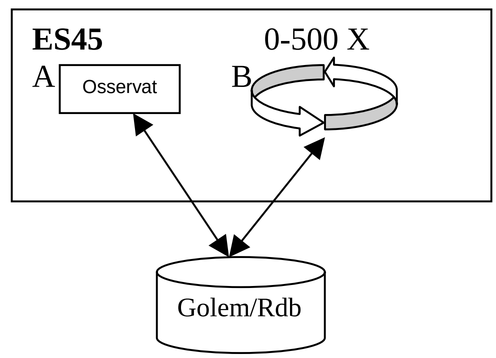
Test Structure

A general overview of the benchmark shows two kind of process to be run:

- Main interactive processes (one or two processes called A or Osservato) monitored by SIAER personnel using general system and Rdb-specific tools.
- Many (0 to 500) workload processes (called B or Disturb) in order to simulate an effective workload against the systems.

We ran both A Osservato processes and B Disturb processes and collected data about system parameters and elapsed time; that data has been compared to results from a test system (a DS20E) located in Italy at SIAER.
The target of the test plan is to analyze the A Osservato process when we increase the number of B Disturb processes.

A: Osservato process: an interactive process simulating user activities at the office. B: Disturb processes: workload processes simulating overall activities in a typical office (usually batch processes about report and printing).
We collected system data and analyzed log files for each A Osservato process running different workload conditions.



B Disturb process, coded with specific SIAER language (SIC), the implementation language of the SiDist main SAIER application, simulates back-office activities typical at either local or main offices: read, modify, add, and delete of records in the Golem database. To accurately simulate back-office tasks, we also introduced "idle time" that emulates human activities (average idle time was calculated from DTM (DEC Test Manager) sessions recorded at typical local and main offices in Italy).

Back-office tasks run against the Golem database to a limited extent (local office data), but batch tasks (report, printing, and so forth) usually run against the whole Golem database.

The A Osservato process runs at the same time with different workloads (0 to 500 Disturb processes): we collected elapsed time from all sessions.

From the system log, we estimated transactions of the systems, and from Rdb monitor and log files we estimated transactions of the database. In both cases we determined an average number of transactions per second calculated on a timeframe of 90 seconds while A Osservato process and B Disturb processes were running.

History Reports

July 15th to 26th

During these two weeks we gained access to systems in Nashua and refined systems and executables as follows:

- Built up and adjusted batch procedures and control statements.
- Made changes to the main program (SiDist) to remove a record update used specifically by the distributed model of SiDist.
- Improved the algorithm for report generation.
- Developed a detailed plan and schedule for the next two weeks, officially allocated for test.

July 29th to August 2nd

Monday, Tuesday, Wednesday:
A first step was performed with strange results: we experienced several problems that badly altered results and the assessment between simulated and real environment: priority, idle time, high collision rate of database access. We made adjustments and procedure changes and planned a new series of tests.
Thursday:
Due to network problems, the system was inaccessible from Italy. Support teams in Nashua and HP and SIAER personnel worked together on the problems. The problems were fixed Thursday evening, and we planned new tests and batch sessions for that night.
Friday:
The DTM recorded session did not work properly. A new session was recorded and we ran tests TP1, TP2, TP3, TP4, TP5 Rdb: 80000 global buffers, no global buffers in VLM. (See the appendix for all references to tests named TPx, TZx, T…)

Summary after the first week:

Many problems have been discovered: DTM recorded sessions are not reliable due to many failures during execution.

A new strategy has been implemented.

We created two new processes, OSSERVATO and OSSERVATO_L, which simulate human behavior; in detail:

- OSSERVATO: user session on global data (company and related database structures)
- OSSERVATO_L: user session on local data (local financial accounting)

Both processes execute standard operations on specific database instances (updates, insert, delete) with idle time between operations in order to simulate human activities.

Those changes do not alter the tests: we still have A Osservato processes and B Disturb processes, and we still consider it to be a new session when we increase B Disturb processes. The main change is the Osservato processes: they are now executable and not recorded sessions.

August 5th to 9th

Monday:

Hardware and software were both reconfigured for further test sessions (database and application server, cluster configuration, and so forth); changes were made to batch procedures to have a heavier workload (from 230 to 500 users — disturb processes).

Tuesday:

Ran tests TZ2, TZ3, TZ4, TZ5. Rdb: global buffers in VLM 524000, 700 per user

Wednesday:

Ran tests TZ1 and TZ6.
Ran tests TDB1, TDB5, TDB7 with database machine + global buffers in VLM 524000, 700 per user

Thursday:

Used a new software configuration with row cache; made changes to restore database procedures.
Ran tests TRC5, TRC7 database machine + row cache + global buffers in VLM 524000, 700 per user

Friday:

Ran a new software configuration with row cache.
Ran test TRC7N: database machine + row cache + global buffers in VLM 524000, 700 per user

Summary after second week:

The changes made the system more robust, reliable, and stable; performance has been increased. Tests ran as planned without problems in all configurations.

We achieved our planned goals. Due to high loads of work for the systems, and for SIAER and HP people, we closed all sessions and the week after we conducted manual tests and reorganized the data and database, collected log files and results, etc.

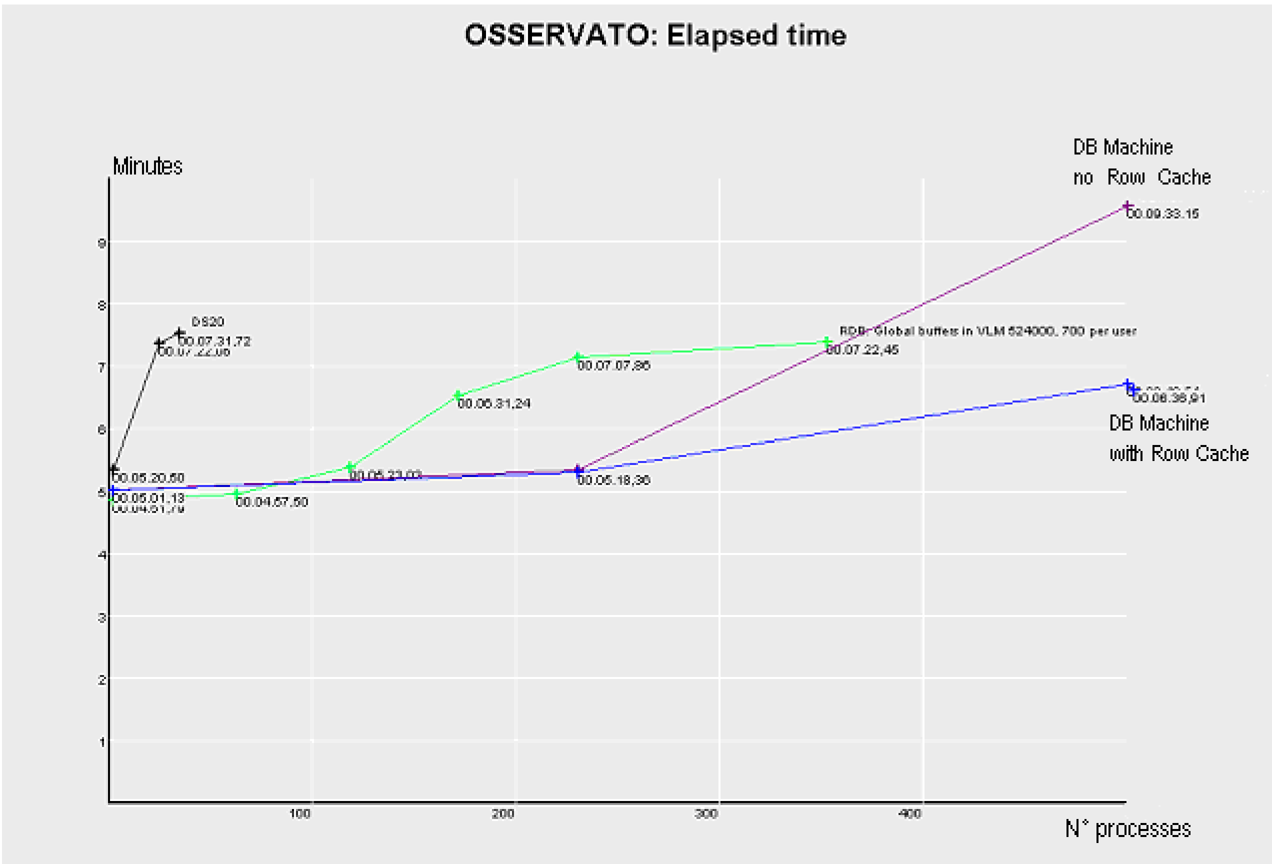
As agreed early in July, systems and storage were released to HP on August 18th.

