

SQL/MONITORING FACILITY

The SQL/Monitoring Facility ("**SQL/MF**") is a state-of-the-art execution-time monitor for DB2/VM with many unique and exciting features. The product provides database administrators with detailed information about **global** database performance and the efficiency of running **SQL statements**. Monitor information is available for dynamic queries and compiled applications. SQL/MF monitors all DB2/VM users, including DRDA and TCP/IP clients.

MONITORING SQL STATEMENTS

In most cases, degradation of DB2 performance is due to SQL statements that do not perform adequately. Correcting these statements will result in significant performance improvements for the entire database. The facilities provided by SQL/MF greatly facilitate this tuning process.

The SQL/MF **Statement Monitor** continuously notes the execution characteristics of all SQL statements in progress and records, for each executing statement:

- 22 **runtime counters** (CPU-time, I/O-time, number of rows and pages processed ...)
- the statement **access path** (the index used)
- the dynamic or compiled **statement text** (with host variables replaced by their contents)

Database	VM-name	SQL-name	Started	Elapsed	Package	Type	State	SQL-Cost
SQLDBA	DIAD	DIAD	14:15:25	00.05.58	DAS41SU1	Fetch	Comm	85
SQLDBA	DBADM	DBADM	15:12:51	00.00.32	ARIISQL	Fetch	Comm	18
SQLDBA	SVTG	SVTG	11:25:59	00.07.24	DAS41SU1	Fetch	Lock	11
SQLPRD	VSEPRD	CICSU1	15:13:24	00.00.02	LB00233	Open	DSPF	20

Running Statement List

Database	SQLDBA	VM_name	USRG3	SQLname	USRG3	Agent	2
Package	DRVD11	Section	9	Command	Fetch	Isolatn	CS
Access	Using index JOB_11 (+JOBLPST)						
Started	10:11:08	Curtime	10:12:21	Elapsed	00.01.13	Rowcount	24939
CPUtime	1.501	Locktime	0.000	IOWait	68.369	Comtime	4.001
RDSscall	494	DBSScall	23497	DispCall	2420	Buflooks	28597
Pagread	2398	Pagwrite	0	Logread	0	Logwrite	0
Dirbuffl	20	Dirread	18	Dirwrite	0	Int_DBSP	0
DSfaults	0	BlockIO	2416	Waitlock	0	Escalate	0
SELECT JOBNR,JOBDTCRE,JOBSRT,JOBLPST,JOBLSTRK FROM VB.JOB WHERE JOBLPST >= '2400' AND JOBLSTRK = '373'							

Statement Detail

The DBA has real-time access to these data, using the **Running Statement List** and **Statement Detail** functions of the SQL/MF user interface.

The interface allows the DBA to **act** upon any running statement in order to:

- get catalog information for the table and index accessed
- perform lock analysis
- terminate the statement

Graphical Displays

SQL/MF can provide the Running Statement List and the Statement Detail screens in graphical format.

Database	TSTADB	SQL_id	TSTAST1	VM_id	TSTAST1
Program	SQLCVRFY	Section	1	Command	Fetch
Starttime	15:28:14	Elapsed	00.00.09	Status	Running
Access	No index access noted				
SQL-Cmnd	SELECT ITEM,"SQL/DS HELP" FROM SQLDBA.SYSTEXT2				
CPU	6446				
IOWait	97				
Comwait	7740				
NrRows	51233				
RDSscall	565				
DBSScall	51296				
DISPcall	1139				
Buflook	53848				
Read IO	1298				
Write IO	3				

Statement Detail in graphical format

Statement Statistics

When an SQL statement completes execution, SQL/MF stores in its **SQL_Statements** table:

- the text of the statement
- the statement's access path
- the runtime statistics for the last statement execution

By consulting this table, the DBA can always obtain the monitor information for the last execution of every SQL statement.

Package Statistics

SQL/MF maintains the resource consumption of every executed DB2 package in its **Package Statistics** table, for accounting purposes.

