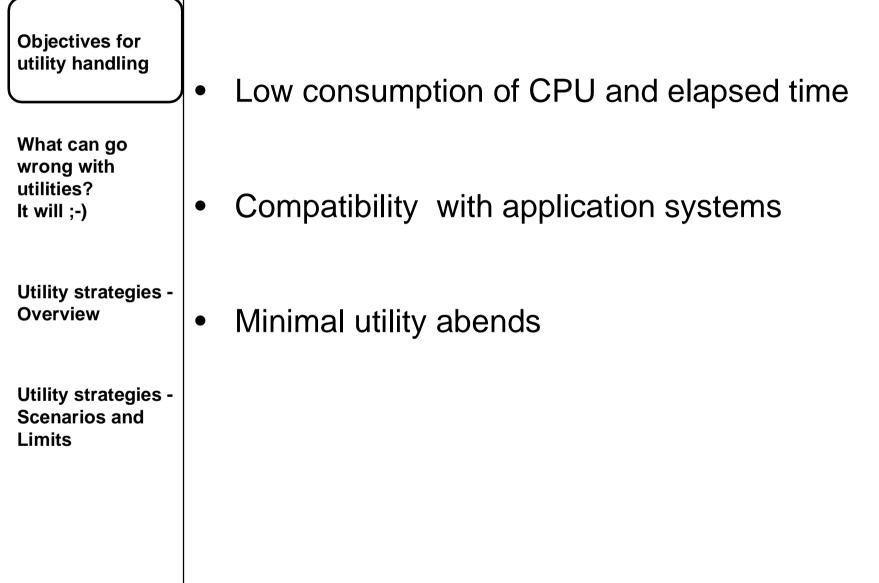
Lessons Learned in Utility Management



Objectives for utility handling	
What can go wrong with utilities? It will ;-)	Jürgen Glag SOFTWARE ENGINEERING GmbH
Utility strategies - Overview	Düsseldorf, Germany
Utility strategies - Scenarios and Limits	juergen_glag@compuserve.com j.glag@seg.de





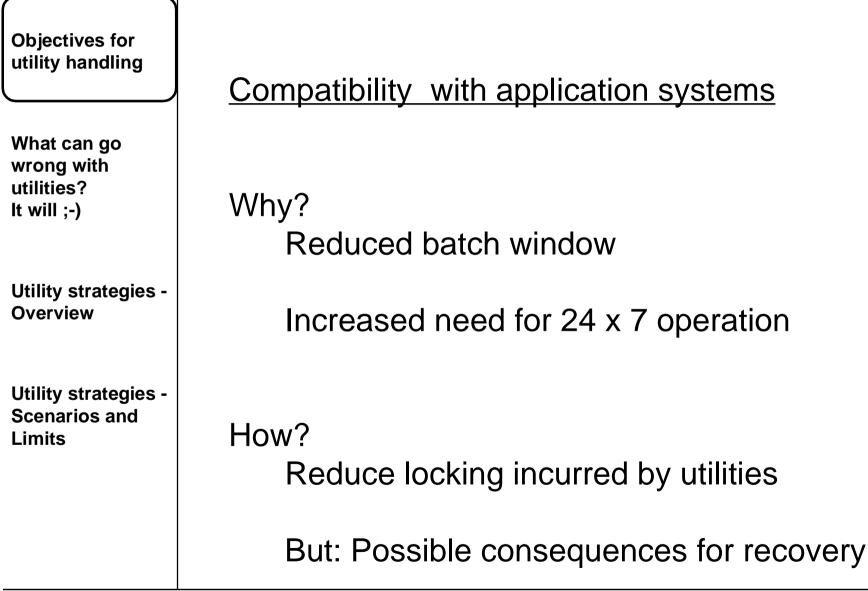


Objectives for utility handling	Low consumption of CPU and elapsed time
What can go wrong with utilities? It will ;-)	Why?
Utility strategies - Overview	Machine resources primarily required for application systems
Utility strategies - Scenarios and Limits	How? Utilities performed only on an as needed basis
	Fast utilities

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Lessons Learned in Utility Management