August 19th to 27th

To compare test results with the current production environment, we organized a test session with an internal system (code name: Foa001). We used the same database and scripts with minor changes due to different hardware (DS20). On August 27th, we ran Osservato processes with a workload of disturb processes that simulated 25 and 35 users.

Comments About Tests

The Technical Analysis of Benchmark (the second section of this document) details processes and results. A more in-depth analysis needs more time and work, but we have comments and information that could be made public, as follows:

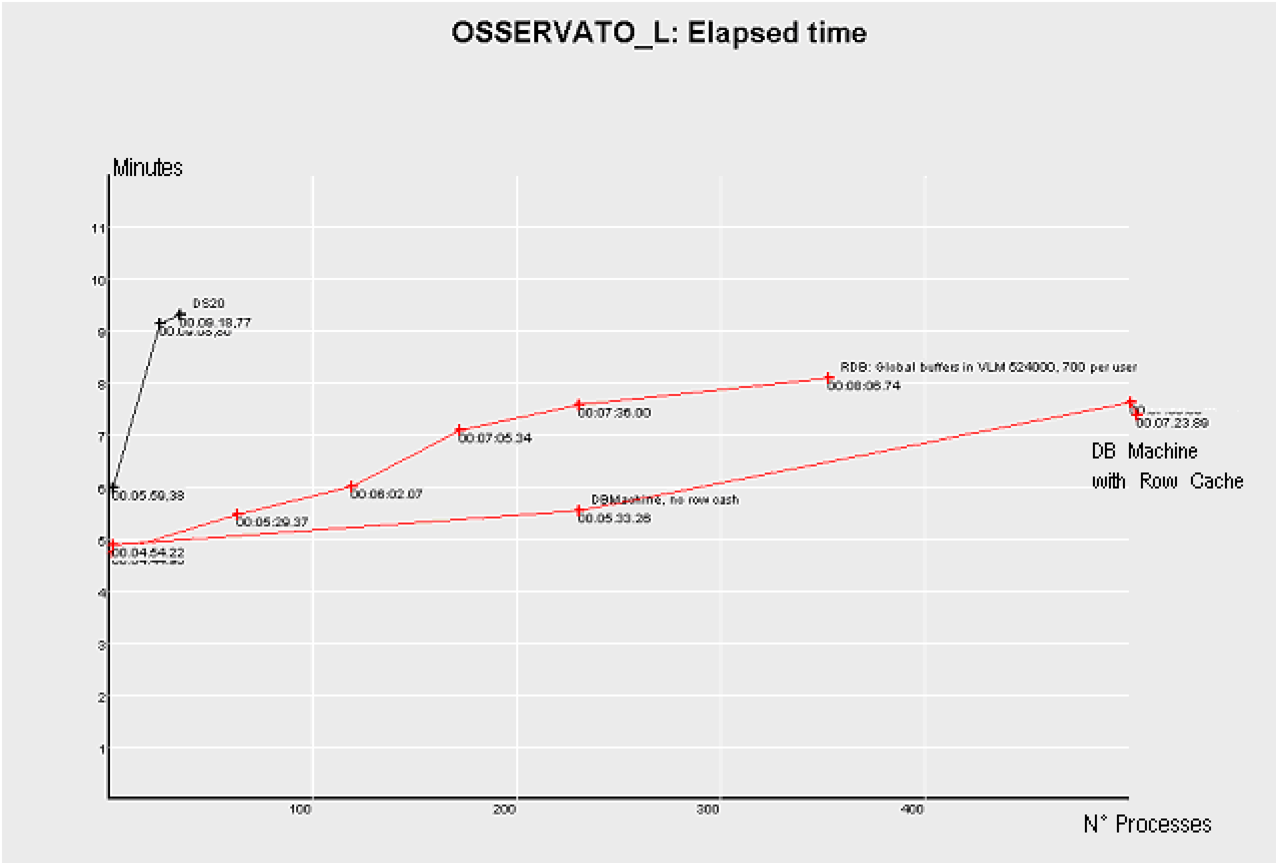


The previous figure shows Osservato process elapsed time (this process run against global data) in different configurations. It may be interesting to look at the left side of the picture where the results of the DS20 used locally in SIAER can be seen (it simulates offices called Foa001).

The less favorable configuration is database machine; there is no row cache and the result shows a breakpoint when we have 350 users (or disturb processes).

The other two configurations are better.

Note that the Osservato process is a heavy workload for the system because it runs on global data.



The previous figure shows Osservato_l process elapsed time (this process run against local data) in different configurations. Look at left side of the picture where the results of the DS20 used locally in SIAER can be seen (it simulate offices called Foa001).

All configurations are better than today.

Final Results

Let's review the target and results of our benchmark:

Validate configuration and structural changes to the main application program (SiDist) and to the Rdb database: this should enable us to implement a unique Rdb database for each single area (province in Italy).

> Functional tests were run before this benchmark, but in our recent tests with new AlphaServer ES45 systems and MA8000 FC storage, the main program (SiDist) was stressed as never before: a heavy workload of more than 500 users was simulated; note that 500 users are 70% of the theoretic overall users of the Modena area. We did not find a single fault or problem in either system architecture or database.

Check and validate the new environment (Golem) with an up-to-date hardware and software system architecture as included in the HP proposal, with the goal of offering performance at least as good as users have today in the distributed environment.

> The Technical Analysis of Benchmark (the second section of this document) fully details this target. Looking ahead, we found that in all configurations we tested, Osservato processes ran faster than on DS20's. We cannot say at this point which is the best system architecture and configuration; it is possible that changes to the database and SiDist code caused the performance improvements.

Verify concurrent access to the unique Rdb consolidated database by a large number of users.

> This was the main concern we had before the benchmark. The tests show that Rdb manages concurrent access in an excellent way, and database-served queues contained few entries (20-30) at the worst workload (>500 users simulated). The database table containing local financial accounting was critical: tests on Osservato_l process do not show any problems on concurrent access.

Summary

Here are some final comments:

- The code and performance of the SiDist main application can be improved.

- The performance of the Rdb database can be improved through reorganization. Mr. Bill Gettys from Oracle Corp. in Nashua, after a quick review of our architecture, said the Golem database could be considered a "very large database"; for those databases, a correct architecture and organization is absolutely necessary in order to gain better performance.

- The Golem database has been robust and reliable in all workloads and conditions. Golem crashed rarely, and the causes were immediately identified.

- The benchmark shows that the application SiDist can be implemented in a consolidated environment and that the HP proposal well matches application requirements. Now that we have proven that the server and Rdb consolidation can be implemented on HP architecture, we have to refine and complete all applications.

Technical Analysis of Benchmark

Methodology

This section describes how we implemented the test strategy. We developed a set of scripts using SiDist (file extension is .SIC) language; those scripts emulate back-office activities inside local and main area CNA facilities based on a set of data significant enough for testing. All test procedures and reports run in batch mode on a specific queue with base priority 4 (the base priority OpenVMS reserves for interactive processes).
Scripts execute typical activities like record modify, add, delete on local data concerning the local office itself. On the other side, we also have scripts and reports running on global data and emulating the main area (province) offices. That is, the first set of scripts run local data against the local database; the second set of scripts and reports run global data against the "whole database"; they run in different configurations in order to generate a workload of from 1 to 500 users.

At the same time, two specific procedures, both named 'osservati', ran on the system and we monitored them with different workloads (users) and collected the corresponding elapsed times. From log files we extracted interesting details concerning overall activities that the system/cluster can perform; also, using Rdb monitor tools, we collected from the whole database an average transactions per second measured on a timeframe of 90 minutes during the execution of the 'osservati' processes.

As a first step, we executed two DTM interactive procedures to test the system and collect details on transactions; unfortunately, the DTM recorded interactive sessions were not reliable due to problems in events synchronization. Therefore, we decided to change our strategy as previously described.

