

WELCOME

Making of: The Price We Pay –

Performance and HA with Data Guard

Axel vom Stein 📣 BSS Bohnenberg GmbH with Martin Klier 🔶 Performing Databases GmbH

About me ...

- Technical Project Manager, Head of IT (working for BSS since 2001)

- Oracle:

- since 2001 -
- started out as a developer (PL/SQL, C, C#) -
- interest moved more towards DBA topics _

- Focus and soft spots:

- teaching trainees and young professionals -
- HA concepts -
- migration projects _
- standardization _
- everything you can automate -











Company – BSS focuses on...

- Design and detailed planning of intralogistic systems and facilities
- Flowpicker® (patent for special high performance order picking)
- Warehouse Management Control System (WMCS)
- Material Flow Control (MFC)
- Automated highbays and mini-loads
- Automated Guided Vehicles (AGV's)
- Pick-by-light / pick-by-voice
- Forklift Control System (FCS)
- Visualization
- PLC technology
- etc.





Speaker

SYMPOSIL

Proud Member of symposium42

- Martin Klier
- Solution Architect and Database Expert
- My focus:
 - Performance + Tuning
 - Highly available systems
 - Cluster and Replication
- Linux since 1997
- Oracle Database since 2003







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Performing Databases

- Three Experts for Database technology
 - Concepts and Project Competence
 - Architecture- and System planning
 - Licensing
 - Implementation and Troubleshooting
- Get in touch
 - Performing Databases GmbH Wiesauer Strasse 27
 95666 Mitterteich // Germany
 - <u>http://www.performing-databases.com</u>
 - Twitter: @PerformingDB





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Agenda ...



1.) Motivation

2.) Challenges

3.) Tools

4.) Summary

Motivation: Main actors





Just in Ő,







Is this art or can you scrap it?



Our way of communication:





The best quotes:

• "Incredible: Things in documentation – they really exist!"

← we will see ...

- "I am darkening because I can't see anything. And it is not a contradiction!"
- "We attract the figures with the greatest show effects."
- "With glasses it works without not!"
- "When size matters, we can top it."
- "If the result is not spectacular we will start from scratch."
- "That's the rough plan, but it won't work in reality."

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- Long term cooperation in intra-logistic projects
- Sizing of infrastructure by rule of thumb and experience
- The wish to have provable figures
- Which performance does HA (here Data Guard) actually "steal" from us?
- Feelings, hope, expectations: the performance loss is below 5%
- Research in the web delivers little output
- \rightarrow trial and share the findings ...

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Motivation: The lab

- Oracle 19c (19.9) Multitenant architecture with Data Guard
- ASM with disk groups (DATA, FRA, REDO1, REDO2)
- 2 Oracle Linux VM's (Primary/Standby) on different ESXi hosts
- Test environment where CPU is very strong in relation to the storage





Agenda ...



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Challenges: The distance











Challenge: The distance





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Making of: The Price We Pay - Performance and HA with Data Guard



• Refresh knowledge ... Oracle Documentation up to 10.2 (Picture in Chapter Redo Transport Service)

Figure 5-4 LGWR SYNC Archival to a Remote Destination with Standby Redo Log Files





Oracle Documentation from 11g onwards (Picture in Chapter Redo Transport Service)





Challenge: Data Guard Architecture Reloaded



• But I	 But how did we come up with the diagram (an extract)? 									
Sear	ch on pri	mary for LNS (log	vriter network	s erver) : ps -ef	grep <mark>lns</mark> →	NOTHING ??				
SQL> NAME	select PID	name,pid,role f	rom <mark>v\$datagı</mark> ROLE	l <mark>ard_process</mark> orde	er by name	on primary				
ARCØ	17356		archive	local	•					
ARC1	17364		archive	redo						
DMON	17137		broker n	onitor						
INSV	17415		broker i	nstance slave						
LGWR	17097		log writ	er						
NSS3	25539		sync							
NSV0	17424		broker r	et slave	• NSSx =	LNSx?				
NSV2	27519		broker r	et slave						
RSM0	17500		broker w	orker	• x = 3?					
TMON	17175		redo tra	insport monitor						
ТТ00	17358		gap mana	iger						
TT01	17360		redo tra	insport timer						
TT02	27535		heartbea	nt redo informer						
TT03	22996		control	ile update						

Challenge: Data Guard Architecture Reloaded







• Due to time aspects with measurement series we thought about test cases (enough surprises left ...)