Objectives for utility handling	Minimal utility abends
What can go wrong with utilities? It will ;-)	Why? No restart required with negative impact on applications = less resource consumption
Utility strategies - Overview	Higher availability of DB2 objects = application systems
Utility strategies - Scenarios and Limits	How? Test, Test, Test Correct integration in job schedulers Controlling utilities during run-time



Objectives for utility handling What can go wrong with utilities? It will ;-)	<u>Scope of Ut</u> "Online Utili	<u>ilities</u> ties" = Utilities ur	nder DSNUTILB				
Utility strategies - Overview	CATMAINT COPY MERGECOPY RECOVER TABLES REPAIR STOSPACE	CHECK DATA DIAGNOSE MODIFY SPACE RECOVER INDEX REPORT	CHECK INDEX LOAD QUIESCE REORG RUNSTATS				
Utility strategies - Scenarios and Limits	Return Cod	es:					
	4 co 8 fa	normal completion completion with warning messages failure authorization error					



What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

Reasons for Failure

- DB2 terminates utility step
 Action: New job, same utility identifier
- DB2 does not execute a specific utility function, but prior functions
 - Action: New step to execute the function
- Utility function is placed in stopped state
 - Action: Restart job step, same utility identifier

or

-TERM UTIL(utilid) and resubmit



What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

Restart Options

- Restart of Utility
 - PHASE restart:
 - CURRENT restart:
- from the beginning of the phase from the last checkpoint
- Restart Step (= DSNUTILB)
 - Change
 - То
 - Change
 - to

- //ddname DD DISP=NEW,... //ddname DD DISP={OLD/MOD},...
 - // DSN=dsname(+1)
 - // DSN=dsname(0)

Lessons Learned in Utility Management



Objectives for utility handling	<u>DD N</u>	<u>lan</u>	nes	<u>s a</u>	<u>nd</u>	Ut	<u>iliti</u>	<u>es</u>									
What can go wrong with utilities? It will ;-)		C A T M A I N T	CHECK DATA	С Н Е С К І Х	C O P Y	D I A G N O S E	L O A D	M E R G E C O P Y	M O D I F Y	Q U I E S C E	R E C V T S	R E C O V I X	R E O R G	R E P A I R	R E P O R T	R U N S T A T S	S T O S P A C E
Utility strategies - Overview Utility strategies - Scenarios and Limits	DATAWKnn DSSPRINT SORTLIB SORTOUT SORTWKnn SYSCOPY SYSDISC SYSERR SYSIN SYSBR SYSPRINT SYSREC SYSUT1 UTPRINT	X X X	A X X X X X X X X X X X X X	X X X X X X X X X X	X X X X X X	X X X	X X X X X X X X X X X X X X X X X X X	X X X X X X	X X X	X X X	X X X	X X X X X X X X X X	X X X X X X X X X X X X X X X	X X X	X X	X	X X



Objectives for utility handling What can go		<u>o SB37 on Outp</u> startable at Corr	
wrong with	Utility	Phase	Output Dataset
utilities? It will ;-)	COPY	Сору	SYSCOPY COPYDDN RECOVERYDDN
Utility strategies - Overview	MERGECOPY	Mergecopy	SYSUT1 SYSCOPY RECOVERYDDN
Utility strategies - Scenarios and	LOAD	Reload	SYSUT1 SYSERR SYSMAP
Limits	REORG	Unload (SORTDATA not specified)	SYSREC
	REORG	Reload	SYSUT1 SYSERR SYSMAP



Objectives for utility handling What can go wrong with utilities? same DCB It will :-) **ICEGENER**) **Utility strategies -Overview Utility strategies -**Scenarios and Limits operation

<u>Restart due to SB37 on Output Datasets (cont'd)</u>

- Copy output DS to temporary DS
 - no reblock (DFDSS ADRDSSU or DFSORT
- Delete and define output DS with more space - same VOLSER, DS-Name, DCB
- Copy temporary DS into output DS
 - no reblock (see above)
- Restart utility at last commit point
- Never use IEBGENER or ISPF 3.3 for copy



What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility abends

- DB2 abends
- MVS abends
- Return Codes

Organizational errors / inefficiencies

Utility strategies -Scenarios and Limits

• Example: Recover TOCOPY impossible



Utility DB2 abends and reactions

What can go
wrong with
utilities?
lt will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