Hardware Configuration

The cluster configuration contained the following hardware:

1. ES45 (sia047), 16 GB memory, 4 CPU 1001MHz
2. ES45 (sia048), 12 GB memory, 4 CPU 1001MHz
3. MA8000 storage array with 5 volumes:
   - 1DGA200: 36 GB (2 x 18 GB disks stripe set)
   - 1DGA300: 36 GB (2 x 18 GB disks stripe set)
   - 1DGA400: 144 GB (8 x 18 GB disks stripe set)
   - 1DGA500: 72 GB (4 x 18 GB disks stripe set)
   - 1DGA800: 36 GB (2 x 18 GB disks stripe set)

We also used the following equipment for communication and services purposes:

1. DS20 (sia049); it operated as a DTM server and to launch interactive sessions
2. XP1000 (isvlab); it ran as a gateway between lab and external internet access
3. CISCO Firewall

From SIAER facilities in Modena, Italy and Nashua Labs we had access via telnet with triple authentication: Cisco, isvlab AlphaServer and ES45's cluster.

Software Configuration

The software configuration was as follows:

1. OpenVMS 7.3 with XFC cache enable
2. Oracle Rdb v 7.1-02
3. Data monitor and collector PSDC
4. SiDist application with Golem support (global database):
   - Local and global data access
   - Query optimization (for report generation only)
5. DCL procedures to start test execution
6. SiDist procedures, as described in Table 1.

– *Table 1: Procedure Descriptions*

Name	Description
Gol_ente_rag.sic	Add and update of ENTE (company) record and related structures
Gol_ente_rag_nonew.sic	Update of ENTE (company) record and related structures
Gol_pers_cognomi.sic	Add and update of PERSONA (person) record and related structures
Gol_pers_nonew.sic	update of PERSONA (person) record and related structures
Gol_genmov1.sic, gol_genmov2.sic, gol_genmova.sic, gol_genmovb.sic, gol_genmovc.sic	Different procedures to read and manage financial accounting record and data structure
Gol_crediti.sic	Read CLIENTE_CNA record and add / update credits
Gol_f24.sic	Mining of 'pkey' details for proxy payment
Gol_dett.sic	Add and create invoices
Gol_righe.sic	Reading and updating all financial accounting record for selected ENTE
Report gol_tess.sic	Complex report (iscritto, casind, impresa, albo_costruttore, auto_trasportatore, operatore_estero, esercente_commercio, tessera, artigiana, separata_sezione, commerciale, piccola_impresa)
Report gol_repcon.sic	Simple report
Report gol_reppag.sic	Simple report
Report gol_prato.sic	Complex report (iscritto, cliente_cna, impresa, sede, comuni, casind, contabilità, mia, consulenza, cose, coge, coge_attivita, pa_mensile, paghe, istanza, artigiana, separata_sezione, piccola_impresa, commerciale)

We used the set of scripts, procedures, and records as shown in Table 2.

– *Table 2: Sets of Procedures*

Workload	Set of Scripts
Set ONE (< 350 users, test 1,2,3,4 e 5)	• Ufficio (7 procedures) o 1 x Gol_ente_rag.sic o 2 x Gol_ente_rag_nonew.sic o 1 x Gol_pers_cognomi.sic o 1 x Gol_pers_nonew.sic o 2 x Gol_genmov[1|2].sic • Provincia (7 procedures) o 1 x Gol_ente_rag_nonew.sic o 2 x Gol_repcon.sic o 2 x Gol_reppag.sic o 2 x Gol_crediti.sic • Unici (5 reports and procedures) o 1 x Gol_f24.sic o 1 x Gol_righe.sic o 1 x Gol_dett.sic o 1 x Gol_prato.sic o 1 x Gol_tess.sic • Osservati (2 procedures) o 1 x Gol_osservato.sic o 1 x Gol_osservato_l.sic

Set TWO (~ 350 users, test 6)	• Ufficio (9 procedures) o 1 x `Gol_ente_rag.sic` o 3 x `Gol_ente_rag_nonew.sic` o 1 x `Gol_pers_cognomi.sic` o 2 x `Gol_pers_nonew.sic` o 1 x `Gol_genmov[1|2].sic` • Provincia (7 procedures) o 1 x `Gol_ente_rag_nonew.sic` o 2 x `Gol_repcon.sic` o 2 x `Gol_reppag.sic` o 2 x `Gol_crediti.sic` • Unici (5 reports and procedures) o 1 x `Gol_f24.sic` o 1 x `Gol_righe.sic` o 1 x `Gol_dett.sic` o 1 x `Gol_prato.sic` o 1 x `Gol_tess.sic` • Osservati (2 procedures) o 1 x `Gol_osservato.sic` o 1 x `Gol_osservato_l.sic`

Set THREE (~ 500 users, test 7)	• Ufficio (13 procedures) o 1 x Gol_ente_rag.sic o 4 x Gol_ente_rag_nonew.sic o 1 x Gol_pers_cognomi.sic o 3 x Gol_pers_nonew.sic o 3 x Gol_genmov[a|b|c].sic o 1 x Gol_crediti.sic • Provincia (7 procedures) o 1 x Gol_ente_rag_nonew.sic o 2 x Gol_repcon.sic o 2 x Gol_reppag.sic o 2 x Gol_crediti.sic • Unici (5 reports and procedures) o 1 x Gol_f24.sic o 1 x Gol_righe.sic o 1 x Gol_dett.sic o 1 x Gol_prato.sic o 1 x Gol_tess.sic • Osservati (2 procedures) o 1 x Gol_osservato.sic o 1 x Gol_osservato_l.sic

To generate a correct workload, the amount of "set of scripts" was increased. Table 3 shows the different workload types we used to test the whole architecture.

– *Table 3: Workload Types*

Workload Type	Procedures	Processes
1	No workload 2 osservati	2 osservati Total 2
2	7 local offices x 7 procedures Ufficio (49) 1 main offices x 7 procedures Provincia (7) 5 Unici (5) 2 osservati	61 disturb processes 2 osservati Total 63
3	14 local offices x 7 procedures Ufficio (98) 2 main offices x 7 procedures Provincia (14) 5 unici (5) 2 osservati	117 disturb processes 2 osservati Total 119
4	21 local offices x 7 procedures Ufficio (147) 3 main offices x 7 procedures Provincia (21) 5 Unici (5) 2 osservati	173 disturb processes 2 osservati Total 175
5	28 local offices x 7 procedures Ufficio (196) 4 main offices x 7 procedures Provincia (28) 5 Unici (5) 2 osservati	229 disturb processes 2 osservati Total 231
6	38 local offices x 9 procedures Ufficio (342) 1 main offices x 7 procedures Provincia (7) 5 Unici (5) 2 osservati	354 disturb processes 2 osservati Total 356
7	38 local offices x 13 procedures Ufficio (494) 1 main offices x 7 procedures Provincia (7) 5 Unici (5) 2 osservati	506 disturb processes 2 osservati Total 508

Table 4 shows the architecture and system configuration models we used to run workload procedures. The last digit in Test Name indicates the corresponding workload as shown in Table 3; for example, TZ4 means we used workload number 4 from Table 3, which is 175 processes.

– *Table 4: Configuration Models*

Configurations	Description	Test Name
P	Single ES45 and Global Buffer in 32 bit memory (max. 81550 buffers)	Test TP1, TP2, TP3, TP4 e TP5
Z	Single ES45 and Global Buffers in VLM (max. 524000 buffers)	Test TZ2, TZ3, TZ4, TZ5 e TZ6
DB	Application server ES45 and database server ES45 with Global Buffers in VLM (max. 524000 buffers)	Test TDB5 e TDB7
RC	Application server ES45 and database server ES45 with Global Buffers in VLM (max. 524000 buffers) and row cache configuration type 1	Test TRC5 e TRC7
RCN	Application server ES45 and database server ES45 with Global Buffers in VLM (max. 524000 buffers) and row cache configuration type 2	Test TRC7N

The row cache configurations are shown in Table 5.