• An extract of possible test cases:

Mode	-	SYNC	-	AFFIRM 🖃	Standby Redo Logs 🖵	Apply Lag 星	Transport Lag 星
Baseline - no DG		n/a		n/a	n/a	n/a	n/a
Max Performance		ASYNC		NOAFFIRM	no	ja	no
Max Performance		ASYNC		NOAFFIRM	yes	ne	yes
Max Performance		ASYNC		NOAFFIRM	no	no	no
Max Performance		ASYNC		NOAFFIRM	yes	no	yes
Max Performance		ASYNC		NOAFFIRM	no	no	no
MaxAvailability		SYNC		NOAFFIRM	no	n/a	n/a
MaxAvailability		SYNC		AFFIRM	no	n/a	n/a
Max Protection		SYNC		AFFIRM	no	n/a	n/a

\rightarrow Well, only 4 cases and the baseline left

Agenda ...



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Tools: Overview



Mixture of load generation and graphical representation:

- dd
- ORION
- Excel
- Swingbench
- AWR snapshots
- nmon
- nmonchart



- Separate volume for testing the base load (read & write)
- Using of dd, because ORION is not able to use multiblock read
- Test with dev/zero and dev/urandom, a value of 1024k due to DB_FILE_MULTIBLOCK_READ_COUNT=128

[oracle@bench1]\$ dd if=/dev/zero of=/dev/BENCHMARK1 bs=1024k count=0 # write test 10000+0 records in1000 10000+0 records out 10485760000 bytes (10 GB, 9.8 GiB) copied, 23.9062 s, 479 MB/s [oracle@obench1]\$ dd if=/dev/urandom of=/dev/BENCHMARK1 bs=1024k count=10000 # write test 10000+0 records in 10000+0 records out

10485760000 bytes (10 GB, 9.8 GiB) copied, 238.682 s, 43.9 MB/s

• Findings made: the storage is "silly" and dev/zero is enough, second test series with 8k delivers:

write ~ 450 – 500 MB/s and read ~ 200 – 250 MB/s

Tools: ORION (ORracle IO Numbers)



- Tool to generate I/O load with the same software stack as the database itself
- part of the Oracle software stack (DB/GI), usable without a database: \$ORACLE_HOME/bin/orion
- several load characteristica possible: OLTP or DWH as a mixture as well
- with the data you can create a matrix graphic for instance in Excel
- you need: test name, device (file is also possible), shell script, lun file

```
    script: $ORACLE_HOME/bin/orion -run advanced -testname 8disk_4small_16GBcache_80write \
        -num_disks 8 -size_small 4 -type rand -simulate raid0 \
        -write 80 -cache_size 16384 -duration 30 -matrix basic \
        -rtstats_interval 30
```

• lun - file: /dev/BENCHMARK1

Tools: ORION (ORracle IO Numbers)



• Sample output:

ORION: ORacle IO Numbers -- Version RDBMS_19.3.0.0.0DBRU_LINUX.X64_190417 8disk_4small_16GBcache_80write_20220524_2045 Calibration will take approximately 20 minutes. Using a large value for -cache_size may take longer.

Interval(s)	Num-Read-IOs	Avg-Read-Lat(us)	(Std.Dev)	Read-IOPS (MBps)	Num-Write-IOs	Avg-Wr-Lat(us)	(Std.Dev)	Write-IOPS(MBps)
30.05	1910	13338.60	(6687.82)	0.25	7404	605.86	(197.46)	0.96
30.00	3030	17543.80	(13798.08)	0.39	12112	560.12	(322.88)	1.58
30.01	3829	28987.41	(26613.49)	0.50	15444	563.37	(454.10)	2.01
30.00	4323	39244.37	(33862.33)	0.56	17333	551.00	(255.63)	2.26
30.03	4914	46478.90	(44978.76)	0.64	19714	531.62	(326.64)	2.56
30.01	5639	50476.91	(38759.63)	0.73	22318	640.35	(1918.90)	2.91

