**MaxDB** Internals **Performance Analysis** Version 7.8

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THE BEST-RUN BUSINESSES RUN SAP"



Performance Analysis: Tools	SAP
x_cons shows current DB activity (snapshot)	
<ul> <li>Database Analyzer</li> <li>detects possible bottlenecks</li> <li>collects and stores data at given intervals</li> </ul>	
Shared SQL <ul> <li>Shared SQL collects runtime data for the statements in the cache</li> </ul>	
Command Monitor <ul> <li>Lists single long running SQL commands</li> </ul>	
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# Performance Analysis Tools

MaxDB provides various tools and methods for the analysis of performance bottlenecks and monitoring current database activities. Some of these tools were originally developed only for testing and analysis in MaxDB development, but can also be used by experienced database administrators for performance analysis.

The following are of particular importance for performance analysis:

- The x\_cons console for monitoring current operations
- The Database Analyzer program for analyzing performance bottlenecks
- As of version 7.8 Shared SQL collects performance data with each statement in the cache. This substitutes the former Resource Monitor in older versions which had to be enabled explicitly.
- The Command Monitor provides a list of long-running or poorly-processed SQL statements

x\_cons and Database Analyzer are stand-alone programs and are called from the operating system command line. The Command Monitor and Shared SQL are part of the core functions of the MaxDB kernel.

In SAP WebAS, all functions and results can be controlled and analyzed using transaction DBACockpit => Current Status or DBACockpit => Performance.

The former transactions DB50 and ST04 have been substituted by transaction DBACockpit in newer SAP WebAS versions.

DB-Console: x_cons	SAP
<ul> <li>Database console x_cons features:</li> <li>process overview</li> <li>configuration overview</li> <li>observing session activities and wait states</li> <li>watching I/O activities and wait queues</li> <li>measuring of detailed task specific times</li> </ul>	
<ul> <li>Call:</li> <li>x_cons <serverdb> <command/> [<interval>] [<repeat>]</repeat></interval></serverdb></li> <li>e.g. x_cons WB5 show active 10 6</li> <li>advantage: delta information using ,interval' and ,repeat'</li> <li>dbmcli -du [-n <node>] db_cons <command/></node></li> <li>advantage: works per remote connection to database host</li> </ul>	

#### DB Console x\_cons

The database console  $\mathbf{x}$ -cons gives you a quick overview of the operating system resources that the database system is using, the distribution of the database session among the operating system threads, and the status of the active database sessions. You can also use other functions that are intended mainly for support employees and developers.

Start on shell level: x\_cons <dbname > <command> [<interval>] [<repeat>]

x\_cons <dbname> *help* returns a complete overview of all available command functions.

The database console can also be addressed remotely via the DBM server.

DB Console x_cons (II)	SAR
<pre>x cons <dbname> <command/> [<interval>]</interval></dbname></pre>	[ <repeat>]</repeat>
- <command/> (choice):	-
	SHOW ACTIVE [ DW   SV   US   GC] SHOW ALL SHOW AIO (backup only)
show io statistics/states	SHOW IO SHOW DEV IO SHOW IOPENDING SHOW CPORT
show move info (load balancing)	SHOW GPORT SHOW MOVEINFO SHOW QUEUES SHOW REGIONS SHOW RTE
UKT sleep statistic	SHOW RUNNABLE [ DW   SV   US   GC] SHOW SLEEP SHOW STATE SHOW STORAGE
suspend reasons	SHOW SUSPENDS
show task counts	SHOW T_CNT [ DW   SV   US   T <taskindex>]</taskindex>
show tasks move info	SHOW T_MOVE
show task queues	SHOW T_QUEUE SHOW T_REG
show task regions show task statistics	SHOW T REG SHOW T STAT SHOW TASKS
Thread time usage	SHOW TARD_TIMES SHOW SLEEP SHOW VERSIONS
cancels the command of task	CANCEL <taskindex></taskindex>
displays help file	HELP
time measurement	TIME <enable disable=""  =""></enable>
kills the session of task	KILL <taskindex></taskindex>

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CANCEL	index	cancels the command executed by task <index></index>
KILL	index	kills the session of task <index></index>
SHOW		
DEBUGLEV	level	set debug level for the kernel
DEBUGTASK	index	writes back trace of task to knldiag
RESET	obj_cnt	resets counter about the following objects: IO T_CNT REGIONS (ALL) incl. local counters of any task
TIME	enable	enables time measurements
QUIT		exit console driver

The option -e before a SHOW command shows an extended output for tasks lists.

x_cons	Pro	cess	confi	gurati	on (	(1)		
								SAP
x_cons <		ne> sh	ow rte					
Kernel Thread Thread		NIX Stat	e Sle	00				
Name		Tid	e Sie Tim	*				
TIMER		660 Slee						
COORDINATOR		639 Slee						
CLOCK		654 Slee						
CONSOLE		655 Slee						
REQUESTOR	16	658 Slee						
User Kernel T	hreads:							
Thread	UNIX	State	Dispatch	TaskSwitch	Active	Total	Task	
Name	Tid		Counter	Counter	Tasks	Tasks	Cluster	
UKT1	19067	Sleeping	3	0	1	1	TW	
UKT2	19068	Sleeping	18210	0	1	1	LW	
UKT3	19069			0	0		UT	
UKT4	19070			393			43*SV	
UKT5	19071			0	-	-	8*FS	
UKT6	19072			3533			10*GC	
UKT7	19073			52103			TI,64*PG	
UKT8	19074	Sleeping		18583			46*US, IDL	
UKT9	19075	Sleeping	457240	15572	10	55	54*US,IDL	
Kernel parameters (don't change directly): TaskCluster01 tw;lw;ut;2000*sv;10*fs;10*gc; TaskCluster02 ti,100*pg;1*bup,50*us; TaskCluster03 equalize								
Processor i	nform	ation						
Processors		8						
Processor c	-	2						
FIDCESSOFC	ores.	2						

# x\_cons <dbname> show rte

This shows the distribution of the MaxDB threads among the operating system processes. The DB threads coordinator, console, timer, requestor and Dev0 each have their own operating system threads. The entire database kernel runs in a single process.

However, multiple database tasks (user task, log writer, utility task, and so on) can be located together in an operating system thread, which is called a UKT (user kernel thread). The MaxDB runtime environment uses internal tasking to administer these database tasks. Internal MaxDB administration takes up less operating system time, and gives you more control over the scheduling and prioritization of individual database sessions.

The database parameters MAXCPU and UseableCPUs are normally used to distribute the tasks automatically to the UKTs; the (support) database parameter TASKCLUSTER (requires change in the control file cserv.pcf) can also be used for this purpose, but only in consultation with SAP support.

# x\_cons Process Configuration (2)

SA	D	/

read	UNIX	Volume	Devs.	Read	Write	Queue	
ame	Tid	Name	No.	Count	Count	Len. Max.	
<b>T1</b>	16669	knltrace	1	0	174	()	
(Т2	16670	/sapdb/ADISKL001	11	0	1745	()	
′00	0	knltrace	1	0	1	0 (1)	
00	0	/sapdb/AISKD0001		0	0	0 (0)	
'01	0		2	171775	66	1 (1)	
′02	0		2	65178	16	0 (1)	
'03	0		2	23567	6	0 (1)	
'04	0		2	6663	3	0 (1)	
'05	0		2	1270	3	0 (1)	
'06	0		2	173	2	0 (1)	
07	0		2	7	0	0 (1)	
00	0	/sapdb/AISKD0002		0	0	0 (0)	
'01	0		3	154935	57	0 (1)	
'02	0		3	59352	21	0 (1)	
'03	0		3	21569	8	0 (1)	
04	0		3	6099	4	0 (1)	
05	0		3	1085	3	0 (1)	
06	0		3	128	1	0 (1)	
07	0		3	17	0	0 (1)	
00	0	/sapdb/AISKD0003	4	0	0	0 (0)	
Kernparameter: VolumelOQueuesForPriority: number of I/O-Queues per volume, see chapter Kernel parameter							

Abbreviations of the Database Tasks in TASKCLUSTER:

#### Abbreviation

- tw Trace writer, writes kernel traces and dumps
- ti Task for timeout monitoring
- al Log writer
- dw Tasks for cache monitoring and asynchronous cache displacement as well as savepoint I/O
- ut Utility task for administration tasks (start backup, recovery, and so on).
- sv Server processes for backup I/O and special operations such as parallel index generation
- us User tasks for executing SQL statements
- gc Garbage collector
- ev Event task
- fs Floating service for load balancing

# x\_cons Task Activity



x\_cons <dbname> [-e] show active [<interval>] [<repeat>]

x\_cons E70 show active 10 6

ID T146 T147 T152 T154	UKT U 7 7 8 8 8	id -1 -1	TASK type User User User User	pid 28069 28072 28071	Current state Running *Runnable *Runnable Running	48 56	cnt <b>220</b>	try 99 111	Wait item 741131(r) 741131(r) 424309(r) 424309(r)	
T2 T152	2 8		2		IO Wait (W) LogIOwait(234)	-	1 0	5	1978(s) 424800(s)	
Т66 Т67 Т87	6 6 4	-1	Pager Pager Savepnt	-1	Vvectorio IO Wait (W) PagerWaitWrit:	0	0 0 0	1	3258 (s) 3258 (s) 234617 (s)	
Т75 Т76 Т159	4 4 8	-1	BUPvol BUPvol User	-1	AsynWaitRead AsynWaitWrite IO Wait (R)	0	0 0 0	2	11368 (s) 11368 (s) 429215 (s)	
T152 T154	8 8	-	User User		InvRootExcl Running	-	0 74 55	1573	24185(r) 438561(r)	
T142 T157	7 8	_	User User	-	Vwait IO Wait (R)	•	0 0	1	745843 (s) 852579 (s)	

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x\_cons <serverdb> show active [<interval>] [<repeat>]

Presents an overview of the states of all active tasks.