– *Table 5: Row Cache Configurations*

Configuration type 1: (326,707,172 byte RAM used)

Users = 700	SLOTS	LENGTH	WSSIZE	Tot.Mem	Phy.Mem
SIB003EE70001D04AA_VIS_IDX	13,000	430	10	6,417,828	6,416,416
SIB003EE7001E904AA_VIS_IDX	35,000	430	10	17,173,924	17,172,512
SIB003EE70001D04AA_PK_ENTITA	33,000	120	10	5,918,116	5,916,704
SIB003EE7001E904AA_PK_ENTITA	88,000	120	10	15,420,836	15,419,424
RDB$SYSTEM_AREA_CACHE	200,000	512	10	113,175,972	113,174,560
SIB003459000B404AC_IDX	19,000	450	10	9,743,780	9,742,368
SIB003459000BC04AC_IDX	13,000	450	10	6,679,972	6,678,560
SIB003EE70001D04AA	58,000	600	10	37,957,028	37,955,616
SIB003EE7000DC04AA	30,000	260	10	9,489,828	9,488,416
SIB003EE7001E904AA	130,000	360	10	53,685,668	53,684,256
SIB003EE7002E204AA	57,000	134	10	10,866,084	10,864,672
SIB003EE7002F404AA	50,000	232	10	14,372,260	14,370,848
SIB013A1E0B8E30A4A	14,000	200	10	3,640,740	3,639,328
SIB003EE7000DC04AA_PK_ENTITA	22,000	120	10	3,935,652	3,934,240
SIB003EE7002E204AA_PK_ENTITA	48,000	120	10	8,441,252	8,439,840
SIB003EE7002F404AA_PK_ENTITA	43,000	120	10	7,597,476	7,596,064
SIB013A1E0B8E30A4A_PK_ENTITA	12,000	120	10	2,190,756	2,189,344

Configuration type 2: (396,374,224 byte RAM used)

Users = 700	SLOTS	LENGTH	WSSIZE	Tot.Mem	Phy.Mem
SIB003EE70001D04AA_VIS_IDX	13,000	430	10	6,417,828	6,416,416
SIB003EE7001E904AA_VIS_IDX	35,000	430	10	17,173,924	17,172,512
SIB003EE70001D04AA_PK_ENTITA	33,000	120	10	5,918,116	5,916,704
SIB003EE7001E904AA_PK_ENTITA	88,000	120	10	15,420,836	15,419,424
RDB$SYSTEM_AREA_CACHE	200,000	512	10	113,175,972	113,174,560
SIB003459000B404AC_IDX	19,000	450	10	9,743,780	9,742,368
SIB003459000BC04AC_IDX	13,000	450	10	6,679,972	6,678,560
SIB003EE70001D04AA	58,000	600	10	37,957,028	37,955,616
SIB003EE7000DC04AA	30,000	260	10	9,489,828	9,488,416
SIB003EE7001E904AA	130,000	360	10	53,685,668	53,684,256
SIB003EE7002E204AA	57,000	134	10	10,866,084	10,864,672
SIB003EE7002F404AA	50,000	232	10	14,372,260	14,370,848
SIB013A1E0B8E30A4A	14,000	200	10	3,640,740	3,639,328
SIB003EE7000DC04AA_PK_ENTITA	22,000	120	10	3,935,652	3,934,240
SIB003EE7002E204AA_PK_ENTITA	48,000	120	10	8,441,252	8,439,840
SIB003EE7002F404AA_PK_ENTITA	43,000	120	10	7,597,476	7,596,064
SIB013A1E0B8E30A4A_PK_ENTITA	12,000	120	10	2,190,756	2,189,344

SIDIST_HASH_BIS_CACHE	100,000	120	10	17,444,260	17,442,848
SIDIST_HASH_CACHE	200,000	120	10	34,778,532	34,777,120
SIDIST_HASH_LOCALI_CACHE	100,000	120	10	17,444,260	17,442,848

The following list provides the cache names and related descriptions:

- Physical caches in Table 6 (they include data corresponding to all record types in the database)

– *Table 6: Physical Caches*

RDB$SYSTEM_AREA_CACHE	Physical Rdb system area
SIDIST_HASH_BIS_CACHE	Physical area with HASH indexes
SIDIST_HASH_CACHE	Physical area with HASH indexes
SIDIST_HASH_LOCALI_CACHE	Physical area with HASH indexes

- Logical caches in Table 7 (they include data corresponding to specific record type in the database)

– *Table 7: Table and Index Caches*

SIB003EE70001D04AA	Table ENTE
SIB003459000B404AC_IDX	Index on RAGIONE_SOCIALE of ENTE
SIB003EE70001D04AA_PK_ENTITA	Index PK_ENTITA for ENTE
SIB003EE70001D04AA_VIS_IDX	Visibility index of hierarchy ENTE
SIB003EE7000DC04AA	Table CLIENTE_CNA
SIB003EE7000DC04AA_PK_ENTITA	Index PK_ENTITA of CLIENTE_CNA
SIB003EE7001E904AA	Table PERSONA
SIB003459000BC04AC_IDX	Index on COGNOME of PERSONA
SIB003EE7001E904AA_PK_ENTITA	Index PK_ENTITA for PERSONA
SIB003EE7001E904AA_VIS_IDX	Visibility index of hierarchy PERSONA
SIB003EE7002E204AA	Table CLIENTE_P
SIB003EE7002E204AA_PK_ENTITA	Index PK_ENTITA of CLIENTE_P
SIB003EE7002F404AA	Table DR_PERSONA
SIB003EE7002F404AA_PK_ENTITA	Index PK_ENTITA of DR_PERSONA
SIB013A1E0B8E30A4A	Table CONTABILITA
SIB013A1E0B8E30A4A_PK_ENTITA	Index PK_ENTITA of CONTABILITA

Analysis of Results

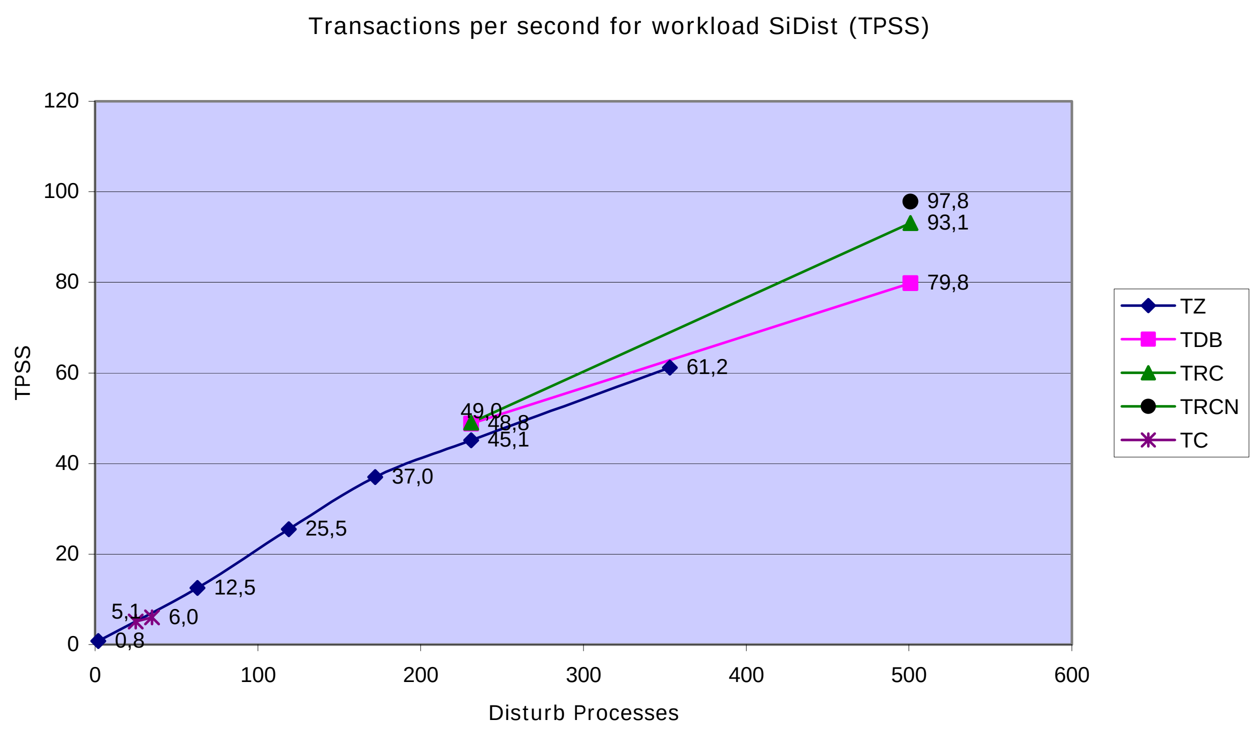
The following figures and tables show all the results we gathered from tests. For detailed information on the tests, see the Appendix.