		MVS	MVS	DB2 Reason	
Utility	Phase	cc	RC	Code	Action
CHECK DATA, CHECK INDEX	Any	Any	Any	Any	-TERM UTIL
COPY	Any	Any	Any	Any	-TERM UTIL
		S04E			Try again, then -TERM UTIL
					(-904,-911,-913,-923:
					Timeout during lock request)
		S04E		00C9008E	Try again, then -TERM
					(Object started for RO access,
					RW required)
		S04E		00C90080	Try again, then -TERM
					(Timeout, Resource in use)
		S04E		00C90082	Try again, then -TERM
					Deadlock
REORG IX		S04E			Try again, then -TERM
					Deadlock in Build Phase
REORG IX	Build	S04E			Try again, then Recover Index



Utility MVS abends and reactions

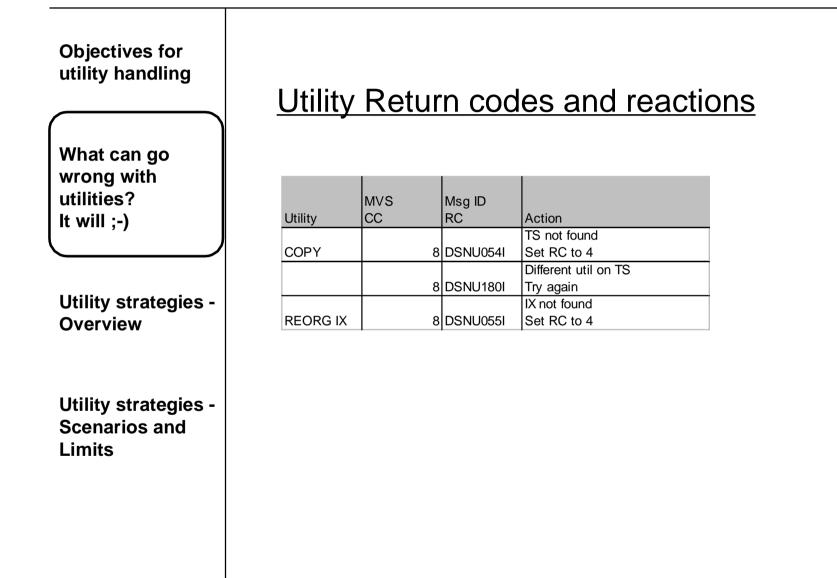
What can go wrong with utilities? It will ;-)

Utility strategies -Overview

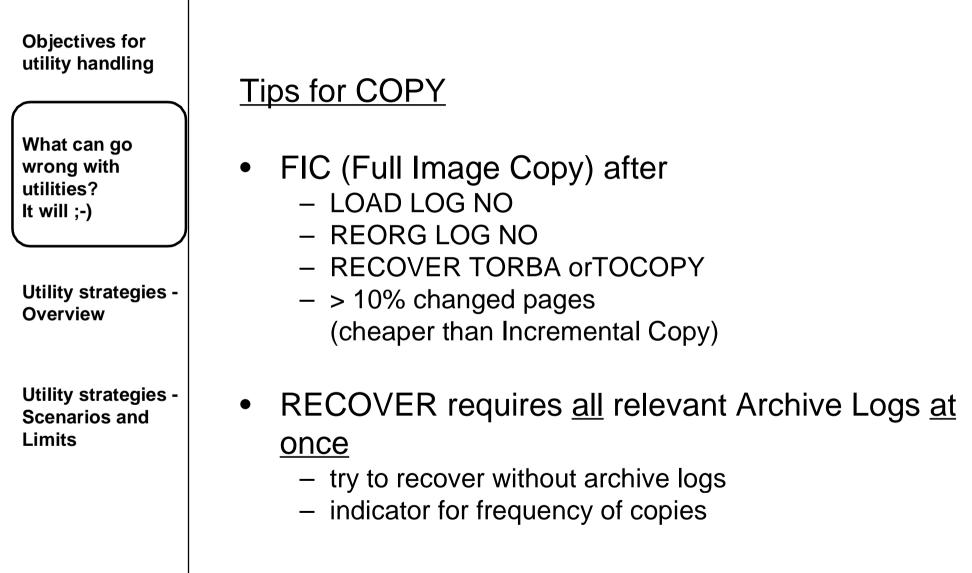
Utility strategies -Scenarios and Limits