Appl pid

 Process ID of the application program linked to the task. An asterisk (\*) before the PID indicates that the process ID is on a separate computer and is being accessed remotely.

Region

- cnt: Displays the number of times the region has been accessed since the task has been running.
- try: The number of the queried or held region

UKTsleep

Number of semaphore waits per UKT

x_cons: Task	x States (1)
AsynClose	closes an I/O port after backup or recovery
Asyncntl	determines parameter or initialises a backup device
AsynIO	asynchronous I/O (during backup oder recovery)
AsynOpen	opens an I/O port for backup or recovery
AsynWaitRead	waits for an I/O operation to end, then read (backup or recovery)
AsynWaitWrite	waits for an I/O operation to end, then write (backup or recovery)
Command reply	delivers a result to the application
Command wait	task is waiting for a new request
Connect wait	task is free for a new session
DcomObjCalled	a DB-procedure or a COM-object is currently executed
Diaginit	initialises the datenbase internal trace files
Inactive	task is in initial state and has no resources yet
InsertEvent	creates an event
IO Wait (R)	waiting for I/O (R=read)
IO Wait (R)	waiting for I/O (W=write)
IO2 Wait (R)	waiting for I/O for mirrored disk (log only)
IO2 Wait (W)	waiting for I/O for mirrored disk (log only)
Locked	task is locked during kernel shutdown (to prevent rescheduling)

In a system with one CPU, only one task can be running at a given time. If  $x_{cons}$  nevertheless shows two tasks running, this is due to unprotected access.

# x\_cons: Task States (2)

Not Connected RescheduleMsec Runnable Running Stopped Terminated UNKNOWN Vacknowledge	brief wait, continues automatically immediately runnable running, using CPU time suspended by kernel and waiting to proceed running task or database session has been canceled task state unknown
Vattach	opens I/O ports (volumes, normal operation)
Vbegexcl Vblockio	waiting for protected memory access runnable after protected memory access
Vdetach	closes I/O-ports (volumes, normal operation)
Dual Vector I/O	performs a vector-I/O-operation on two volumes in parallel
Vendexcl	leaving a protected area
Enter ExclLock	waiting to access a protected region with an exclusive lock
Enter ShareLck	waiting to access a protected region with a share lock

SAP

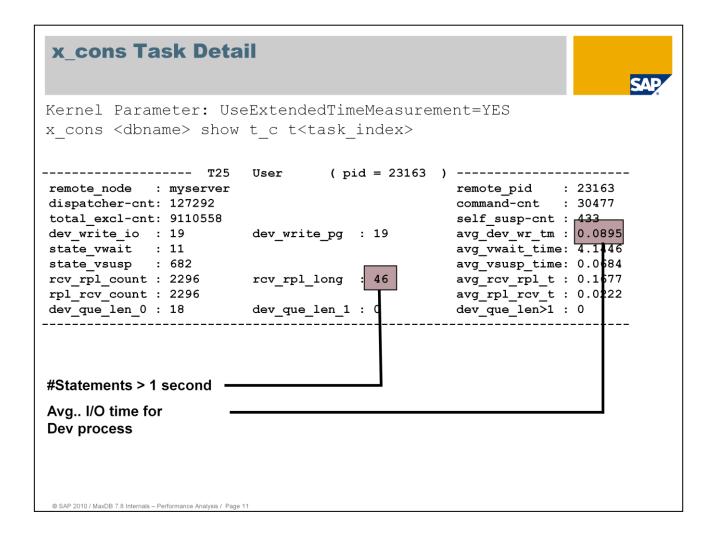
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# x\_cons: Task States (3)



Leave ExclLock Leave ShareLck ShutDown Connect close	leaves a protected region leaves a protected region database is shut down (changing state from ONLINE to ADMIN) ends the database session
Vsleep	brief wait, continues automatically
Vsuspend	suspended and waiting to be explicitly activated by another task (e.g. for B*-Tree locks (very brief) or log I/O)
Vvectorio	performs a vector-I/O-operation (reading or writing)
Vwait	waiting to be explicitly activated by another task (e.g. waiting for an SQL-lock)
WaitForEvent	waiting for an event
Yielding	Briefly cedes control of CPUs during Busy Waiting

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 $x\_cons < dbname > show t\_c t < task\_index > displays highly- detailed measurement values for individual database tasks. In this way, you can, for example, monitor the DB activity of an application while it remains connected to a database task (no permanent release/connect).$ 

As of version 7.8 the database should run with the default setting UseExtendedTimeMeasurement=YES. The kernel collects time values of most wait situations. Shared SQL stores time values belonging to SQL statements.

Much of the output of the 'show  $t_c$ ' function was developed exclusively for developers, however, some of the values are of more general interest in special situations.

dispatcher-cnt Count of how often the task passed control to the UKT dispatcher, because it could not run, its time slot had expired, or another task was prioritized.

total_excl-cnt	Number of region accesses
command-cnt	Communication count between application and kernel
self_suspend-cnt	Number of task suspensions in which the task remained executable but still gave up control
<dev self="">_<read write="">_io</read></dev>	Number of I/Os via UKT (self) or DEV threads (dev)
<dev self="">_<read write="">_tm</read></dev>	Duration of an I/O via UKT (self) or DEV threads (dev)
state_vwait	Number of waits on SQL locks
avg_vwait_time	Average wait time for an SQL lock
avg_rcv_rpl_t	Average processing time of an SQL statement in the database kernel

rcv\_rpl\_long second

Number of SQL statements with a processing time of more than one

x_cons I/O Ac	tiviti	es					
x_cons <dbname></dbname>	show	io					SAP
Volume		N	n Pon	d(s)	RPages	Write(s)	WPages
/sapdb/E70/sapdata/				0539	10539	WIICE(S) 11	wrages 12
/sapdb/E70/sapdata/				0525	10525	23	27
/sapdb/E70/sapdata/				0338	10323	23	22
/sapdb/E70/sapdata/				0000	10000	22	25
/sapdb/E70/saplog/D				0000	00001	36	36
total I/0	10111001	•	•	1402	41402	117	122
			-	1402	41402	11,	122
x_cons <dbname></dbname>		dev_io					
Volume	Devs.	Read(s)	Read	AvgRead	Write(s)	Write	AvgWrite
Name	No.	Count	Pages	Time(ms)	Count	Pages	Time(ms)
/sapdb/ISKD0001	2	3	3	0.838	1	1	0.929
/sapdb/ISKD0001	2	603392	603392	3.660	622	633	0.702
/sapdb/ISKD0001	2	266987	266987	4.589	28	35	3.576
/sapdb/ISKD0009	10	304632	304632	3.522	622	740	0.658
/sapdb/ISKD0009	10	13074	13074	4.018	13	95	9.436
/sapdb/ISKD0009	10	196	196	8.681	13	78	8.379
total I/O:		8613812	8613843		6247	7095	
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The command *show io* displays the number of read and write operations per volume as well as the number of 8 KB pages read. These numbers are independent of whether the I/O are synchronous or asynschonous.

Show dev\_io displays the number of read and write operations of the I/O threads and the average I/O times.

# **Performance tables: Process Configuration**

## **TASKGROUPSTATISTICS**

- shows all threads, dealing with tasks
- analog to "x cons <dbname> show rte"

#### BACKUPTHREADS

- shows all volumes and backup media, used during a backup or restore
- analog to,x cons <dbname> show aio"

#### **IOTHREADSTATISTICS**

- Shows I/O figures per volume
- analog zu "x\_cons <dbname> show dev\_io"

#### IOJOBS

- Current state of the I/O orders in the I/O Queues
- analog to,x\_cons <dbname> show iopending"

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Performance Tables/ Database Console

Much of the data generated with x\_cons is also accessible through tables. Thus this performance data can also be displayed by other tools (SQLStudio, SAP WebAS->DBACockpit.

The columns of the respective tables largely correspond to those of the database console.

# **Performance tables: Task Activities (1)**

# SYSMON\_TASK

- Shows all tasks
- analog to "x\_cons <DBNAME> show tasks"

#### SYSMON\_US

- shows all User Tasks
- analog to "x\_cons <DBNAME> show tasks us"

### SYSMON\_DW

- shows all DataWriter Tasks
- analog to "x\_cons <DBNAME> show tasks dw"

# SYSMON\_SV

- shows all Server Tasks
- analog to "x\_cons <DBNAME> show tasks sv"

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# **Performance tables: Task Activities (2)**

# SYSMON\_ACTIVE\_TASK / SYSMON\_RUNNABLE

- shows all active tasks
- analog to "x\_cons <serverdb> show [active|runnable]"

## SYSMON\_US\_ACTIVE / SYSMON\_US\_RUNNABLE

- shows all active User Tasks
- analog to "x\_cons <serverdb> show [active|runnable] us"

#### SYSMON\_DW\_ACTIVE / SYSMON\_DW\_RUNNABLE

- shows all active DataWriter Tasks
- analog to "x\_cons <serverdb> show [active|runnable] dw"

## SYSMON\_SV\_ACTIVE / SYSMON\_SV\_RUNNABLE

- shows all active Server Tasks
- analog to "x\_cons <serverdb> show [active|runnable] sv"

