DB2 Family: Client/Server Performance Measurement Series
Importing/Exporting using DDCS for AIX

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Contents

1. Introduction

This technical report is one of a series of technical reports dealing with performance prediction and capacity planning issues for the DB2 family of products operating in a client/server configuration. The goal of these technical reports is to help the customer:

- Assess proposed configurations for acceptable performance
- Assess performance of current configurations
- Choose proper hardware capacity for a proposed configuration
- Choose the proper software programs for a proposed configuration
- Tune a new or current configuration

This report is unique because it describes the impacts on the numerous components involved in a client/server environment when importing and exporting between the DB2 common server platforms and DB2 for MVS/ESA. Use this report as an example configuration that could be analyzed and potentially applied to other configurations. This report describes the throughput, CPU utilization, CCU utilization, network utilization, and response times when importing and exporting between DDCS for AIX and DB2 for MVS/ESA.

In order to provide a general configuration that can be used widely, four things were determined to be the most important measurement considerations:

- Small size tables vs. large size tables
- Fixed size rows vs. variable size rows for the tables
- Many combinations of RQRIOBLK size and RU size
- Default thresholds for all buffer pools

2. Configuration

This technical report provides information in regards to the following configuration:

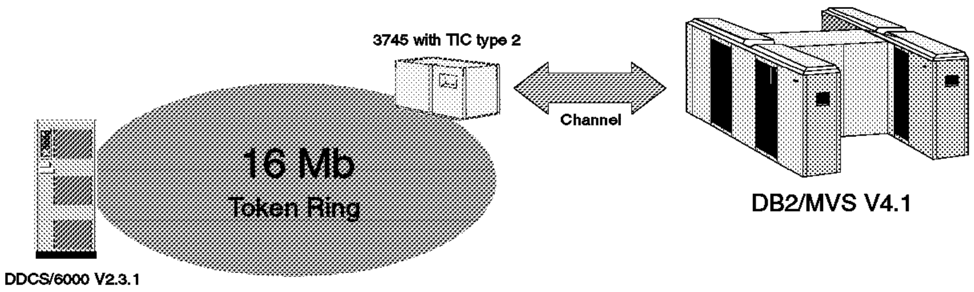

Figure 1. Measurement Configuration

Specifications

- **DB2 for MVS/ESA** Version 4.1 running on MVS Version 5.2 with VTAM Version 4.2. The processor is a 9121-742 (4-way) with 1 GByte of main storage and 1 GByte of expanded storage. The processor is partitioned into four logical partitions, with any one partition having the ability to utilize the other processors, if needed. The partition running DB2 for MVS/ESA has 576 MBytes of storage available to it. The processor is attached to a 3745 model 210 with 8 MBytes of storage on a 4.5 MByte block multiplex channel. The 3745 is attached to the 16 Mbit LAN via a TIC type 2.
- **Distributed Database Connection Services for AIX** Version 2.3.1 running on a 590 server which is where the Import/Export utility runs.
- **16 Mbit Token Ring LAN**

Network protocols in use between the components are as follows:

- APPC is in use between DDCS for AIX and DB2 for MVS/ESA.

The components in this configuration are monitored using the following programs:

- MVS: Resource Measurement Facility (RMF)
- DB2 for MVS/ESA: DB2 Accounting and Statistics traces
- 3745: Netview Performance Monitor (NPM)
- LAN: DatagLANce Network Analyzer for Ethernet and Token Ring for OS/2
- The UNIX ″time″ command

3. Workload Description

The Import and Export utilities for DB2 for AIX are used for these measurements. Import will take data from an external file and put it into the target database table. Export will create an external file from the data that is in the target database table.

The UNIX ″time″ command is used to time the importing and exporting of each table on AIX. For the two tables measured, the following syntax is used:

```
time db2 †import from table.ixf of ixf modified by compound=100 insert into table†

time db2 †export to table.ixf of ixf select * from table†
```

Table Characteristics

Table 1 describes the characteristics of the tables used in the measurement.