		MVS	MVS	DB2 Reason	
Utility	Phase	СС	RC	Code	Action
					Error during OPEN SYSCOPY
COPY		SA13			-TERM
		SB37			More Space, then RESTART
					Cancel by operating,
		S222			-TERM
					I/O error on workfile,
	COPY	S04E	E40071		-TERM
	Build /				
REORG IX	Sort	S04E			Recover Index
REORG IX	Unload	S04E			-TERM
	Build /				
REORG TS	Sort	S04E			Recover Index
REORG TS	Reload	S04E			Recover Tablespace
REORG TS	Unload	S04E			-TERM











What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

Tips for COPY (cont'd)

- Always take dual copies (media failure!)
- For speeding up recovery have at least 2 successive full copies with incremental copies in between
- Catalog and Directory should be copied always together
- DFSMS Concurrent Copy
 - ICTYPE = F, STYPE = C
 - No Incremental Copy possible



What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

Tips for Archive Logs

- No Archive logs from different subsystems (of a data sharing group) on same tape
 - Recovery can be inhibited!!!
- Recovery from Archive logs on tape may require more tape units than you have
 - Solution: Frequent Image Copies and recovery points (QUIESCE)



What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

Tips for Active Logs

- Dual Active logs
 - separate controllers
 - separate channels
 - separate volumes
- One log fails
 - Recover from the other log
 - Update BSDS



What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits Tips for Active Logs (cont'd)

- Both logs fail
 - No recovery possible
 - Cold start DB2
 - Full Image Copy immediately
- Data Sharing:
 - Changes of one object may be written to all log datasets on all subsystems



What can go wrong with utilities? It will ;-)

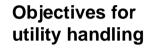
Utility strategies -Overview

Utility strategies -Scenarios and Limits

Tips for BSDS

- Dual copies
 - One BSDS fails
 Recover from the other
- Both BSDS fail
 - Recover from most recent Archive Log
 - Active -> Archive Log: BSDS always included





Tips for RECOVER

What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

- RECOVER TOCOPY

 IC with SHRLEVEL REFERENCE
 - IC with SHRLEVEL CHANGE



RECOVER TORBA

 IC with SHRLEVEL CHANGE + QUIESCE



Tips for RECOVER (cont'd)

What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits RECOVER dropped object

- Recreate like last IC
 - Be careful with DDL changes
- Recover utility cannot be used (no OBID translation)
- Instead: DSN1COPY
 - Logs cannot be applied
- Solutions:
 - CREATE TABLE ... WITH RESTRICT ON DROP
 - Frequent Copies



Tips for RECOVER (cont'd)

What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

- Catalog and Directory
 - Recover to same point
 - 2 separate utility control statements required
- When data sharing is disabled:
 - immediate backup of whole system
 - otherwise: no recovery possible



What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

General Recommendations

• Primary objective:

Availability of application systems



Objectives for utility handling **General Recommendations** What can go COPY wrong with utilities? - SHRLEVEL CHANGE for better availability of It will ;-) applications, but: QUIESCE before and after Utility strategies - DSNUM where applicable **Overview** DFSMS Concurrent Copy for better availability of applications **Utility strategies -**Scenarios and Limits LOAD LOG NO with inline COPY (COPYDDN)



Objectives for utility handling **General Recommendations** What can go REORG wrong with utilities? LOG NO and inline COPY (COPYDDN) It will ;-) - SHRLEVEL CHANGE for better availability of Utility strategies applications, **Overview** but: QUIESCE before and after **Utility strategies -**Scenarios and Limits



Strategy Types

What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

- Execution of utilities in a time block on weekends
- Distribution of utility execution, but still no common time intervals for applications and utilities
- Utilities and applications share a common time frame



Objectives for utility handling Strategy #1: Week-ends are reserved for Utilities What can go wrong with utilities? • Execution of utilities (COPY, REORG) in a time It will ;-) block on week-ends Full Image Copy of every tablespace Utility strategies - Reorg of every tablespace **Overview** Incremental Image Copy on a daily basis Utility strategies -Scenarios and Limits