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	mea	UJ .		a 51	× 1V		nay	Jei	· <b>(1)</b>					SAF
ask Manager														
A     IIII System Cc →       System WB5     IIII	Processors Used Max. Number of Use	er Tasks	2 100											
P MaxDB Database Admi		Y Terminat	e Commani		Ind Sessio	m	Running	Comma	de					
Current Status	Active Tasks	Runnable		User Tasks		m Task			105					
Attributes System Settings														
Performance Activities Overview	Automatic Ref				econds	10.02	.2011 14:13	3:51						
Database Activities					1									
Transactions  P C Performance Wareh	Active Tasks Task ID Three	ad ID Task Ty		Task Status	0	atus Da	scription	Ar	pl. PID Application S	owor	Logon Date	Time [		
👂 🗋 Database Analyzer		0.075 User		Running	0	atus De	scription		0.295 Id8513	erver	09.02.2011	11:01:09		
<ul> <li>SQL Performance</li> <li>SQL Locks</li> </ul>	163 19	0.075 User		IO Wait (R)	Is	apdb/WB	B5/sapdata/D		0.296 ld8513		09.02.2011	11:01:10		
V G Kernel Threads	168 19	0.074 User		Running	Ta	ask Man	ager		8.291 Id8513		09.02.2011	11:01:09		
Task Manager		Active Tasks						/						
Thread Overview Thread Statistics		Task ID	Thread ID		TeTa	sk Statu	s Stat	us Descr	ption	Loci	k Reque Lock		D Statement	
I/O Operations		120	19.075			nning	/			_				Z" FROM "ZZTELE" T_00
Space		163 168	19.075 19.074			Wait (R)		k Manage	sapdata/DISKD0007 r	-				071K" WHERE "FLAG" = .ospid, Itrim (11.tasktype
					/	/								
					/									
rocess Overv	view			/	101									
	av B		·	8 1	' 🖪 🛛									
No. Type PID	Status	Reason		rr Lock	edSem.	C	CPU	Time	Report	Cli	User Name	s Action	Ê.	Table
0 DIA 20291	Waiting	-	Yes											
1 DIA 20292	Waiting		Yes					_						
	Waiting		Yes								-			
2 DIA 20293	Waiting	- K	Yes											
3 DIA 20294			Yes					27	ZFBAD		WB5		ential Read	ZZTELE
3 DIA 20294 4 DIA 20295	Running							59	ZFSCANE071	1001	WB5	Seque	ential Read	E071K
3 DIA 20294 4 DIA 20295 5 DIA 20296	Running		Yes					00	LIGOTITET				onnun record	Loring
3 DIA 20294 4 DIA 20295			Yes Yes Yes					1	SAPLTHE		WB5			Lorint

The task manager in transaction DB50 displays all database tasks and their current status. The system displays an overview of the database tasks and information about the current state of each individual task.

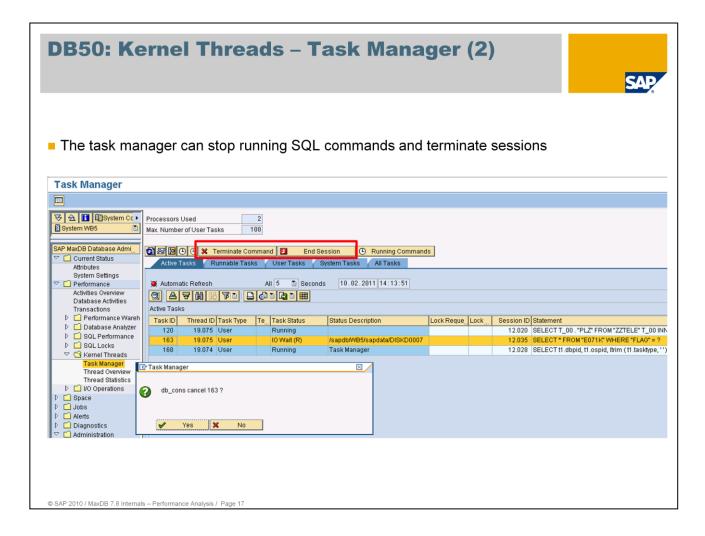
The following views are available: Active Tasks, ExecutableTasks, User Tasks (task type User), System Tasks , All Tasks.

We use the task manager to analyze the following:

- For this database MAXCPU is set to 2. Thus the database can use 2 CPUs in parallel. Task T168 is running in another UKT (see Thread Overview, thread ID:19074) than task T120 and T163 (thread ID:19075). Tasks T120 and T168 can both have the *Running* status.
- We see a command (T163) that reads data from the disk to the cache IO-WAIT (R).
- The task manager show the SQL statements executed by the sessions as of MaxDB version 7.8.

In the Application column we see the process ID of the work process and via the Application Server column we see the SAP application server.

With transaction SM50, we can identify the application that caused the long-running command using the application PID (20296).



With the task manager it is possible to terminate the respective task (T163) directly on the database level.

The information in the process overview can then be used to examine the application for possible programming errors or missing indexes.

# **Database Analyzer Consider a Typical Problem ...** Customer ... is reporting performance issues he thinks are database related Support ... analyses the situation configuration? (caches, MAXCPU...) collisions? (SQL/BD locks, regions ...) strategies? (used strategies, bad indices, current statistics.,...) I/O system? (log / data accesses?) **...** ... gathers data from system tables / x\_cons tedious work time consuming © SAP 2010 / MaxDB 7.8 Internals - Performance Analysis / Page 18

SA.

Database Analyzer Objectives	SAP
<ul> <li>Gathering relevant performance data with one tool</li> <li>Flexible and upgradable through new rule sets</li> <li>Release and instance independent</li> <li>Remote access possible</li> </ul>	
<ul> <li>Parameter setting recommendations</li> <li>Check current parameter values</li> <li>Show parameter recommendations according to the used version</li> <li>SAP note 1111426 provides configuration files</li> </ul>	
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CSN note 530394 describes bottleneck analysis with the Database Analyzer.

The DBAnalyzer is available as of version 7.3.00 Build 25.

#### Enhanceability

The logic and rules for monitoring with the **Database Analyzer** are defined by way of a **configuration file** (ASCII text). In case of changes or enhancements, you only have to cahnge the configuration file in the directory INSTROOT/env.

#### Release independence

As accesses to the system tables are defined in the **configuration file**, adjustments for new releases only require adjusting the configuration file. Consequently, this is release-independent, but the **Database Analyzer** itself is not. The configuration file takes account of the instance type (OTLP/LVC).

#### Remote capability

The *Database Analyzer* uses only system tables. The data generated by "x\_cons" can be queried via the SYSMON\_..., system tables, which means they can be called remotely (e.g. via OSS).

# Database Analyzer Properties S Reporting weak spots in database configuration per given time intervals Automatically classifies messages by color indicator (info, light to severe performance problem) Collecting monitor data each time interval

#### Database Analyzer

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For routine monitoring of database operation in the production system, an interval of 15 minutes (-t900) is adequate. For short-term monitoring of database operation, a measuring interval of 10-30 seconds is recommended.

If class W3 warnings occur frequently, you should certainly try to remove the bottleneck. W3 warnings generally indicate that the runtime behavior of the database is severely compromised. If you suspect poor search strategies (rows read/rows qualified), a more precise analysis is unavoidable. Shared SQL and the command monitor are available for this purpose.

Not all *Database Analyzer* outputs are necessarily caused by actual bottlenecks. For example table scans can be useful in certain situations, long runtimes of statements can automatically occur with large datasets etc.

# Database Analyzer Technical Details

SAP

Executable dbanalyzer

- collects, assesses and stores data
- has (almost) no hard coded knowledge about system tables
- only rule based infrastructure

Configuration file dbanalyzer.cfg

Global Data>/env/dbanalyzer76.cfg

All changes concerning rules and assessments can be made in the configuration file without need to touch the software executable.

Configuration File: dbanalyzer.cfg

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- Describes the data to be collected or calculated (*parameters*). These *parameters* are either taken from the database (system tables) or calculated from the *data* taken from the database. As the manual evaluation of parameters is time-consuming, the Database Analyzer formats the logged data.
- Describes the evaluation rules (monitors) for the parameters. The monitors have up to four conditions (*Information* and *Warnings 1* through 3) and are logged in a way that takes account of the conditions. For logging the monitors, in the configuration file you can store a verbal assessment or even concrete instructions for the user.

# Database Analyzer Monitoring System Tables

ID	= DC_HIT
Label	<pre>= "Data cache hitrate (SQL Pages) " + DC_Hit + "%, " + DC_Fails + " of "+ DC_Acc + " accesses failed"</pre>
Class	= Caches
Description	= For a running database application the data cache hitrate \ should not be less than 99%, otherwise too much data has \ to be read physically. Data cache hitrates less than 99% \ for intervals of 15 minutes or more must be avoided.
Warning3	= DC_Hit < 96 $\setminus$
	&& ( PReads ) > MAX_IDLE_IO_ALL_DEVS
Warning2	= DC_Hit < 98 $\setminus$
	&& ( PReads ) > MAX_IDLE_IO_ALL_DEVS
Warningl	$= DC_{Hit} < 99 \setminus$
	&& ( PReads ) > MAX_IDLE_IO_ALL_DEVS
Information	$= DC_{Hit} < 99 $
	&& ( PReads ) < MAX_IDLE_IO_ALL_DEVS
UserAction	= In addition to enlarging the data cache (note the paging risk of the operating system), search for the cause of the high read activity. Frequently, individual SQL statements cause

Up to four conditions for triggering the monitor. Conditions are boolean expressions that refer to parameters.

The top-level message is stored in the *label*. The *label* is an expression that is calculated when the *monitor* is activated. This enables references to the *parameters*.

User-selected texts for Description and UserAction.

# Database Analyzer Features (1)

General warnings on

- Iow cache hitrates (data-/catalog-cache)
- high I/O rate
- Iow hitrates on Selects, Updates und Deletes (ratio found/read rows; optimizer strategy)

- log queue filling level too high / overflows
- lock list escalations

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# Database Analyzer Features (2)

SAP

Task specific warnings on

- poor I/O-times
- high lock waits (vwait/vsuspend)
- Iong command runtimes (receive/reply)
- high read activity (reads)
- a Usertask blockades in a certain state (e.g. Vwait, Vbegexcl...)