Table 1. Table Characteristics

Table	**Row Length**	**# of rows**	**# of columns**	**# of Indexes**	**Partitioned**	**Total size**
T1	85 bytes (fixed)	100,000	4	1	No	9.3 Mbytes
T2	179-679 bytes (variable)	240,000	21	1	No	140.7 Mbytes

For the table characteristics:

- Row Length - describes whether each row of the table is fixed or variable, and if variable, the range of bytes possible.
- Partitioned - describes whether the table is partitioned versus segmented. ″No″ indicates the table is not partitioned.

Locking definitions

Type 2 indexes are used for all indexes. Page level locking is in use for both tables.

Buffer Pool Allocation

Table 2 on page 6 describes the characteristics of the buffer pools used for the tables and indexes.

Default values are used for all buffer pool thresholds.

Table 2. Buffer Pool Characteristics

Buffer Pool	Size	Table/Index
BP4	7000	T2/Index1
BP7	2000	T1/Index2

4. Results

The next sections describe the results from the measurements. The effects on each component in the configuration are described as well as the performance. The component results can help you understand hardware capacity issues.

Network

Each measurement adjusts the RU size to find the optimal RU size for the Import/Export of these tables. For importing, a RU size of 32K is optimal and is the only RU size described in this report. For exporting, a RU size of 4K and a RQRIOBLK of 32K is optimal. This report provides the full matrix of RQRIOBLK sizes and RU sizes measured for export.

NCP

The GROUP LNCTL=CA DELAY parameter and the PCCU DELAY parameter in the NCP are both set to 0.0. Initially the LNCTL=CA parameter was set to 0.1. By changing the parameter to 0.0, throughput is improved 30-50%, though this adds approximately 10% to the CCU utilization of the NCP. The NCP CCU utilization reaches a maximum of 47% at the highest throughput level.

LAN

The 16 Mbit Token Ring LAN is lightly utilized during these measurements.

CPU

The maximum throughput while exporting is achieved with a RQRIOBLK size of 32K and an RU size of 4K. At this point, the 590 reaches a CPU utilization of 86% and the 9121-742 reaches 11.3%.

Note: The 9121-742 reaches a maximum CPU utilization of 12.4% with a lower throughput than the maximum. This is attributed to the less efficient RQRIOBLK and RU size.

Important: The processor running MVS for these measurements is not 100% dedicated. Therefore, the CPU numbers for MVS should be looked at as a worst case value.

Import

Table 3 on page 8 describes the results for the import measurements of tables T1 and T2. An RU size of 32K is used throughout. RQRIOBLK size has no effect on import traffic.

Table 3. Import measurement results for tables T1 and T2

Table	Throughtput (MB/hr)	590 CPU%	MVS CPU%	NCP CCU%	LAN%
T1	128.0	20.0	7.3	22.0	5.7
T2	260.5	9.0	9.6	9.0	5.3

For the import measurement results in Table 3 :

- Throughput - describes the amount of data in megabytes per hour that is inserted into the table on MVS/ESA.
- 590 CPU% - describes the CPU used by the Power 590 running DDCS.
- MVS CPU% - describes the CPU utilization on the 9121-742 running MVS/ESA.
- NCP CCU% - describes the CCU utilization on the 3745 that is running the NCP.
- LAN% - describes the percent utilization of the Token Ring LAN between the DDCS for AIX and the NCP.

Export

Export results for table T1

Table 4 on page 9 describes the results for the export measurements of T1. In this table, throughput describes the amount of data in megabytes per hour that is retrieved from the database table and saved in a file on the DDCS machine. The RQRIOBLK size and RU size are varied from 4K to 32K.

The greatest throughput is achieved with a RQRIOBLK size of 32K and an RU size of 4K. In general, the throughput increases as the RQRIOBLK size increases and the RU size decreases. This also improves the efficiency of the NCP and the LAN.

Table 4. Export measurement results for table T1.