Objectives for utility handling Strategy #1: Week-ends are reserved for Utilities What can go wrong with utilities? Scenarios It will :-) Small operational application systems - Relatively low update rate, therefore no need for **Utility strategies** intensive Copy and Reorg **Overview** Read-only application systems Packaged application systems (SAP R/3, Peoplesoft) Utility strategies with a low number of users Scenarios and Limits Limits Rising number of transactions and updates - Increased number of users, esp. with packaged systems



Objectives for utility handling Strategy #2: Everyday is Utility day - with fixed schedules What can go wrong with utilities? COPY, REORG executed daily in an own time It will :-) frame, i.e. after online and batch **Utility strategies -Overview** Fixed schedule for COPY of tablespaces – Monday: COPY TS1, ..., TS1000 Tuesday: COPY TS1001, ..., TS2000 Utility strategies -Scenarios and . . . Limits • Fixed schedule for REORG of tablespaces and/or indexes schedule not based on update rate or growth



Objectives for utility handling Strategy #2: <u>Everyday is Utility day - with fixed schedules</u> What can go wrong with utilities? Scenarios It will :-) Small operational application systems - Low / medium update rate **Utility strategies -** Batch window for utilities still sufficient **Overview** Limits Utility strategies -Rising number of DB2 objects and corresponding Scenarios and Limits updates - Clusterratio can differ significantly, therefore performance degradation on particular objects - Highly different update rates imply different time required for recovering particular tablespaces



What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits <u>Strategy #3:</u> <u>Deployment of Fast Utilities</u>

- BMC, CA, CDB, ...
- Utility execution comparable to strategy #2, i.e. fixed schedules
- Insufficient time to execute standard IBM utilities COPY, REORG in a dedicated batch window



What can go wrong with utilities? It will ;-)

Utility strategies -Overview

Utility strategies -Scenarios and Limits

<u>Strategy #3:</u> <u>Deployment of Fast Utilities</u>

- Benefits:
 - Formerly up to 8-10 times faster than IBM utils
 Sufficient batch window for utils
 - Fast Utils often based on log files
 - => No locking conflicts
 - => Can be executed during application availability



Objectives for utility handling Strategy #3: **Deployment of Fast Utilities** What can go wrong with utilities? Caveats: It will :-) Extra cost for license and maintenance => MIPS based pricing may become too expensive **Utility strategies** for big shops **Overview** - IBM utils Utility strategies became faster Scenarios and offer better compatibility to applications due to reduced Limits locking and granularity options => Utilities "fit" into the available batch window => Can be executed during application availability

Different update rates or growth not reflected



Objectives for utility handling Strategy #4: Reduce to the necessary - generate only the What can go required utilities wrong with utilities? It will :-) Define thresholds for utility execution - grouping of DB2 objects for common thresholds **Utility strategies -**- reflect size of object **Overview** depending on rate of changes **Utility strategies -**Check if catalog statistics need to be refreshed Scenarios and Limits Avoid RUNSTATS for checking Instead: Check Space Map pages if RUNSTATS necessary Generate and execute RUNSTATS to provide correct statistics



Objectives for utility handling Strategy #4: Reduce to the necessary - generate only the What can go required utilities wrong with utilities? It will :-) Check if thresholds are reached Based on correct catalog statistics **Utility strategies -**- Change rate, growth, ... imply COPY, REORG **Overview** - Generate and execute only required utilities Utility strategies -Scenarios and Limits



Objectives for utility handling Strategy #4: Reduce to the necessary - generate only the What can go required utilities wrong with utilities? It will :-) **Benefits**: Applicable for standard IBM and fast utilities Utility strategies -- Space Map analysis **Overview** => fast, suitable even for largest DB2 systems => no locking conflicts with applications Utility strategies - DB2 Catalog always represents reality Scenarios and => only least necessary activities required for catalog Limits maintenance Minimal execution of COPY, REORG Tablespaces / Indexes always correspond to individually defined thresholds Copyright Jürgen Glag, 1999



Objectives for utility handling Strategy #4: Reduce to the necessary - generate only the What can go required utilities wrong with utilities? It will ;-) Caveats: - ??? **Utility strategies -Overview** Further activities - Running minimal number of utilities during availability Utility strategies of application systems (care about SHRLEVEL) Scenarios and Limits - Deployment of fast utilities