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# Database Analyzer: Program Start

#### Calling the Database Analyzer

- from a UNIX- or DOS-Shell
  - start: dbanalyzer
  - -n <server>
  - -d <database>
  - -u <user,pwd>
  - -f <configfile>
  - -t <interval>,<number>
  - -o <outputdir> -c <level>
  - stop: dbanalyzer

Command Prompt - dbanalyzer	- 🗆 ×
D:\>dbanalyzer MaxDB Database Analyzer, The Performance Analysis To Copyright 2000-2004 by SAP AG	ool, Versi
Enter database name: tz75 Enter user name: dba Enter password:	
Used protocol directory: d:\sdb\data\wrk\TZ75\analy; Used configuration file: d:\sdb\programs\env\dbanal;	

- -n <server> -d <database> -u <user,pwd> -f <configfile> -o <outputdir> -stop
- with the DBMCLI command dban\_start
- per WebAS
  - manually via DBACockpit ->Performance->Database Analyzer
  - implicit start with SAP WebAS 6.20 Basis SP 37
- using the SAP CSS Support connection (SAP DB Connection → SAPDBCON)
  - Enables SAP support to collect and store data on a host of their choice

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You can also call the Database Analyzers with the DBMCLI command dban\_start. The Database Analyzer is then implicitly started in the background. The Database Analyzer call can be supplemented with various options.

#### -n <server>

Name of the computer on which the database instance is running. If you enter this argument, you have to specify a directory for logging with the -o switch.

-d <database>

Name of the database instance that is to be examined.

-u <user,pwd>

User name and password for authorization on the database server.

-f <configfile>

Indicates the name of the configuration file to be used. The standard setting specifies the file **dbanalyzer.cfg** in the directory **\$INSTROOT/env**.

-t <interval>,<number>

Defines the time interval (in seconds) between two evaluations. If <number> is specified, the Database Analyzer ends automatically when it has reached the specified number.

-o <outputdir>

Specifies the directory in which the log files of the Database Analyzer are written. If you specify -n <server> at the time of the call, you also have to specify a log directory. If you fail to specify a log directory, logging is done in the **RUNDIRECTORY** of the database instance in the subdirectory **analyzer**.

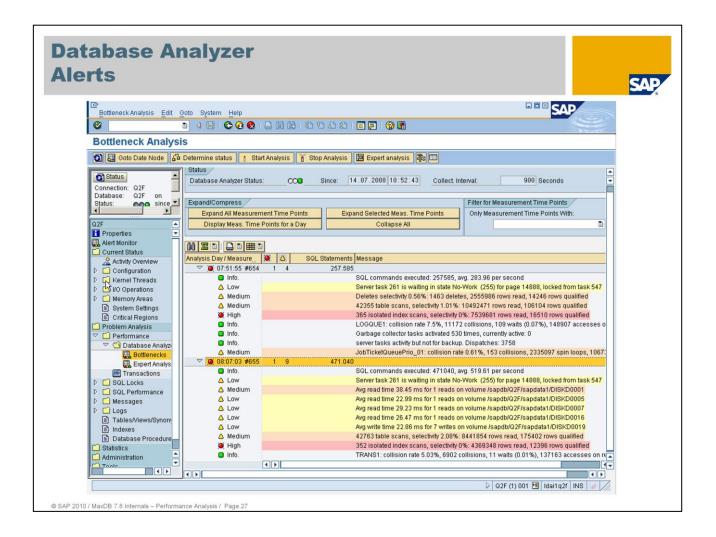
-c <outputlevel>

Specifies that Database Analyzer output also be written to the console. In the standard setting, no output is written to the console. With <outputlevel> you can specify how much is to be output. The possible values are **1**, **2**, **3** and **4**.

-i Deletes (initializes) any pre-existing log files. This enables the logging of data from different databases in the same directory, which is otherwise prohibited. The data of the previously analyzed database are deleted in the process.

Database Analyzer Time Interval	SAD
short term analysis: -t 10 time interval 10 seconds evaluating data online	
<ul> <li>long term analysis: -t 900 (default)</li> <li>time interval 15 Minuten</li> <li>If necessary start with "nohup Database Analyzer &amp;" and option -s in background UNIX)</li> <li>All time data saved (ca. 1MByte/day)</li> </ul>	ound (nur
in both cases <ul> <li>creating and saving the protocol files</li> </ul>	

For routine monitoring of database operation in the production system, an interval of 15 minutes (-t900) is adequate. Logging should be activated with -p to obtain a retrospective overview of DB activities. For short-term monitoring of database operation, a measuring interval of 10-30 seconds is recommended.



As of support packages 6.20 SP37, the Database Analyzer starts automatically when the SAP WebAS system is started.

You can call the Database Analyzer from transaction DBACockpit ->Performance->Database Analyzer. You can also stop and restart it from there.

The default time interval for determining measurement data is 15 minutes. You can override this configuration stopping and restarting the Database Analyzer.

Each time the Database Analyzer is started, information about the configuration and performance-relevant data from system tables is output, including, for example, the number of tables that require an Update Statistics. You can determine the table names with a Select on the system table sysupdstatwanted.

Detected bottlenecks are output in text form to rapidly provide database administrators with an overview of the possible causes of performance problems. The analysis can be performed just once or at regular intervals.

Image: Solution of the second state	
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Tables/views/Synom	
■ Indexes ▶ 19.07.2008	
Database Procedure 1 18.07.2008	
Statistics	
▲ ▷ 16.07.2008	

Under Expert Analysis you can view into the logs of a particular day.

Logs are implicitly deleted periodically via the program *RSDBANCONTROL*. You can configure how long logs are kept using transaction DB59 in the integration data for the respective system. (6.20 as of basis SP 37).

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• Status           Aggregated Data From         • 03.04.2008         To         17.07.2008             Connection:         Q2F         Database:         Q2F         Oo         sicu         Aggregated Level / Monitor Classes / Period             Varsion:         7.7.02.21           Veekly Aggregates             Veekly Aggregates           veekly Aggregates	
22F <ul> <li>CACHES</li> <li>CACHE _ OCCUPANCY</li> <li>CPU_UTILIZATION</li> <li>Corrent Status</li> <li>Corrent Status</li></ul>	3

You can build aggregates on a daily, weekly, monthly or quarterly basis for the journalized data. Data can be prepared furthermore by the list viewer building sums, min, max and average values, can be loaded to the local desktop or graphically displayed.

# Database Analyzer Example: Running Commands

(T)	File File : DBAN_RUNNING_COMMANDS.prt
SAP MaxDB Database Admin	
<ul> <li>Current Status</li> <li>Performance</li> </ul>	I 1: SELECT DISTINCT T_01 . "STADTTEIL" FROM "ZZTELE" T_00 INNER JOIN "ZZSTADTTEIL" T_01 ON T_01 . "PLZ" = T_00 . "PLZ I 1: SELECT * FROM "E071K" WHERE "FLAG" = ?
Activities Overview Database Activities Transactions	===== #2 at 2011-02-11 10:14:10 * I 1: SELECT * FROM "E071K" WHERE "FLAG" = ?
▷ 🗋 Performance Wareh ▽ 🔂 Database Analyzer	===== #3 at 2011-02-11 10:15:11 * I 1: SELECT * FROM "E071K" WHERE "FLAG" = ?
Bttlncks Expert Analysis ▷ □ SQL Performance	===== #4 at 2011-02-11 10:16:12 * I 1: SELECT * FROM "E071K" WHERE "FLAG" = ?
<ul> <li>SQL Locks</li> <li>Kernel Threads</li> </ul>	=====#5 at 2011-02-11 10:17:13 * I 1: SELECT * FROM "E071K" WHERE "FLAG" = ?
VO Operations     Space	===== #6 at 2011-02-11 10:18:14 * I 1: SELECT * FROM "E071K" WHERE "FLAG" = ?
<ul> <li>D Jobs</li> <li>D Galerts</li> <li>D Galerts</li> </ul>	===== #7 at 2011-02-11 10:19:15 * I 1: SELECT * FROM "E071K" WHERE "FLAG" = ?
<ul> <li>Administration</li> <li>Tools</li> </ul>	===== #8 at 2011-02-11 10:20:16 * I 1: SELECT * FROM "E071K" WHERE "FLAG" = ?
Documentation	===== #9 at 2011-02-11 10:21:17 * I 1: SELECT DISTINCT T_01 . "STADTTEIL" FROM "ZZTELE" T_00 INNER JOIN "ZZSTADTTEIL" T_01 ON T_01 . "PLZ" = T_00 . "PLZ * I 1: SELECT * FROM "E071K" WHERE "FLAG" = ?

SAP

The Database Analyzer writes snapshot data like the running commands and the task activities (x\_cons show active) into log files as of version 7.8.

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Storing performance data in the logs is useful when checking runtime behavior later.

The collected data is stored as "csv" files in the directory/YYYYMMDD specified with "-o".

If you start the Database Analyzer on the DB server, you can omit the "-o" entry. In that case, logging is done in the run directory/YYYYMMDD

A directory contains the data from one day.

The data is grouped by contents and stored in different files. You can display the day in a table with MS Excel and from the WebAS.

# Database Analyzer Log Files (2)



quick overview; records monitor data including all rule based values

# DBAN\_BACKUP.csc

physical reads/writes for backup, read/write time (ms) for backup

# DBAN\_CACHES.csv

accesses, successful, failed and hit rates of all caches (DATA, CATALOG,...)

#### DBAN\_FILLING.csv

database filling level (size, permanently/temporarily occupied...)

# DBAN\_IO.csv

virtual/physical reads/writes (common, permanent, temporary, long)

## DBAN\_LOAD.csv

accesses / selektivity of selects and fetches, inserts, updates, deletes

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# Database Analyzer Log Files (3)

DBAN\_LOGGING.csv

number of actual log writes, log queue overflows, max log queue used

DBAN\_OVERVIEW.csv

summarizing the other protocols key points

#### DBAN\_REGIONS.csv

Region accesses, collisions, waits and dispatches

#### DBAN\_SPINLOCKS

spinlock collisions, read/write locks

## DBAN\_STRATEGY\_INDEX.csv

accesses / selectivity of index, index ranges and isolated index / index ranges

## DBAN\_STRATEGY\_PRIMKEY.csv

accesses / selectivity of primary key and primary key ranges

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# Database Analyzer Log Files (4)

# DBAN\_STRATEGY\_SCANS.csv

accesses / selectivity of table and isolated index scans

DBAN\_TASK\_ACTIVITIES.csv

SQL commands, task statistics (active, running, runnable...)