RQRIOBLK size	RU size	Throughput (MB/hr)	590 CPU%	MVS CPU%	NCP CCU%	LAN Util%
32K	32K	574.2	67	8.5	21	8.1
32K	16K	666.1	78	10.0	26	8.6
32K	8K	708.6	84	11.2	31	9.2
32K	4K	724.0	86	11.3	29	9.5
16K	32K	537.1	64	12.4	23	7.1
16K	16K	545.0	65	8.5	23	7.1
16K	8K	616.7	75	9.2	28	8.1
16K	4K	666.1	80	9.8	33	8.7
8K	32K	512.4	63	8.5	26	6.8
8K	16K	512.4	62	8.5	26	6.7
8K	8K	512.4	62	8.6	25	6.7
8K	4K	564.5	68	9.2	32	7.5
4K	32K	421.6	54	8.4	31	5.7
4K	16K	421.6	54	8.2	30	5.7
4K	8K	421.6	53	8.2	28	5.7
4K	4K	427.0	53	8.1	29	5.8

Export results for table T2

Table 5 on page 10 describes the results for the export measurements of T2. The RQRIOBLK size and RU size are varied from 4K to 32K.

The greatest throughput is achieved with a RQRIOBLK size of 32K and a RU size of 4K. In general, the throughput increases as the RQRIOBLK size increases and the RU size decreases. This also improves the efficiency of the NCP and the LAN.

Table 5. Export measurement results for table T2.

RQRIOBLK size	RU size	Throughput (MB/hr)	590 CPU%	MVS CPU%	NCP CCU%	LAN Util%
32K	32K	643	37	4.7	25	9.2
32K	16K	771	34	6.2	33	11.1
32K	8K	846	37	5.9	40	12.2
32K	4K	860.2	39	5.3	47	12.5
16K	32K	602.5	27	5.3	27	8.7
16K	16K	602.5	27	5.5	27	8.7
16K	8K	721.8	32	5.7	36	10.4
16K	4K	749.5	35	6.1	43	10.9
8K	32K	552.5	37	5.5	30	8.1
8K	16K	552.5	37	5.4	30	8.1
8K	8K	554.3	37	5.1	30	8.1
8K	4K	604.6	31	6.7	39	8.9
4K	32K	441	35	5.4	34	6.6
4K	16K	441	34	5.5	34	6.6
4K	8K	441.3	34	5.5	34	6.6
4K	4K	447.6	34	5.6	33	6.7

Results using different line speeds

To illustrate the effects of varying the line speeds, additional Import/Export measurements using 1.544 Mbps (T1) and 256 Kbps are performed. The optimal RU size of 32K is used for import. The optimal combination of 32K and 4K for RQRIOBLK size and RU size respectively is used for export.

As the line speeds increase, the throughput, CPU utilization, and LAN utilization all increase. For the 256 Kbps and 1.544 Mbps line speeds, the line itself is the bottleneck. When increasing to the channel attached speed, DDCS for AIX becomes the bottleneck.

Configuration for varying line speeds

Figure 2 on page 11 displays the configuration used for varying the line speeds. A 3745 running a NCP is attached to the 16 Mbit LAN via a TIC type 2. This NCP is attached to another 3745 running a NCP which is channel attached to the 9121-742 running DB2 for MVS/ESA. The line speeds are simulated through the use of NCP internal clocking, thus eliminating the need for external modems.

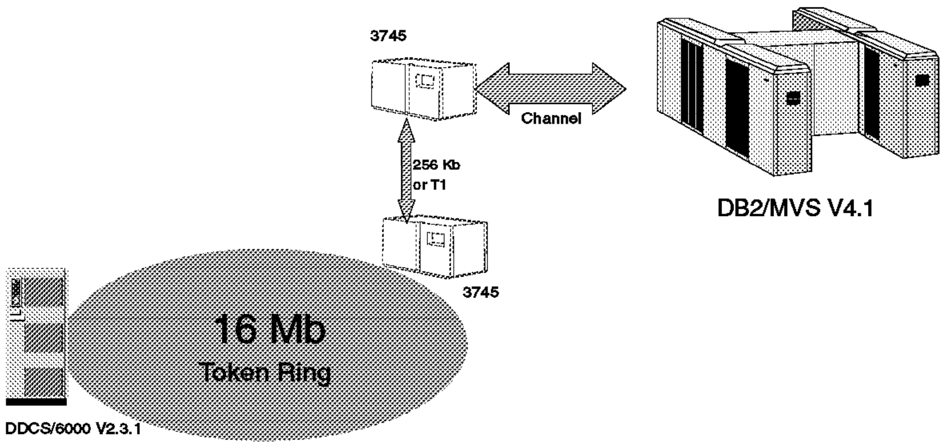

Figure 2. Measurement Configuration

Import results for table T1 using different line speeds

Table 6 describes the results for the import measurements of table T1 using different line speeds. All three line speeds are provided to help make a clear comparison.