Figures 1, 2, 3, and 4 show the details collected from the tests.

Figure 1 shows transaction per second, as Oracle Rdb monitor tool reports, for different workloads. Configurations are shown in colors, see legend aside. We reported also the comparison system we used locally: (TC: comparison test).

Note that only the configuration with a global buffer in VLM @ 524000 and single ES45 (TZ) runs tests 2, 3, 4, and 6 (corresponding to 63, 119, 175 e 356 disturb processes); configurations with database server, with or without row cache (TDB e TRC), run tests 5 and 7 (231 and 508 disturb processes). Test 5 (231 disturb processes) has been used against configurations TZ, TDB e TRC. The configurations with database server, with row cache type 2, run test 7 only (508 processes). We'll use TPSS name in order to show TPS (Transactions per second) for workload on SiDist main application.

Figure 1: Transaction per Second at a Different Workload (Disturb Processes)



In Figure 1, note that TPSS has a linear increase on TZ configuration up to test 4 (178 processes); then, it shows a nonlinear curve, meaning that this configuration cannot support a heavier workload. If we highlight the configuration with row cache, it shows a linear growth, like a straight line; if we take only the line portions of tests 1, 2, 3, and 4 for TZ, test 5 for TRCm, and test 7 for TRCN, we will obtain the results in Figure 2.

Figure 2: Trend of Better Results at a Different Workload (Disturb Processes)

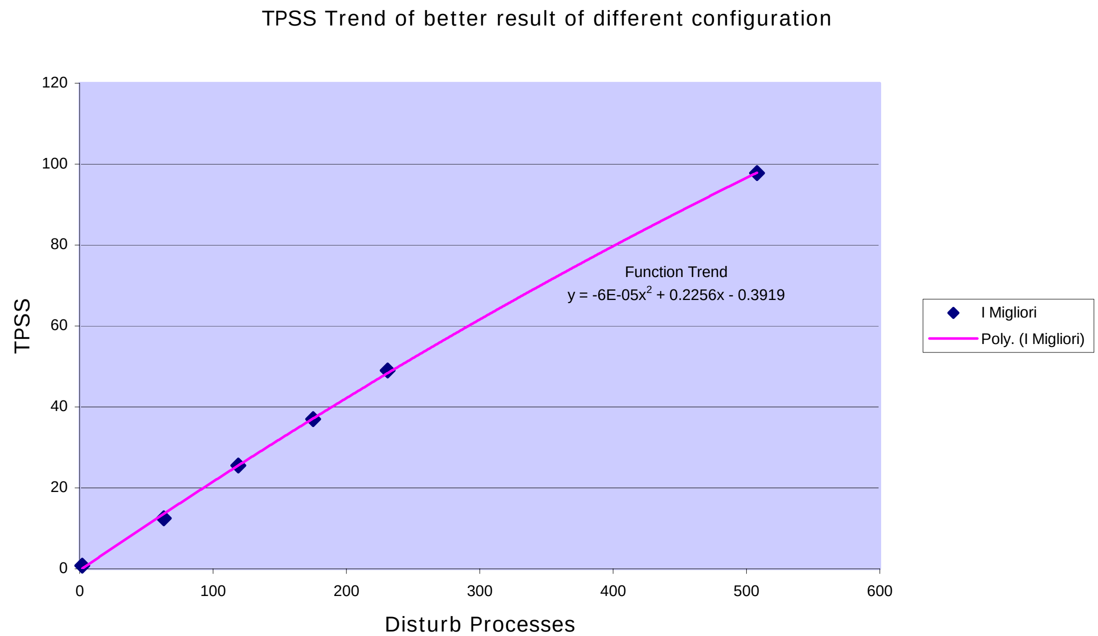


Figure 2 shows a linear curve of TPSS; the configuration with database machine and row cache is the best configuration because it keeps a linear growth at different workload, higher included (508 disturb processes). Also note in this figure that Migliori in the key means "Top of Series."

Figure 3 shows the amount of TPSS per single process (average). We have a very low decline of performances.