#### DBAN\_TASK\_IO.csv

I/O number / duration for logwriter, user und datawriter Tasks

DBAN\_TASK\_STATES.csv

- number and elapsed time of processed commands
- number and used time in task states Vsuspend, Vwait, Vsleep

#### DBAN\_TRANSACTIONS.csv

number commands, prepares, executes, commits, rollbacks, subtrans, lock request timeouts and lock request escalations

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# Database Analyzer Log Files (5)

# RUNNING\_COMMANDS.prt

Running SQL commands at the time of the data collection

SHOW\_ACTIVE.prt

Active tasks at the time of the data collection

# DBAN\_UKT\_CPU\_UTILIZATION.prt

CPU Usage of the User Kernel Threads at the time of the data colleciton

SA

DBAN\_USER\_TASKS\_CMDS\_EXECUTED.prt

Dispatcher Counts per Usertask serving a session

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Database Analyzer	
Log Files (6)	
	SAP
Maintain Database Integration	
Maintain Database Integration	
Database Connection Information	
Name of Database Connection Q2F	
Database name Q2F	
Database Server Iddbq2f	
Description	
User Data Automatic Monitoring	
Oser Data Automatic wontoning	
CCMS Monitor Sets (RZ20)	
Activate Alert Monitor	
Report Critical Alerts When the Database Assistant Is Called	
Bottlenck Analysis (Database Analyzer)	
Activate when starting the SAP system	
Collect. Interval: 900 Seconds (Min: 60, Max: 3600)	
DBALogs	
Automatic Deletion of the DBA Logs	
On the Database Host and in the DB After 53 Weeks (>= 4)	
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Via transaction DB59 -> Integration Data-> Automatic Monitoring, you can define the time interval at which Database Analyzer logs are deleted.

By default, the logs are stored for 93 days.

The corresponding information in the database table SDBCCMS, however, is kept for 15 weeks. For more information, see **note 530394**.

You can make your own personal settings by choosing Display/Change.

Database Analyzer Data Cache	SAP
low data cache hitrate: <percentage> % <number> accesses, <number> successful, <count> u</count></number></number></percentage>	nsuccessful
Cause: data cache too small SQL statements creating a lot of page reads (unselective commands, missing in	ndices)
<ul> <li>Action:</li> <li>Finding cause, e.g. with the Diagnose Monitor and pay attention to further Data messages</li> <li>If nothing indicates an application or design problem: increase cache size to red sequentialization</li> </ul>	-

#### Database Analyzer: Data Cache

Low data cache hit rate : <percentage> %

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<number of> accesses, <number> successful, <number> unsuccessful

#### Explanations

The hit rate is too low when accessing the database cache. The data cache hit rate for a running database application should not be less than 98%; otherwise, too much data has to be read physically. For a short time, lower hit rates may occur; e.g., when reading tables for the first time, or when the table does not fit into 10% of the data cache with repeated table scans (only with

UseDataCacheScanOptimization/LRU\_FOR\_SCAN = NO). Data cache hit rates under 98% for intervals of 15 minutes or more must be avoided.

#### User response

In addition to enlarging the data cache (note the paging risk in the operating system), search for the cause of the high read activity. Frequently, individual SQL statements cause a high percentage of the total logical and physical read activities. Enlarging the cache only transfers the load from the disk to the CPU although an additional index, for example, could transform a read-intensive table scan into a cheap direct access.

## Database Analyzer Paging Cache Entries

User task physical writes <number of phys. writes>

Causes:

- write transactions changing data pages in the cache
- data cache full, no more space for new pages
- before reading a new page, an already modified page has to be displaced

#### Action:

- increase cache size
- activate pager

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Database Analyzer: cache displacements

Cache displacements: <number of> pages/second

#### Explanations

Modified pages are displaced from the data cache to disk because the data used by the applications cannot be completely kept in the data cache. If the size of the data cache were sufficient, the physical write would be delayed until the next SAVEPOINT and then be done asynchronously. Cache displacements result in synchronous I/O and should be avoided, if possible.

#### User response

Enlargement of the data cache. Particularly with larger data imports, the so-called *pagers* should be activated for regular asynchronous buffer flushes between the SAVEPOINTS database parameter DataCachelOAreaSize, DataCachelOAreaFlushThreshold, DataCacheLRUAreaFlushThreshold or in earlier versions \_DW\_IO\_AREA\_SIZE, \_DW\_IO\_AREA\_FLUSH, \_DW\_LRU\_TAIL\_FLUSH).

## Database Analyzer Selectivity



low access hitrates via <Optimizer Strategy>:

<percentage> % <number> accesses, <number> rows read, <number> rows
qualified

Causes:

- disadvantageous execution of SQL commands. Too many reads necessary to fetch just a few results
- unfavourable SQL syntax/statement
- missing indices

Action:

- update statistics
- Find the responsible SQL commands with the help of Diagnose Monitor, analyse them and if necessary - rewrite SQL or create index

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#### Database Analyzer: selectivity

#### Explanations

The relationship between read and found (qualified) rows is poor for a certain access strategy applied by the MaxDB Optimizer. This indicates a poor search strategy, caused either by the application (missing or insufficient indexes) or by poor formulation of SQL statements. Searching large quantities of data can seriously compromise the performance of the system as a whole due to the numerous negative effects (I/O, CPU load, etc.).

#### User response

First of all, see if MaxDB Optimizer is able to find a more suitable strategy after updating the internal database statistics. The update should be done directly from the SAP system with transaction DB13.

If this does not produce the desired result, search for the statement that triggers the unfavorable search strategy. The easiest way to do this is with the data in the Shared SQL Cache or with the Command Monitor.

## Shared SQL Display SQL statements



## THE tool for identifying high load causing SQL commands

1					
🗧 🚖 🚹 🗓 System Co 🕨	Output Criteria		Current Monitor	r Status	
System WB5	Page Accesses ≥			Resource Usage 🔢 👔	
	Physical I/O Accesses 2		-		
AP MaxDB Database Admin	Executions 2		Recorded SQL	Statements	1,183
Current Status	Runtime in s 2		Stat. Records		1.183
7 🗋 Performance	Pattern for SQL Statemnt				
Activities Overview Database Activities			Initialize Monito	or Tables 📋	
Transactions	Number of Statements	200			
👂 📫 Performance Wareh	(Display the <n> Statements with the Longest Runtin</n>		Refresh Monit	🔄 Details	
🗢 🗋 Database Analyzer	(Display are she blatements war are congest really	ine)	Trenestrimonia	Column	Contents
Bttincks	Refresh Monitor Display	•		SQL Statement Operation Type	SELECT
Expert Analysis	Reliest monitor Display			Syskey	E302
Command Monitor				Tables	"E071K"
<b>Resource Monitor</b>			20 🖽 🖸	# of Executions of SQL Statement	199
SQL Locks	#Number, P Pages, R Rows, E Executions			SQL Statement Runtime in s Average Runtime in s	6.880.080.756,000 34.573.270.131
Kernel Threads I/O Operations	Operation Tables	# Executions	Runtime	Minimum Runtime in s	31.537.741,000
D Space	SELECT "E071K"	199 6.880.08	0.756,000 34.57	Maximum Runtime in s	78.396.418.000
Jobs	SELECT "ZZTELE" T_00 INNER JOIN "ZZST	5.361 2.283.39		Number of Page Accesses	69.601.792
Alerts	SELECT "ZZTELE"	10.723 1.901.49		Number of Cache I/O	68.166.188
Diagnostics	SELECT "ZZTELE" T_00 INNER JOIN "ZZST	5.361 1.258.47		Number of Page Accesses per Executi	349.758
Administration	SELECT "E071K"		5.985,000 12.24	No. of Page Accesses per Qualified Ro	349.757,75
Tools	SELECT "ZZTELE" T_00 INNER JOIN "ZZST		7.322,000 43	Number of Disk I/O	1.435.604
				Number of Rows Read	1.781.774.161
				Shortened SQL Statement Task suspensions	SELECT * FROM "E071K" WHERE "FLAG" = ?
ho Databas	o Cocknit chows the	data from	tho	Offset	3.710.496
ne Dalabas	e Cockpit shows the o	uala nom	ule	Program	ZFSCANE071K
	Cache in the Resourd	N /			

As of version 7.8 MaxDB collects runtime data for the known SQL commands. These figures are available if Shared SQL is turned on an the parameter UseExtendedTimeMeasurement has the value YES.

The runtime data collection has a small impact on the performance of the system. The statement text is available in Shared SQL and doesn't need to be stored in specific monitoring tables.

The Resource Monitor in the DBACockpit works downward compatible. It shows the data from the diagnose analyze tool in older version and the data from Shared SQL with MaxDB 7.8 and newer versions.

The runtime data includes information about number of executions, overall – minimum – maximum and average execution time, number of page accesses in memory and on disk, number of read and qualified rows, wait situations and more.

Shared SQL collects the execution times in microseconds. The Resource Monitor shows the execution times as milliseconds which is incorrect in the current version of the DBACockpit.

The Shared SQL data helps analyzing the over all load in the systems. The Resource Monitor filters the commands to be displayed by the output criteria.

This example shows a select reading data from table E071K. It runs quite often with a high execution time. It reads all records but doesn't find any according to the WHERE condition. An optimization of the application or an index on table E071K for the field FLAG could reduce the load in the system significantly.