Table 6. Import results for table T1 using different line speeds

Line speed	Throughput (MB/hr)	590 CPU%	MVS CPU%	LAN Util%
256 Kbps	28.4	3.0	3.9	1.3
1.544 Mbps	89.05	13.0	7.3	4.0
Channel attached	128.0	20.0	9.6	5.7

Import results for table T2 using different line speeds

Table 7 on page 12 describes the results for the import measurements of table T2 using different line speeds. All three line speeds are provided to help make a clear comparison.

Table 7. Import results for table T2 using different line speeds

Line speed	Throughput (MB/hr)	590 CPU%	MVS CPU%	LAN Util%
256 Kbps	56.5	5.0	3.2	1.4
1.544 Mbps	257.19	9.0	6.5	5.2
Channel attached	260.5	9.0	9.6	5.3

Export results for table T1 using different line speeds

Table 8 describes the results for the export measurements of table T1 using different line speeds. All three line speeds are provided to help make a clear comparison.

Table 8. Export results for table T1 using different line speeds

Line speed	Throughput (MB/hr)	590 CPU%	MVS CPU%	LAN Util%
256 Kbps	73.7	13	5.9	1.4
1.544 Mbps	462.6	53.0	7.2	6.0
Channel attached	724.0	86.0	11.3	9.5

Export results for table T2 using different line speeds

Table 9 describes the results for the export measurement of table T2 using different line speeds. All three line speeds are provided to help make a clear comparison.

Table 9. Export results for table T2 using different line speeds

Line speed	Throughput (MB/hr)	590 CPU%	MVS CPU%	LAN Util%
256 Kbps	100.9	6.0	3.2	1.5
1.544 Mbps	486.3	23.0	4.4	7.0
Channel attached	860.2	39.0	5.3	12.5

5. Summary of tuning considerations

- Changing the Transmit window count and Receive window count in the Token Ring SNA DLC Profile provides a dramatic improvement in peformance. In this measurement, the Transmit window count is reduced from 16 to 7, and the Receive window count is reduced to 4 from 8. An export that takes 1 hour and 20 minutes to complete, finishes in less than 5 minutes after the change!
- An RU size of 4K is found to have the best throughput for tables of the type measured.
- A RQRIOBLK size of 32K provides the best throughput when exporting.
- Use ″alter bufferpool″ to change buffer pool thresholds to as high as possible during the import/export. When the thresholds are turned off for this measurement, there is approximately 30% degradation in throughput.
- If possible, remove all NCP delays. For our measurements, changing the GROUP LNCTL=CA delay parameter from 0.1 to 0.0 improved throughput by 30-50%, with a CCU utilization increase of approximately 10%.

6. Conclusions

This technical report shows the results and analysis of some performance measurements for a relational database configuration that includes DB2 for MVS/ESA and DDCS for AIX.

The focus of this report is to provide a base throughput result that can be used to assess current import/export performance for tuning and re-configuration purposes.

Some questions to ask when analyzing this report and applying it to your current configuration are:

- How does the data throughput compare to my environment or proposed environment?
  - On the LAN?
  - Through DDCS for AIX?
  - Through the NCP?
- How much processor capacity would I need for my environment considering the throughput and transaction mix? DDCS for AIX, DB2 for MVS, etc...
- How much network line capacity would I need considering throughput?

7. Other sources of information

- **DB2/MVS Administration Guide** SC26-3265
- **DB2 Administration Guide For Common Server V2** S20H-4580
- **DB2 for AIX Command Reference**