Figure 3: TPSS per Process at a Different Workload

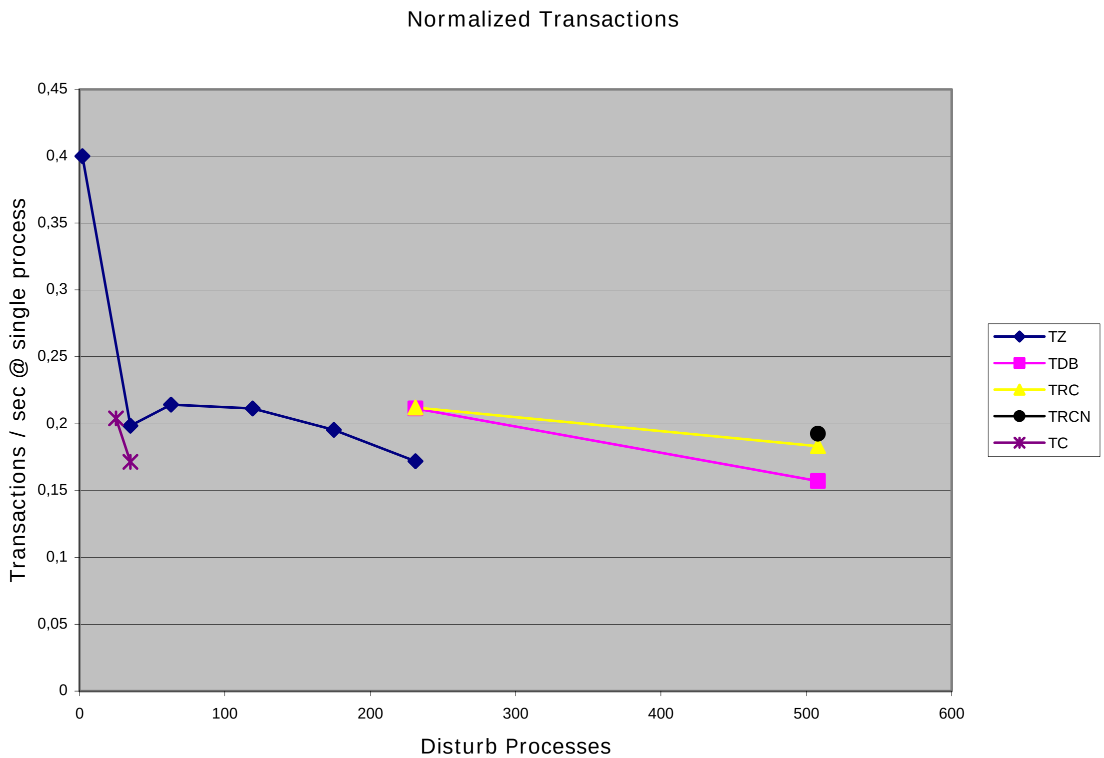


Figure 4: Elapsed time of OSSERVATO_L Process at a Different Workload

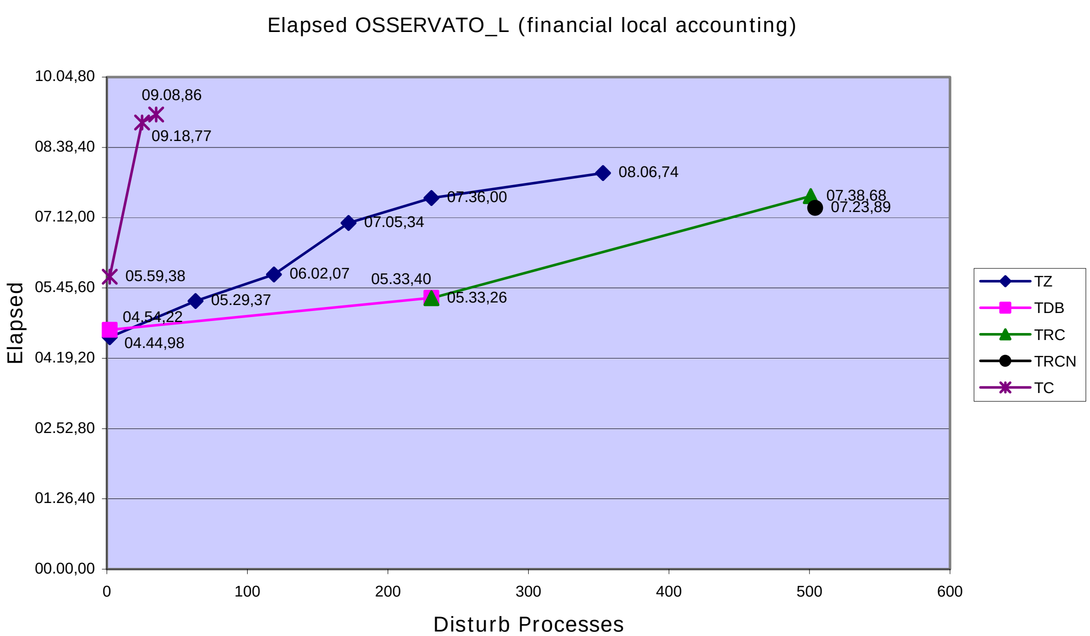
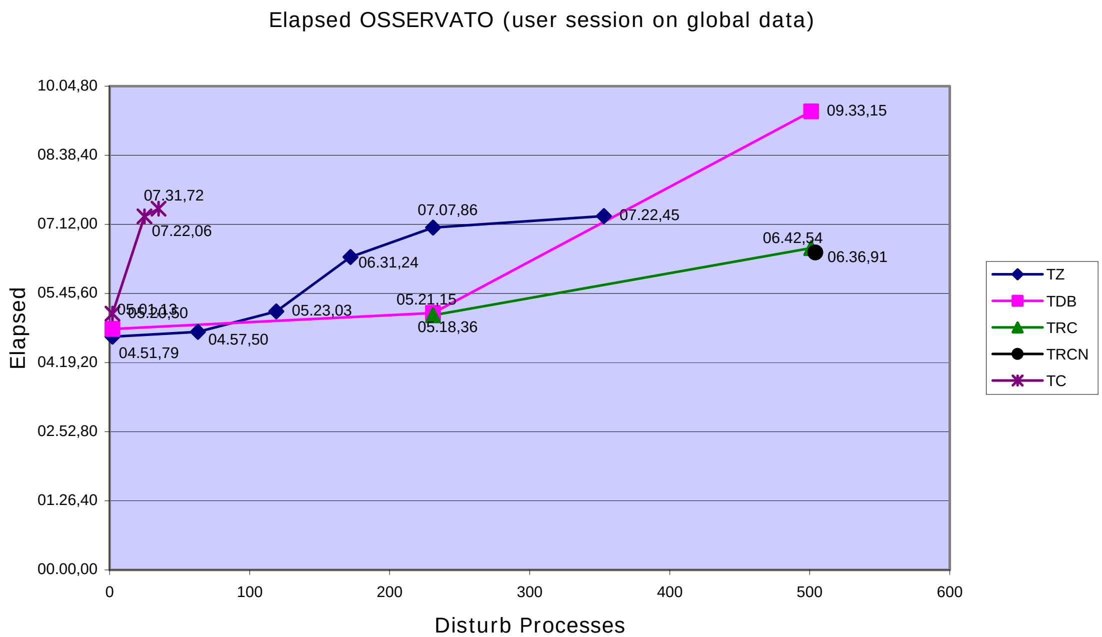


Figure 4 and Figure 5 show the elapsed time for "OSSERVATI" processes on different workloads. Note the elapsed time of "OSSERVATI" processes on the configuration named RCN (the database machine with row cache type 2) and 508 disturb processes. It is clearly less than the elapsed time on the comparison test system (DS20E) with fewer disturb processes (only 25).

OSSERVATO_L: 07:23:89 versus 09:18:77
OSSERVATO: 06:36:91 versus 07:22:06

We may confirm the configuration used for benchmark is better than one we used on our offices; it reacts fine even with higher workload on global data.

Figure 5: Elapsed time of the OSSERVATO Process on a Different Workload



We also collected a number of transactions on different workloads. The data collected were: ENTE creation, update of ENTE and related data structure, PERSONE creation and update, and ACTIVITIES creation.

We normalized transaction data to a one-hour period in order to compare data collected from the benchmark system and comparison test system.

Tests loading and running really penalize the normalization of test results. In fact, tests with a large number of disturb processes have been activated in more than one shot because the server, which handles the generation of disturb processes, did not allow more than 200 disturb processes to start at a time. Therefore, tests with 231 and 356 processes were loaded in two steps and tests with 508 processes were loaded in three steps. In Table 8, start time is related to start time of the last step. We also had difficulties in killing all disturb processes not stopping by themselves as the procedures should do; this may generate some very limited uncertainty in collected results.

Table 8: Transaction Data: Elapsed Time on Different Tests

					ENTE		PERSONE		ACTIVITIES
Test	Processes	Start	End	Elapsed	Creation	Update	Creation	Update	Creation
TP2	61	08:09:43	09:15:43	01:06:00	29	827	26	1319	5704
TP3	117	09:26:18	10:02:31	00:36:13	44	984	34	1454	5874
TP4	173	10:50:20	11:30:38	00:40:18	18	980	32	1602	6150
TP5	229	11:32:10	12:30:00	00:57:50	0	1907	62	3327	13901
TZ2	63	11:06:01	11:41:46	00:35:45	28	501	14	737	3056
TZ3	119	11:45:19	12:22:45	00:37:26	52	1011	33	1484	5982
TZ4	172	08:29:13	09:06:50	00:37:37	70	1377	44	1987	7784
TZ5	233	10:16:43	11:01:35	00:44:52	111	2105	72	2951	11708
TZ6	353	04:17:25	05:06:00	00:48:35	141	3997	92	6475	13834
TDB5	233	07:52:00	08:36:00	00:44:00	95	2224	72	3199	13298
TDB7	501	10:40:00	11:33:00	00:53:00	274	4497	81	7238	19392
TRC5	231	09:27:02	10:07:06	00:40:04	97	2387	71	3574	14514
TRC7	501	11:19:52	12:01:20	00:41:28	136	4866	94	8690	20840
TRC7N	504	08:12:01	08:54:04	00:42:59	150	4826	109	8899	21433
TC2	25	13:41:28	14:30:15	00:48:47	4	166	2	402	1082
TC3	35	16:22:00	17:16:18	00:54:18	4	318	3	741	1092

Table 9: Transaction Data: Elapsed @ different tests and normalized @ 1 hour

		ENTE		PERSONE		ACTIVITIES
Test	Processes	Creation	Update	Creation	Update	Creation
TP2	61	26.4	751.8	23.6	1,199.1	5,185.5
TP3	117	72.9	1,630.2	56.3	2,408.8	9,731.4
TP4	173	26.8	1,459.1	47.6	2,385.1	9,156.3
TP5	229	0.0	1,978.4	64.3	3,451.6	14,421.8
TZ2	63	47.0	840.8	23.5	1,236.9	5,129.0
TZ3	119	83.3	1,620.5	52.9	2,378.6	9,588.2
TZ4	172	111.7	2,196.4	70.2	3,169.3	12,415.8
TZ5	233	148.4	2,815.0	96.3	3,946.4	15,657.1
TZ6	353	174.1	4,936.3	113.6	7,996.6	17,084.9
TDB5	233	129.5	3,032.7	98.2	4,362.3	18,133.6
TDB7	501	310.2	5,090.9	91.7	8,194.0	21,953.2
TRC5	231	145.3	3,574.5	106.3	5,352.1	21,734.8
TRC7	501	196.8	7,040.8	136.0	12,574.0	30,154.3
TRC7N	504	214.0	6,886.1	155.5	12,697.7	30,582.2
TC2	25	4.9	204.2	2.5	494.4	1,330.8
TC3	35	4.4	351.4	3.3	818.8	1,206.6

To compare the results between the benchmark and the comparison test (TC2, TC3), we projected the number of processes to 500, as shown in Table 10.