A double-click on the command guides you to the complete statement. The Resource Monitor can jump to the table definition and to the ABAP program. The DBACockpit supports the explain command in the Command Monitor. MaxDB needs the values of the input parameters for the explain. Shared SQL doesn't store input value parameters of the single executions.

_	system view COMMANDSTATIS	FICS shows	s all entrie	es in Shar	ed SQ	L	
SQL							
SQL							
	Result (1)						
	rom sysinfo.commandstatistics executetime desc						
	STATEMENT	APPLICATIONINFORMATION	APPLICATIONLINENUMBER		EXECUTECOUNT	EXECUTETIME	AVGEXECUTE
1	SELECT * FROM "E071K" WHERE "FLAG" = ?	ZFSCANE071K	76	0	199	6880080756	3457
2	SELECT DISTINCT T_01. "STADTTEIL" FROM "ZZTELE" T_00 INNER JOIN "ZZSTADTTEIL" T_01 ON SELECT "NAME", "VORNAME", "STR", "NR", "PLZ", "ORT", "CODE", "ADDINFO" FROM "ZZTELE"	ZFBAD ZFBAD	515	0	5361 10723	2283397430 1901497105	42
4	SELECT T.00. "PLZ" FROM "ZZTELE" T_00 INNER JOIN "ZZSTADTTEIL" T_01 ON T_01. "PLZ" = T	ZFBAD	542	0	5361	1258475169	2
5	SELECT * FROM "E071K" WHERE "FLAG" = ?	ZFSCANE071K	76	0	30	367465985	1224
6	SELECT DISTINCT T_01 . "STADTTEIL" FROM "ZZTELE" T_00 INNER JOIN "ZZTADTTEIL" T_01 ON SELECT /*+ FIRST ROWS (2000) */ * FROM "ZZTELE" WHERE "STR" = ? AND "NR" BETWEEN ? A	ZFBAD ZEBAD	515	0	284	122317322 104145944	4:
8	SELECT [V=PIRST_ROWS(2000) ] FROM 22TELE WHERE STR = FAND TREBETWEEN FALL SELECT "NAME", "VORNAME", "STR", "NR", "PLZ", "ORT", "CODE", "ADDINFO" FROM "ZZTELE"		333	0	567	102704844	18
9	SELECT T_00 . "PLZ" FROM "ZZTELE" T_00 INNER JOIN "ZZSTADTTEIL" T_01 ON T_01 . "PLZ" = T	ZFBAD	542	0	284	66394602	23
10	SELECT T_00 . "NAME", T_00 . "VORNAME", T_00 . "STR", T_00 . "NR", T_00 . "PL2", T_00 . "O	ZFBAD	442	0	5361	26335801	
11 12	SELECT /*+ FIRST_ROWS (6000) */ "NAME" , "PL2" FROM "ZZTELE" WHERE ROWNUM <= ? SELECT "LDATA" FROM "REPOLOAD" WHERE "PROGNAME" = ? AND "R3STATE" = ? AND "MACH" =	ZFBAD	181	0	5362 895	25877704 18417943	2
13	SELECT VIRTUALKEY FROM DOMAIN. TABLES WHERE OWNER = USER AND TABLENAME = ?	SDB1FADA	2442	0	133806	16830985	
14	SELECT TABNAME, BLOCKNR, FIELDSLG, FIELDS FROM "DDNTF" WHERE TABNAME = ? ORDER B	UNKNOWN	0	0	2274	16348569	
15	SELECT * FROM "ZZTELE" WHERE "NAME" IN (?, ?)	ZFBAD	135	0	5362	14282201	
16 17	SELECT * FROM "ZZTELE" WHERE "STR" = ? AND "NR" BETWEEN ? AND ? ORDER BY "NAME", "VO INSERT INTO "TBTCP" VALUES(?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,	ZFBAD SAPMSSY2	270	0	5362 1877	14229313 9728088	
18	SELECT DISTINCT tablename FROM domain.columns WHERE schemaname = CURRENT_SCHEMA A	CL_SQL_STATEMENT====		0	6	8966320	149
19	SELECT /*+ FIRST_ROWS (2000) */ * FROM "ZZTELE" WHERE "STR" = ? AND "NR" BETWEEN ? A	ZFBAD	294	0	284	7910098	2
20	INSERT INTO "TBTCO" VALUES(?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,	SAPMSSY2	5089	0	975	7342280	
21	SELECT "DEVCLASS", "INTSYS", "CONSYS", "CTEXT", "KORRFLAG", "AS4USER", "PDEVCLASS", SELECT "LDATA" FROM "REPOLOAD" WHERE "PROGNAME" = ? AND "R3STATE" = ? AND "MACH" =	SAPLSTAM	2302	0	78	6161601 5669796	1
			0	0	718	4636797	
2							
2 3 4	SELECT TABNAME, BLOCKNR, FIELDSLG, FIELDS FROM "DDNTF" WHERE TABNAME = ? ORDER B SELECT "JOBCOUNT" FROM "TBTCO" WHERE "JOBNAME" = ? AND "JOBCOUNT" LIKE ? ORDER BY "	SAPLBTCH	67608	0	975	4188609	
2 3 4 5	SELECT TABNAME, BLOCKIR, FIELDSLG, FIELDS FROM "DONTF" WHERE TABNAME = ? ORDER B SELECT "JOBCOLINT" FROM "TBTCO" WHERE "JOBNAME" = ? AND "JOBCOLINT" LIKE ? ORDER BY " SELECT "NUM", "NAME_PREFIX", "NAME_POSTFIX" FROM "SWIRCT_RESOURCES" WHERE "MOD_NU	SAPLBTCH UNKNOWN	0	0	14	3810216	
2 3	SELECT TABNAME, BLOCKNR, FIELDSLG, FIELDS FROM "DDNTF" WHERE TABNAME = ? ORDER B SELECT "JOBCOUNT" FROM "TBTCO" WHERE "JOBNAME" = ? AND "JOBCOUNT" LIKE ? ORDER BY "	SAPLBTCH					21

A select from the system view SYSINFO.COMMANDSTATISTICS returns the runtime values stored in the Shared SQL Cache. The column CURRENTEXECUTECOUNT shows the number of sessions currently executing the command.

The view SYSINFO.COMMANDSTATISTICSRESET show the runtime values of commands executed after a reset. The SQL command "diagnose analyze clear all" performs the reset.

The following SQL statement shows all command executions after a reset: select c.statement, r.\* from commandstatisticsreset r, commandstatistics c where c.commandid = r.commandid order by r.executetime desc

Command Monitor
THE tool to find long running command executions and log them with the input parameter values
Logging of problematic SQL commands according to defined filters.
<ul> <li>The Command Monitor logs the ID of a command with monitoring values if</li> <li>the number of page accesses in memory counted with an execution exceed the given value.</li> <li>the runtime of an execution exceeds the given value in milliseconds</li> <li>the selectivity (relation between read records and qualified records) falls below the given value</li> </ul>

The Command Monitor finds long and/or expensive SQL command executions. Different input parameter values can lead to very different execution times. MaxDB can use different search strategies according to the input parameter values.

The Command Monitor stores the command ID, the monitoring values and the input parameter values when a command execution exceeds (page accesses and execution time) or falls below (selectivity) the given filter value.

The transaction DBACockpit and the Database Studio can run an Explain with the logged command using the input parameter values. Explain shows the search strategy of the statement.

The DBACockpit and the Database Studio use SQL statements to enable the Command Monitor and to display the results of the monitoring. Administrators can use those SQL statements manually, as well.

The Command Monitor has been re-implemented with MaxDB version 7.8. It uses commands stored in the Shared SQL Cache. It doesn't log the statement text anymore but only the command ID known by Shared SQL. This reduces the memory footprint of the Command Monitor significantly.

Furthermore the new implementation has a very small impact on the performance of the system as long as users define reasonable filter values.

#### **Command Monitor DBACockpit** SAP Turn on Command Monitor and show results Filter values combined with OR Choose reasonable filter values to prevent too much logging and performance impact Double click on row shows detailed information Settings remain after database restart **SQL** Command Monitor 🔄 Change Monitor Settings $\boxtimes$ Recording Criteria 0/1010 No. of PageAccesses 500 ms SQL Statement Runtime ≥ 😽 🚖 🚹 🖽 System Co 🕨 Current Monitor Settings 18 % Selectivity System WB5 PageAccesses Save Parameter Values 500 ms Runtime ≥ The recording criteria are linked with "or SAP MaxDB Database Admin 18 % θ Selectivity ≤[ Maximum Number of Monitor Entries Current Status Performance Activities Overview Maximum Number of Monitor Entries O < B C A F M K F0 ∑0 %0 L @ 0 ∰0 ∰ I I 🖌 🗊 🗙 Database Activities #Number, P Pages, R Rows ; 15.02.11 10:59:23 - 15.02.11 11:41:19 Transactions Runtime #P Accesses #P / R #R Read #R Qualified #R Retriev #P Cache I/O # Disk I/O Shortened SQL Statement 100,000 376.101 376.101,00 9.953.639 0 0 359.451 16.650 SELECT \* FROM \* E0711C\* Operati... Tables SELECT "E071K" 16.650 SELECT \* FROM "E071K" WHERE 🗋 Database Analyzer SELECT "E071K" 0 SELECT \* FROM "E071K" WHERE 🗢 🔁 SQL Performance 5,000 303.790 303.790,00 8.953.639 0 0 303.790 SELECT "ZZTELE" 35.029 35.029 2.288 SELECT "NAME", "VORNAME", 4,000 109.353 35.029 107.065 3,12 0 SELECT \* FROM "E071K" WHERE Resource Monitor SELECT "E071K" 4,000 303.790 303.790,00 8.953.639 303.790 0 0 SQL Locks 0 SELECT\*FROM "E071K" WHERE SELECT "E071K" 4.000 303 790 303 790 00 8 953 639 303 790 Π Π 0 SELECT\*FROM "E071K" WHERE Kernel Threads SELECT "E071K" 4,000 303.790 303.790,00 8.953.639 303.790 0 0 🗋 I/O Operations SELECT "E071K" 4,000 303.790 303.790.00 8.953.639 303.790 0 SELECT \* FROM "E071K" WHERE D Space 0 SELECT\*FROM"E071K" WHERE SELECT "E071K" 4.000 303,790 303,790.00 8,953,639 0 0 303.790 Jobs 0 SELECT \* FROM "E071K" WHERE SELECT "E071K" 4,000 303.790 303.790,00 8.953.639 0 303.790 0 Alerts SELECT "E071K" 4.000 303.790 303.790,00 8.953.639 0 0 303.790 0 SELECT \* FROM "E071K" WHERE Diagnostics 0 SELECT \* FROM "E071K" WHERE SELECT "E071K" 4,000 303.790 303.790.00 8.953.639 0 0 303.790 Administration 0 SELECT \* FROM "E071K" WHERE SELECT "E071K" 303.790 303.790,00 8.953.639 4,000 303.790 0 C Tools 476.803 SELECT "ZZTELE" T\_00 INNER JOIN "ZZST 2.000 116.425 0.24 476.797 114.425 2.000 SELECT DISTINCT T 01 . "STAD D Documentation 292.00 280 12 SELECT DISTINCT "IDENT" FRO SELECT "SWNC\_TCOLL\_LOG" 1.000 292 7.516 0 SELECT "TDEVC" 5.247 1.000 299 0.06 5.259 5.247 83 216 SELECT "DEVCLASS" . "INTSYS" P 2010 / MaxDB Intern Analyse / Seite 43