Session Run Statistics

The RunStats function provides a graphical and ordered presentation of resource usage by users and programs during the current DB2 session. The statistics show users, programs and program statements by descending SQL cost. The user may request to keep the RunStats in a DB2 table for a defined period.

Exception Logging

An installation may define a number of **exception criteria** in the SQL/MF configuration file. When an SQL statement exceeds one of them during its execution, it is recorded in the SQL/MF **Exception table**. Exception criteria are specified as:

- a maximum I/O load
- a maximum response time
- a maximum lock wait time
- a defined range of SQLCODEs etc..

Notification Facility

The notification facility alerts the DBA when:

- an SQL statement performs excessive I/O
- response times exceed defined maxima
- a user session is idle
- a long lockwait is detected etc..

Governor Facility

SQL/MF not only records database performance, its Governor facility **prevents** excessive use of database resources. The Governor continuously monitors users and programs and forces them off the database, when a **resource restriction** is violated.

These restrictions are defined in the SQL/MF configuration file as a maximum amount of resources, a user or program is allowed to consume, for example:

- a maximum number of I/O requests
- a maximum statement response time
- a maximum time in lockwait or lockhold
- a maximum idle time while in LUW
- a maximum cost for dynamic SQL requests

The Governor facility can be enabled for all users and applications, both compiled and dynamic.

Benchmarking Facility

The benchmark facility records the execution statistics of all SQL statements executed by a designated program into the **Benchmark** table. These table entries show the "behaviour" of the benchmarked program.

Recording Facility

The **Statement Recorder** registers all SQL statements executed during the recording period. The recorder entries show the statement text, the access path and all execution statistics. To achieve acceptable performance, the facility records using dataspace. Support is provided for both periodical and on-demand recording. In the latter case, recording can be requested for named users, applications or terminals.

The **Lock Recorder** maintains a chronological log of all lockwait events during the DB2 session.

The **Checkpoint Recorder** notes the occurrence and duration of all DB2 system checkpoints.

AutoPrep Facility

The AutoPrep facility reduces the CPU overhead and catalog contention associated with dynamic SQL execution by replacing the dynamic sequence with prepped access. AutoPrep significantly reduces the SQL cost resulting from PC database access, e-business or ERP applications.

Command Analysis

With our **SQL/Command Analysis** product installed, running statements and statements recorded in the SQL/MF tables may be submitted for EXPLAIN and predicate analysis.

SYSTEM MONITORING

While the facilities described above monitor individual SQL statements, the SQL/MF **System Monitor** component provides a **global** view of database performance.

At a user-defined **sampling interval**, the System Monitor records following data in the System Monitor tables:

Global Performance

Records the database resource consumption, as obtained from the DB2 system counters.

MONTIME	RDSC	DBSSC	LUWS	CHKP	ESCAL	WAITL
12.01.03	20462	113474	4817	6	0	107
12.06.04	887	80362	12	0	0	0
12.11.09	923	83611	12	0	0	0
12.16.10	717	64654	19	0	0	0
12.21.14	625	46287	21	0	0	0

System Counters report

Buffer Pool

Records the usage that DBspaces and storage pools are making of the buffer pool and provides information on the distribution of buffer pool accesses among individual DBspaces.

TIME	POOL	TYPE	BUFL	DSREAD	DSWRITE	DSFAULT
16.25.07	DIR	DSP	9145	430	157	0
16.25.07	00001	DSP	36974	9094	27	246
16.30.18	DIR	DSP	2104	60	0	0
16.30.18	00001	DSP	85682	2134	0	34
16.35.29	DIR	DSP	3320	60	0	0
16.35.29	00001	DSP	13676	3350	0	55

Dataspace Counters

Data Spaces

Records the performance of the DB2 Data Spaces facility.

Storage Pools

Records physical DASD space usage and short-on-storage conditions for each pool.

DB2 Log

Records space consumption on the DB2 system log.

MONTIME	USERID	STATE	LOCKS	LONGLOCKS
16.25.07	VMK017	I/O	9	8
16.25.07	DBADM	COMM	37	32
16.30.18	DBADM	I/O	86	12
16.35.29	VSEPRD	I/O	7	6

User Counters

User Activity

Records the status of all agents active at the monitor interval.