Table 10: 500 Processes Projection

		ENTE		PERSONE		ACTIVITIES
Test	Processes	Creation	Update	Creation	Update	Creation
TC2	500	98.4	4,083.4	49.2	9,888.6	26,615.6
TC3	500	63.1	5,019.7	47.4	11,696.9	17,237.6

Note that the configuration we tested in Nashua shows better performance at all times with any kind of workload than the comparison test system at the office.

Database Activity

The Rdb database created on-site at SIAER before our visit to Nashua is the full Modena database; Modena (a province inside the Emilia-Romagna region) has the largest and most populated database of the region. We reorganized the database because after the first tests we discovered a bad organization of the data: excessive fragmented record rate, and a slowness in inserting record operation due to excessive check on database pages. After the reorganization, we experienced better performance. To test different configurations, the Modena database was modified. We changed the parameter related to global buffer allocation (total number of global buffers, global buffers per process, memory location, and so on) and created Row Caches. Row Caches were allocated taking care of two topics:

- The database analysis told us the record sizing and allocation
- The knowledge of applications helped us identify where and how Row Caches have to be applied.

We did not perform any optimization on indexes; we used the original ones at database creation before visiting Nashua.

The entire database was loaded on a single volume of storage array MA8000; it performed fine in any test. The I/O rate of the database has been always lower than the I/O rate of the disks where application data (called KB inside SIAER applications) are stored: the I/O rate was between 800 and 900 I/O per second on the database disk for the test with largest number of disturb processes.

Final Considerations

All tests validated the proposed configuration. This architecture can carry the workload of the biggest province (see database), Modena, performing better than the current smaller databases at local offices.
If we look at the results, the better configuration is to have separate database and application systems – a database machine and an application machine – with row cache: this configuration provided significant performance increases.

The presence of the “visibility table,” a new table we included specifically for the database consolidation, adds one more join level for each record (ENTE, PERSONA, ACTIVITIES); that makes the search operations across the overall database more expensive in contrast to performing current search operations on single and smaller databases located at each local offices.

The use of row cache on the “visibility table” makes the difference, because we do not perform any I/O. The usage of PK_ENTITA, as a sorted index, for search operations (RAGIONE_SOCIALE, COGNOME) in the database, is performed without accessing the records and avoids heavy I/O. Otherwise, any search operation could involve a huge number of tables. In those cases, splitting the query into two or more queries and using fewer tables for each query provides better performance.

A simple consideration we did after the benchmark, and one we are investigating now, is to consolidate the 180 single/local databases into 15 databases. The number of provinces (Modena is one of them and has the biggest database after consolidation) requires more attention on how queries are performed because a “not optimized” query may create bad performances. As stated earlier, the consolidated database of the test province of Modena is approximately 100 GB. A specific guideline will be provided to SIAER programmers in order to optimize the code of applications due to huge dimension of many tables inside the consolidated database (Golem).

Looking Forward

We are reviewing the following recommendations to revise the final SiDist application in the new consolidated environment:

- Database configuration and management: In creating a single consolidated database from 15 databases, some of them approximately 80-100 GB, it is extremely important to have the correct configuration of the database as well as to test and validate all applications involved. Our experience showed that an application that runs fine in a distributed environment with many smaller databases may have performance problems running in a single consolidated database.

- Security: Security is more critical for a consolidated database. A security problem on a local database can generate a corruption or loss of data only in a single office; for a consolidated database the consequences can be much greater. We are planning a "security project" in the near future because of this issue and, because we are also developing external Web-based applications running together with existing applications and databases. All the data we manage is sensitive data, confidential and classified, and requires the implementation of a secure environment.

- Applications: We will review the current set of applications in relation to the following criteria when they run with the single large database:
    - Query optimization: prudent and cautious usage of the "visibility table", key factors for faster and wider queries, and security of data management
    - Re-use of compiled queries, dynamic query optimization
    - Assure security on data access and on qualification of database operation.

Appendix

Test Summary

In this appendix you will find details of the tests we performed and discussed in this document. Note that in the beginning tests were performed by some recorded (using DTM) interactive session, but we discontinued these later due to the instability of the DTM recorded operation.

We used the terminology TPSS to mean transactions per second as reported by the database monitor process. The database monitor collects data for a 90-second time frame when "osservati" processes run.

"Launch end" means times when all batch disturb processes are up and running (each batch log reports start-time of processes).

"Test end" means when all disturb processes completed or, for some processes, when they have been killed.

Global Buffer in Standard Memory (32-Bit)

With the single system, named Sia047 (16 GB, 4 CPU), and the database configured with 81550 global buffer in 32-bit system memory, we ran tests with configurations 2, 3, 4 and 5 of Table 3. For each configuration, user buffers were allocated when the database was opened in order to allow connections to "disturb" processes. The results are as follows:
TP2

Date: August 2, 2002
Configuration: 2 (Table 3), P (Table 4)
User DTM1: PPROD01
User DTM2: PPROD50
User "osservati": PPROD04
Launch start: 08:09:43
Launch end: 08:12:05
Launch DTM: 08:13:23
Launch Osservati: 08:13:57
Test end: 09:15:43
TPSS: 14.2 (with 63 active processes)

TP3

Date: August 2, 2002
Configuration: 3 (Table 3), P (Table 4)
User DTM1: PPROD01
User DTM2: PPROD50
User "osservati": PPROD04
Launch start: 09:26:18
Launch end: 09:29:31
Launch DTM: 09:29:44
Launch Osservati: 09:52:33
Test end: 10:02:31

TPSS: 24.1 (with 119 active processes)

TP4

Date: August 2, 2002
Configuration: 4 (Table 3), P (Table 4)
User DTM1: PPROD01
User DTM2: PPROD50
User “osservati”: PPROD04
Launch start: 10:50:20
Launch end: 10:55:17
Launch DTM: 10:55:20
Launch osservati: 10:55:20
Fine DTM: 11:18:02
Test end: 11:30:38
TPSS: 32.2 (with 175 active processes)

TP5

Date: August 2, 2002
Configuration: 5 (Table 3), P (Table 4)
User DTM1: PPROD01
User DTM2: PPROD50
User “osservati”: PPROD04
Launch start: 11:32:10
Launch end: 11:44:24
Launch DTM: 11:44:44
Launch osservati: 11:44:44
Test end: 12:30:00
TPSS: 39.5 (with 231 active processes)

Global Buffer in VLM (64-Bit)

With the single system Sia047 (16 GB, 4 CPU) and the database configured with 524000 global buffer in 64bit system memory (VLM: Very Large Memory), we ran tests with configuration 1, 2, 3, 4, 5, and 6 of Table 3. For each configuration, we allocated 700 buffers per user. The results are as follows:
TZ1

Date: August 7, 2002
Configuration: 1 (Table 3), Z (Table 4)
Partial collection on “Osservati processes”
Test start: 03:43:01
Test end: 03:47:52

TZ2 (version TZ2B)

Date: August 6, 2002

Configuration: 2 (Table 3), Z (Table 4)
User “osservati”: PPROD04
Launch start: 11:06:01
Launch end: 11:07:35
Launch osservati: 11:09:14
Test closing: 11:39:45
Test end: 11:41:46
TPSS: 12.5 (with 63 active processes)

TZ3 (version TZ3B)

Date: August 6, 2002
Configuration: 3 (Table 3), Z (Table 4)
User “osservati”: PPROD04
Launch start: 11:45:19
Launch end: 11:46:34
Launch osservati: 11:49:55
Test closing: 12:20:39
Test end: 12:22:45
TPSS: 25.5 (with 119 active processes)

TZ4 (version TZ4B)

Date: August 6, 2002
Configuration: 4 (Table 3), Z (Table 4)
User “osservati”: PPROD04
Launch start: 08:29:13
Launch end: 08:31:20
Launch osservati: 08:41:13
Test closing: 09:02:39
Test end: 09:06:47
TPSS: 37.0 (with 175 active processes)

TZ5

Date: August 6, 2002
Configuration: 5 (Table 3), Z (Table 4)
User “osservati”: PPROD04
Launch start part 1: 10:16:43
Launch end part 1: 10:20:00
Launch start part 2: 10:24:04
Launch end part 2: 10:24:54
Launch osservati: 10:27:40
Test closing: 10:56:06
Test end: 11:01:40
TPSS: 45.1 (with 231 active processes)

TZ6

Date: August 7, 2002
Configuration: 6 (Table 3), Z (Table 4)
User “osservati”: PPROD04
Launch start part 1: 04:11:15
Launch end part 1: 04:13:05
Part 1 processes active at: 04:16:05
Launch start part 2: 04:17:25
Launch end part 2: 04:19:10
Part 2 processes active at: 04:25:27
Launch osservati: 04:26:39
Osservati processes active at: 04:27:55
Test closing: 05:00:00
Test end: 05:06:00
TPSS: 61.2 (with 356 active processes)

Database Machine, Global Buffer in VLM

With the system Sia047 (16 GB, 4 CPU) configured as the application server and the second system, named Sia048 (12 GB, 4 CPU) configured as the database server, and the database configured with 524000 global buffer in 64-bit system memory (VLM: Very Large Memory), we ran tests with configuration 1, 5, and 7 of Table 3. For each configuration, we allocated 700 buffers per user.