Users can turn on the Command Monitor with the desired filter value in the Performance section of the DBACockpit. The DBACockpit displays the logged SQL commands with the runtime values.

A double click on the line of a command shows more detail information about the command.

The layout definition allows the selection of user defined output columns. Important columns are:

Table	Table used by the statement
Program	ABAP Program calling the SQL command
Rutime	Runtime of the SQL command in seconds
#P Accesses	Number of page accesses in cache
#R Read	Number of read records
#R Qualified	Number of records matching the where clause
#P/R	Number of page accesses per qualified record
#Fetched	Number of records transported to the application
#Disk I/O	I/O accesses from and to disk
SQL Waits	Number of lock collisions
Task Suspends	Number of internal memory access collisions
No. Fetch Orders	Number of fetch order for record transportation
Result is Copied.	YES: an internal result set was created
Date	execution date
Time	execution time
#P/R #Fetched #Disk I/O SQL Waits Task Suspends No. Fetch Orders Result is Copied. Date	Number of page accesses per qualified record Number of records transported to the application I/O accesses from and to disk Number of lock collisions Number of internal memory access collisions Number of fetch order for record transportation YES: an internal result set was created execution date

Statement view supports: Explain Explain with trace Jump into ABAP program to the statement position Show table definitions Sole Statement   Sole Statement     Stat	Command Monitor Display statement with input parameter values	AP
SAP MaxDB Database Admin   SAP MaxDB Database Admin   Current Status   Performance   Activities Overview   Database Activities   Transactions   Performance   Activities Overview   Database Activities   Transactions   Performance   Pi Detabase Analyzer   SQL Performance   Command Monitor	<ul> <li>Explain</li> <li>Explain with trace</li> <li>Jump into ABAP program to the statement position</li> </ul>	
	Sol Statement     Sol Statement     Sol Statement     Select     Select     Select     FROM   e071k   wHERE   flag = ?     Variables   Variables   Performance   Activities Overview   Database Activities   Transactions   P   Performance Wareho   P1   (RA,5) = 0x'x'	

The Command Monitor collects the input parameter values belonging to the command executions. The DBACockpit inserts the values into the command text and executes an Explain.

Explain show the search strategy found by the optimizer at the time of the explain execution.

The DBACockpit can jump into the ABAP program calling the SQL command. It can also jump into the table definition view with the tables referenced by the SQL command. The table definition view shows the definition in the database, not the data dictionary definition of the WebAS.

Command M Explain	Aonite	or			SAP
EXPLAIN shows	the sear	rch strategy of	f the command		
<ul> <li>Search strategy a</li> <li>No SQL comman</li> </ul>	d executi	ion			
<ul> <li>Explain with kern</li> <li>Explain with hints</li> </ul>					
Execution Plan of SQL S	Statement (E	xplain)			
Explain with Hint	SQL Statement				
System WB5  SAP MaxDB Database Administration  Current Status  Performance  Activities Overview	SELECT * FROM e071k WHERE flag = 'x				
Database Activities Transactions	Execution Plan	n for SQL Optimizer		I	
<ul> <li>Performance Warehouse</li> <li>D atabase Analyzer</li> <li>SQL Performance</li> </ul>	OWNER SAPWB5	TABLENAME E071K	COLUMN OR INDEX	TABLE SCAN RESULT IS NOT COPIED , COSTVALUE	PAGECOUNT 298272 5 298272
Command Monitor Resource Monitor D C SQL Locks D Kernel Threads		SHOW SHOW		QUERYREWRITE : APPLIED RULES: DistinctPullUp	10 230272
© SAP 2010 / MaxDB Internals Version 7.8 – I	Performance Analyse	9 / Seite 45			

Explain show the search strategy of the command at the current time. The search strategy can change with modified table definitions or updated statistics. The search strategy at the Explain time can be different to the search strategy at the execution time of the statement.

The chapter Query Optimization provides more detailed information about the Explain command.

	Command Monitor Display Call position in ABAP Program						
Shared SQL stores the	rogram with the call position of the ABAP program and the call position his information to jump into the ABAP p I and Resource Monitor						
ABAP Editor: Display Rep	🕂 🛃 🖾 🚺 🛛 😭 📽 Pattern Pretty Printer	ive					
SAP MaxDB Database Administration         ▷       Current Status         ▽       Performance         Activities Overview         Database Activities         Transactions         ▷       Performance Warehouse         ▷       Database Analyzer         ▽       SOL Performance	<pre>     *_d     *_d</pre>						
Command Monitor Resource Monitor  Command Monitor  Command Monitor  Resource Monitor  Command Monitor  Resource Monitor  Command Monitor  Resource  Command Monitor  Resource  Command Monitor  Resource  Resource Resource  Resource  Resource  Res	15       16       ⇒ while loop = 1.         17       is select * from e071k         18       where flag = 'x'.         19       endselect.         20       endwhile.						

The database interfaces transport the name of the ABAP program and the call position with a prepare of a statement to the database. Shared SQL stores this information with the command.

The DBACockpit uses this information to jump directly into the ABAP program to the call position of the statement. Both, the Command and the Resource Monitor support this functionality.

ABAP SQL statements often look different to the commands sent to the database. The ABAP database interfaces generate the SQL commands depending on profile settings and the used database management system.

<b>Command Monitor</b> <b>Table Definition</b>		SAP
Display table definition		
<ul> <li>Jump from statement view into</li> <li>Shows table definitions on data</li> </ul>	table definition view abase level (SE11 jumps into DDIC-Editor)	
Table / view information		
Image: System Configuration         Table/View Schema           Image: System WB5         Table / View Name	SAPW85 E871K	
SQLDBC Trace Package SCT	ht geclustert. DEFAULT Ga Table Consistency ange & Transport System: Key Entries of Requests/Tasks (S_REQ CTS: Request Editing CTS-OR6 SE11 SE16	

Resource and Command Monitor allow to jump from the statement to the table definition view. The

DBACockpit here shows the definition and more detailed information about the chosen table. The table size, optimizer statistics and the table data can be displayed in this view. Optimizer statistics can be updated as well.

DBACockpit Further useful Diagnose Functions	SAP
The DBACockpit provides further diagnose functions supporting analyzing the performance of a system:	users when
<ul> <li>Caches         Cache sizes and usage, incl. hitrates</li> <li>Missing Tables and Indexes         Jump into transaction DB02</li> </ul>	
<ul> <li>EXPLAIN</li> <li>Enter a command to get the search strategy</li> <li>Select-Editor</li> <li>Input and execution of SQL commands</li> </ul>	✓ ☐ Space Caches Data Area Log Area Database Fill Level Snapshots
<ul> <li>Critical Regions</li> <li>Accesses to synchronized memory areas (x_cons SHOW REGION)</li> </ul>	✓ Diagnostics Missing Tables and Indexes EXPLAIN SELECT-Editor Database Files Official Designs
<ul> <li>Database Console x_cons output</li> <li>SYSINFO Views Direct access to all views of the schema SYSINFO</li> </ul>	Critical Regions Database Console Database Trace SQLDBC Trace SYSINFO Views Error Codes
<ul> <li>Database Objects</li> <li>Show database object definitions and observe table growth</li> </ul>	Messages     Database Objects     Tables/Views/Synonyms     Indexes     Database Procedures     Table Sizes

## Statement Analysis with Database Studio



### The Database Studio supports extended filter values defined in a WHERE condition

ld 13:PC2 ONLINE Data: 87,81 %	Log:	Overwrite mode is activated!	Sessions:	20,00 %
i User 'SAPR3' doesn't have privileges to change state of extended time measurem	nent. DBM or SYSDBA rights needed to	perform this task.		2
nfigure Monitoring Bottleneck Candidates				
onfigure Monitoring				
Monitoring				
Monitoring running				Reset Monitoring Data
Extended Time Measurement				
Extended time measurement running.				Deactivate
Detail Collection				
Detail Collection running				
Configure detail collection to catch statements which match at least one of the given o	criteria			
C Simple		Advanced		
Number of Page Accesses		Constraint		
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Selectivity of the statement 10.0 %				
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	Default	Clear		Clear
then applying changes to the detail collection settings then				
Reset Monitoring (cumulated values will be reset)				
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2010 / MaxDB Internals Version 7.8 - Performance Analyse / Seite	49			

The DBACockpit can access to remote database. It can use the Command and Resource Monitor on databases without ABAP WebAS data.