Locks

Records agents in the LOCK wait state and provides information about the locks being held.

MONTIME	CHKP	CHKP-DUR	CHK_DELAY	DELAY_DUR
16.25.07	2	2378	0	0
16.30.18	0	0	0	0
16.35.29	2	1729	0	0

Checkpoint Counters

Connections

Records the state of the DB2 connections at each monitor interval.

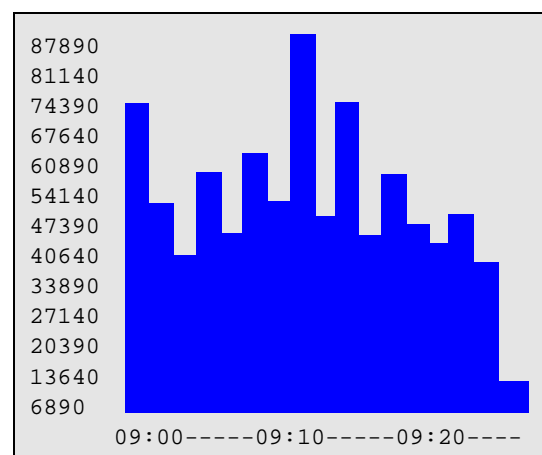
Checkpoint Monitoring

Records the frequency and the duration of system-initiated checkpoints and notes eventual checkpoint delays.

System Monitor Graphs

The System Graph function provides a graphical view of system activity. It shows, for a given time period, the number of:

- LUWs
- RDS calls
- buffer lookups or I/O requests



System Graph

SQL/MF USER INTERFACE

All monitoring data collected by SQL/MF are examined from a single CMS application, using structured menus and a standard PFkey interface.

The user interface provides a **Catalog Navigator** for easy and full-screen access to the DB2/VM catalog tables. Using its **Related Object** function, the Navigator shows the dependencies between associated objects in the catalogs.

CUSTOMIZING SQL/MF

User Reports

SQL/MF comes with 63 interactive reports, which are invoked from the Report Menu. Because all SQL/MF tables are regular DB2 tables, an installation can easily write its own monitor reports. These user reports are automatically added to the Report Menu.

User Attached Process facility

Attached processes are user-written REXX programs, invoked during monitoring. The processes have real-time access to the monitored data. They enable an installation to incorporate its own monitoring procedures into SQL/MF.

Connect exit

A connect exit is a REXX program invoked whenever a DB2 user issues an explicit CONNECT statement. The exit receives the connect parameters as invocation arguments and can reject the connect, if desired.

Monitor Tables

SQL/MF stores its monitoring results in DB2 tables. These tables are also available for user processing. The Program Statistics table for example, can be used for accounting purposes.

SQL/MF BENEFITS

- The SQL/MF System Monitor allows to quickly locate periods with high database load.
- The System Monitor supplies data useful for tuning the database I/O system.
- The System Monitor provides valuable data for optimizing the DB2 checkpoint component.
- The SQL/MF Statement Monitor provides very detailed information about all SQL statements in progress. The access path adopted by DB2 for statement execution is shown in all cases.
- An SQL/MF monitor table maintains the run-time statistics for every SQL statement executed.
- Using the SQL/MF Exception table, poorly performing SQL statements can be located easily.
- The RunStats function quickly locates SQL programs and statements with high resource consumption.
- The SQL/MF Benchmarking and Recorder facilities trace all database access performed by designated programs.
- The SQL/MF Governor is a unique facility for automated management of database performance.
- If our SQL/Command Analysis product has been installed, SQL statements captured by SQL/MF can be forwarded for further analysis of the statement text.
- SQL/MF is an open system: user processing can be incorporated easily.

SOFTWARE PREREQUISITES

The SQL/Monitoring Facility requires:

- VM/ESA Version 1 Release 1.0 or higher
- DB2/VM Version 3 Release 3 or higher