TDB1

Date: August 7, 2002
Configuration: 1 (Table 3), Z (Table 4)
Partial collection on “Osservati processes”
Test start: 07:36:48
Test end: 07:41:49

TDB5

Date: August 7, 2002
Configuration: 5 (Table 3), DB (Table 4)
User “osservati”: PPROD04
Launch start part 1: 07:52:00
Launch end part 1: 07:54:33
Part 1 processes active at: 07:55:33
Launch start part 2: 07:56:32
Launch end part 2: 07:57:34
Part 2 processes active at: 07:58:40
Launch osservati: 07:59:43
Osservati processes active at: 08:00:58
Test closing: 08:30:50
Test end: 08:35:38
TPSS: 48.8 (with 231 active processes)

TDB7

Date: August 7, 2002
Configuration: 7 (Table 3), DB (Table 4)
User “osservati”: PPROD04
Launch start part 1: 10:40:05
Launch end part 1: 10:41:44
Part 1 processes active at: 10:42:56
Launch start part 2: 10:44:18
Launch end part 2: 10:45:47
Part 2 processes active at: 10:47:50
Launch start part 3: 10:49:06
Launch end part 3: 10:51:07
Part 3 processes active at: 10:55:23
Launch osservati: 10:55:27
Osservati processes active at: 10:56:34
Test closing: 11:29:49
Test end: 11:33:53
TPSS: 79.8 (with 508 active processes)

Database Machine, Global Buffer and Row Cache in VLM

With the system Sia047 (16 GB, 4 CPU) configured as the application server and the second system Sia048 (12GB, 4CPU) configured as the database server, and the database configured with 524000 global buffers in 64-bit system memory (VLM: Very Large Memory) and two specific row cache configurations in VLM (see Table 5), we ran tests with configurations 5 and 7 of Table 3. For each configuration, we allocated 700 buffers per user.

TRC5

Date: August 8, 2002
Configuration: 5 (Table 3), RC (Table 4)
User “osservati”: PPROD04
Launch start part 1: 09:21:36
Launch end part 1: 09:24:09
Part 1 processes active at: 09:25:56
Launch start part 2: 09:27:02
Launch end part 2: 09:30:04
Part 2 processes active at: 09:30:58
Launch osservati: 09:32:30
Osservati processes active at: 09:33:44
Test closing: 10:04:10
Test end: 10:07:06
TPSS: 49.0 (with 231 active processes)

TRC7

Date: August 8, 2002
Configuration: 7 (Table 3), RC (Table 4)
User “osservati”: PPROD04

Launch start part 1: 11:10:00
Launch end part 1: 11:11:38
Part 1 processes active at: 11:14:11
Launch start part 2: 11:15:22
Launch end part 2: 11:16:55
Part 2 processes active at: 11:19:00
Launch start part 3: 11:19:52
Launch end part 3: 11:22:03
Part 3 processes active at: 11:26:46
Launch osservati: 11:27:58
Osservati processes active at: 11:29:33
Test closing: 11:58:25
Test end: 12:01:20
TPSS: 93.1 (with 508 active processes)

TRC7N

Date: August 9, 2002
Configuration: 7 (Table 3), RCN (Table 4)
User "osservati": PPROD04
Launch start part 1: 08:02:31
Launch end part 1: 08:04:16
Part 1 processes active at: 08:06:07
Launch start part 2: 08:07:14
Launch end part 2: 08:08:48
Part 2 processes active at: 08:10:07
Launch start part 3: 08:12:01
Launch end part 3: 08:14:05
Part 3 processes active at: 08:18:58
Launch osservati: 08:20:04
Osservati processes active at: 08:21:16
Test closing: 08:50:59
Test end: 08:54:04
TPSS: 97.8 (with 508 active processes)

Comparison Test

To better evaluate results, we got ready a comparison system that looks like a typical system at local offices (Foa001); it's a DS20 single CPU@500MHz processor and 1GB memory; disks are as follows:

- DKA0 (9GB) OpenVMS operating system and layered products
- DKA100 (9GB) database: user data
- DKA200 (36GB) application: user space - database: root file
- DKA300 (36GB) not used
- DKC0 (18GB) database: rdb$system space, user space
- DKC100 (36GB) database: RUJ
- DKC200 (36GB) database: user space
-

The comparison system refers to a local office with a number of users between 25 and 35; we adjusted the scripts launching "disturb" processes in order to emulate a typical office workload and related number of users. Osservati processes remains as before.

Table 11: Comparison Test Configuration

Configuration TC1 (2 users)	• Only Osservati Processes (2 procedures) o 1 x `Gol_osservato.sic` o 1 x `Gol_osservato_l.sic`
Configuration TC2 (25 users)	• Disturb Processes Ufficio (23 procedures) o 1 x `Gol_ente_rag.sic` o 5 x `Gol_ente_rag_nonew.sic` o 1 x `Gol_pers_cognomi.sic` o 5 x `Gol_pers_nonew.sic` o 5 x `Gol_genmovu[1|2|3|4|5].sic` o 1 x `Gol_repcon.sic` o 1 x `Gol_reppag.sic` o 4 x `Gol_crediti.sic` • Osservati Processes (2 procedures) o 1 x `Gol_osservato.sic` o 1 x `Gol_osservato_l.sic`
Configuration TC3 (35 users)	• Disturb Processes Ufficio (33 procedures) o 1 x `Gol_ente_rag.sic` o 10 x `Gol_ente_rag_nonew.sic` o 1 x `Gol_pers_cognomi.sic` o 10 x `Gol_pers_nonew.sic` o 5 x `Gol_genmovu[1|2|3|4|5].sic` o 1 x `Gol_repcon.sic` o 1 x `Gol_reppag.sic` o 4 x `Gol_crediti.sic` • Osservati Processes (2 procedures) o 1 x `Gol_osservato.sic` o 1 x `Gol_osservato_l.sic`

Comparison tests provided the following results:

				ENTE		PERSONE		ACTIVITIES	OSSERVATO		OSSERVATO_L	
test	date	start	end	creation	update	creation	update	creation	elapsed	CPU	elapsed	CPU
Tc1	27/08								05:20.50	03.90	05:59.38	09.53
Tc2	27/08	13:41:28	14:30:15	4	166	2	402	1082	07:22.06	04.55	09:08.86	10.96
Tc3	27/08	16:22:00	17:16:18	4	318	3	741	1092	07:31.72	04.71	09:18.77	11.45

Test Summary for Comparison

Tests run on local DS20 single CPU processor running at 500 Mhz and 1 GB memory.
TC1

Partial collection on “Osservati processes”
TC2

Date: August 27, 2002
Configuration: 2 (Table 8)
User “osservati”: PPROD04
Launch start: 13:41:28
Launch end: 13:41:37
Processes active at: 13:48:39
Launch osservati: 13:48:42
Osservati processes active at: 13:51:02
Test closing: 14:29:13
Test end: 14:30:15
TPSS: 5.1 (with 25 active processes)
TC3

Date: August 27, 2002
Configuration: 3 (Table 8)
User “osservati”: PPROD04
Launch start: 16:22:00
Launch end: 16:22:04
Processes active at: 16:32:08
Launch osservati: 16:32:25
Osservati processes active at: 16:35:28
Test closing: 17:14:40
Test end: 17:16:18
TPSS: 6.0 (with 35 active processes)