The Database Studio supports SQL command analysis as well. This is very helpful if no DBACockpit is available. The Database Studio combines Resource and Command Monitor in one "SQL Performance Analysis" Editor. It allows the detailed definition of filter values for the Command Monitor in a WHERE condition .

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The Database Studio shows all command stored in the Shared SQL Cache. The commands are sorted by the execution time by default.

Different variants show groups of runtime figures. This insures a proper overview. The variant "Caller Details" show the commands logged by the Command Monitor only.

A double click on a statement line guides to the detailed statement view.

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The r	nonitc	oring	data o	f the c	omma	nd exec	cution o	ollect	ed by t	he C	omm	and M	onitor	
		•				selecte								
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i ne e	explain	rout	put of	ine sei	ect co	mmand	with It	s valt	Jes					
king 13:PC2 of	ILINE Data:	_	87,87 %		Log:	Overwrite mode is	activated	Sessions: (						
				asurement. DBM or SY	5DBA rights needed to	perform this task.								
onfigure Monitoring E		s Bottleneck Ca	ndidate Detail											
his page lists all single Single Executions (3)		tatement along v	with the parameters u	sed if any. In case of 9	ELECT statements ar	explain is provided as we	el.							
• I			11-02-14 13:17:01)		splay Variant Defaul		¥2							
<sup>4</sup> a Runtime 79.622.281 78.368.525	CPU Time IO Time 8,213 9,045 8,294 9,976	83,031	ectivity Rows Read 0,000 8.953.639 0,000 8.953.639		ccesses/Rows Qual 0,000 0,000	Page Accesses Cache 1 377.568 367.2 378.461 367.9		-02-15 17:50:13.42 -02-15 17:39:37.68	28628					
76.265.263	8,578 9,203		0,000 8.953.639		0,000	377.529 367.1		-02-15 17:50:13.42						
Statement (2011-02- SELECT *	15 17:50:13.428628	5)					Parameter	/pe Value						
from <mark>e071k</mark> where flag =	'x'													
										_				
								SQL Edit						
							w.	Copy						
								🛄 Open T	Table Definition					
Explain			I Owner\Schem	aname Tablename	Column or In	lex Strategy								
- 🕅 SELECT * fr	rom e071k where fla	ig = '×'												
Table A	kccess	ng = '×'	SAPR3	E071K JDBC_CURSO		TABLE SCAN RESULT IS NOT CO	OPIED , COSTVALUE IS	304083 304083						
SELECT * fr	kccess	ag = 'x'			R_158									

The view "Bottleneck Candidate Details" shows all single command executions collected by the Command Monitor. It shows the input parameter values and the Explain output according to the chosen command execution.

A right click on the statement opens a new SQL editor with this statement. It can open the table definition editor for marked tables as well.

Command Monitor Turn On		SAP
Database parameters (default v	alues)	
UseSharedSQL	= YES	
EnableCommandMonitor	= YES	
UseExtendedTimeMeasurement	= YES	
<ul> <li>The latest entry defines the currer</li> <li>Old entries remain → viewable his</li> <li>Example: Turned off <disabled></disabled></li> <li>Example: Execution time&gt;= 500 m RUNTIME &gt; 500*1000 OR VIRTUALR (QUALIFIEDROWCOUNT/READROW)</li> </ul>	story ns or selectivity <= 10% EADCOUNT > 2147483647 OR	
select * from sysinfo.commandmonitorconstraints		
ID         CREATEDATE         CONSTRAINTS           1         1         2011-01-20 18:16:42.847224 <disabled></disabled>		
2 2 2011-02-15 17:07:07.289902 RUNTIME > 214	7483647*1000 OR VIRTUALREADCOUNT > 2147483647 OR (QUALIFIEDROWCOUNT/RE/ *1000 OR VIRTUALREADCOUNT > 2147483647 OR (QUALIFIEDROWCOUNT/READROWC	
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The latest entry in the table SYSINFO.COMMANDMONITORCONSTRAINTS defines the filter of the Command Monitor. The WHERE condition uses any column of the table COMMANDMONITOR. It can use AND and OR conditions.

With this approach the Command Monitor as of version 7.8 can set more more detailed filters than the monitor in older versions.

The performance impact of the Command Monitor depends on the number of command executions to be logged. A high number of logged commands can lead to high memory consumptions.

The Command Monitor settings remain after a database restart as of version 7.8; i.e. the table COMMANDMONITORCONSTRAINTS stores persistent data.

Tables									SAP
Table SYS	INFO.COMMA	NDMON	IITOR						
	DID references to	o the ID i	n the Sha	red SQL	Cache				
Runtime f									
Execution	-								
	-								
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Table SYS	INFO.COMMA	NDMON	IITORPA	RAME	TERS				
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<ul> <li>COMMAN</li> <li>Position, c</li> <li>Position, c</li> </ul>	DID and executio lata type and valu	n numbe le of inpu	er referen	ce to tab		MDM		۶	
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The Command Monitor stores all runtime figures, the timestamp and the SESSIONID of a command execution matching the filter criteria in the table SYSINFO.COMMANDMONITOR. The COMMANDID references to the COMMANDID in the view SYSINFO.COMMANDSTATISTICS.

The table SYSINFO.COMMANMONITORPARAMETERS stores the input parameter values belonging to the command executions together with the COMMANDID, execution number and the parameter position. This table can become big with many logged command executions specially if the commands have many input parameters. An SQL DELETE command can remove the records from the table.

This select joins the data from the relevant system tables and shows the command executions with their parameter values sorted by the execution runtime:

select m.executecount, c.statement, p.value, m.\*
from sysinfo.commandstatistics c, sysinfo.commandmonitor m, sysinfo.commandmonitorparameters p
where c.commandid = m.commandid
and m.commandid = p.commandid
and m.executecount = p.executecount
order by m.runtime desc, m.executecount, p.inputparameternumber asc

Optimizer Statistics Tools Executing Update Statistics
Transaction DB13, DB20, DB50 <ul> <li>Execution via ABAP programs with sampling</li> <li>Update of SAP WebAS alert tables</li> </ul>
<ul> <li>Determine tables with outdated statistics</li> <li>CALL SYSDBA.SYSCHECKSTATISTICS (<schemaname>, <threshold>) Example: CALL SYSDBA.SYSCHECKSTATISTICS (,SAPWB5<sup>c</sup>, 40)</threshold></schemaname></li> <li>The threshold defines the difference between actual size and statistic in percent</li> <li>The procedure inserts relevant table names into SYSINFO.SYSUPDSTATWANTED</li> </ul>
DBMCLI <ul> <li>sql_updatestat</li> <li>sql_updatestat_per_systemtable</li> <li>auto_update_statistics</li> </ul>
Database Studio <ul> <li>Automatic Update Statistics</li> </ul>

As of version 7.5 MaxDB uses statistics data only for joins and single table selects with a result set limit like "WHERE ROWNUM <= n".

The Update Statistics collects the table size and number of rows only if they are not available in the File Directory. This can happen with tables created by older database version than 7.6.

Update Statistics collects and calculates statistic values for primary- and secondary key columns It collects the statistic values for other columns if statistics already exists.

The database kernel inserts table names into the table SYSUPDSTATWANTED during command execution if it recognizes outdated statistics. The DBM command sql\_updatestat\_per\_systemtable executes an Update Statistics for all tables logged in SYSUPDATESTATWANTED.

The pre-definied database procedure SYSDBA.SYSCHECKSTATISTICS checks the size of all tables in the given schema. It inserts table names into the table SYSUPDSTATWANTED if the actual table size differs to the size in the statistics by more percentage than the threshold.

The database procedure SYSCHECKSTATISTICS checks the size of all tables in the given schema. It inserts table names into the table SYSUPDSTATWANTED if the current table size differs from the statistics by more then the given threshold in percent.

The automatic update statistics function starts a DBM event process. The database kernel sends an event to the DBM process when it inserts a table name into the table SYSUPDSTATWANTED. The DBM process than starts the command sql\_updatestat\_per\_systemtable.

A DBM event process receives an event from the database kernel about outdated statistics

The DBM command sql\_updatestat executes an Update Statistics for all permanent tables of the database.

The Update Statistics speeds up the read of the table records by using parallel I/O orders.

Sampling Rates with Update Statistics
Sample rates for Update Statistics can be configured as
Rows per table: UPDATE STATISTICS ESTIMATE SAMPLE <n> ROWS</n>
Percentage per table <ul> <li>UPDATE STATISTICS ESTIMATE SAMPLE  PERCENT</li> </ul>
Advantage of sampling: Shorter runtime of update statistic job
<ul> <li>Disadvantage of sampling:</li> <li>Sample values are only estimated. If they do not resemble the actual data distribution, the optimizer might chose a suboptimal access strategy</li> </ul>
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#### Sampling with Update Statistics

Database statistics can be created on the basis of samples. The basis for the statistics can be either a number of rows of your choice or a percentage of the table. While the statistics are not exact, there are generally sufficient for a correct calculation of the SELECT strategy since this depends less on precision than on distinguishing between selective and non-selective columns.

Especially when creating an additional index for an inefficiently processed SQL command, the selectivity of all columns of a table can be determined relatively quickly using 'UPDATE STATISTICS COLUMN (\*) ESTIMATE SAMPLE 20000 ROWS'. The selectivity of a column is an important criterion when selecting index columns.

50,000 rows have been proven as adequate sampling quantities for column statistics.

As of version 7.6, the sampling procedure in the standard uses a new algorithm for calculating the statistics data. You can determine the algorithm to be used with the parameter UPDATESTAT\_SAMPLE\_ALGO. The new algorithm generates more accurate statistics with fewer records read.

# Thank you!