• We run measurement series with: 4k, 8k, 16k

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Large/Small, 0,	1, 398,	2, 782,	4, 1091,	6, 1262,	8, 1427,	10, 1747,	12, 1971,	14, 2263,	16, 2483,	18, 2596,	20, 2657,	
 Extract of or 	ne of tl	ne *iops	S.CSV:									
		8disk_4s	small_16GB	cache_80w	rite_20220	524_2045_	summary.t	xt				
		8disk_4s	mall_16GB	cache_80w	rite_20220	9524_2045_	hist.txt					
8disk_4small_16GBcache_80write_20220524_2045_iops.csv												
		8disk_4s	mall_16GB	cache_80w	rite_20220	9524_2045_	lat.csv					
		8disk_4s	mall_16GB	cache_80w	rite_20220	9524_2045_	mbps.csv					
 Files per cas 	se:	8disk_4small_16GBcache_80write_20220524_2045_trace.txt										







- Free load generator to stress test Oracle databases (Dominic Giles), current version is 2.6.x
- Several benchmarks, we used Order Entry (OE) and stress test
- Order Entry (inhomogeneous, varying load, well for database benchmarks):
 - based on the OE example schema from Oracle
 - one-time generation of data with the OE wizard
 - creating schema with several tables (parent/child) and insert data
 - is closed to the BSS application
- Stress test (homogeneous, well for infrastructure benchmarks):
 - I, U, D, S on a single table
 - start immediately, before using no generation of data necessary

Tools: Swingbench



- Load is generated with running PL/SQL-Code
- not only a load generator, also a graphical representation
- you can use command line (Charbench) or GUI (Minibench, Swingbench)
- using config-files (xml) to parametrize the different benchmarks
- Swingbench is able to take AWR snapshots
- Installation
 - Java 8+ necessary
 - unzip and just start ./oewizard or rather ./swingbench

Tools: Swingbench



ile Log Viewer	Oracle Ent	ry Install Wizard : 2.6.0.1137	_ 1	o x			
Welcome to the	File Log Viewer	Oracle	Entry Inst	tall Wizard : 2.6	6.0.1137 _ 🗆 ×		
	Sizing Details	File Log Viewer			Schema Created ×		
This wizard will walk y benchmark. You will n	Select one of the preconfigured sizes for the Scaling factor of $1 = 1$ GB. Based on the size	"Building the Simple Order Entry (con	npleted schema	a successfully		
tablespace, users, tabl	schema size of 42.1 GB for a CPU Intensive		9	Statistic	Value		
	for a more I/O intensive workload.		Connectio	n Time	0:00:00.003		
	• 1 GB	Building the "Simple Order Entry" Sche	Data Generation Time		0:01:15.490		
Author : Dominic Giles 010 GB		white	Total Run	Time	0:01:49.444		
Email : dominic.giles@	○ 100 GB	Inserting data into table ORDERS_1	Rows Inserted per sec		210,157		
5 2		Rows being inserted per second = 261	Data Gene	erated (MB) per.	16.3		
	O Licer Defined Scale	16 of 16 Threads currently running					
	O oser Denned Scale	Data generation is 9.52% complete	The creation of the schema appears to have been successful.				
	OrderEntry tablespace size =	5					
Cancel	Temporary tablespace size required =		Status		Object Name		
				ORDERS, ORD	DER_ITEMS, CUSTOMERS, WAREHOUSES,		
	Cancel			ORDERENTRY	(_METADATA, INVENTORIES, PRODUCT_INFORMATION,		
	Calicet				SCRIPTIONS, ADDRESSES, CARD_DETAILS, PRD_DESC_PK,		
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		Cancel	Valid	ORD_CUSTOMER_IX, ORD_ORDER_DATE_IX, ORD_WAREHOUS			
			valia	ORDER_ITEMS	S_PK, ITEM_ORDER_IX, ITEM_PRODUCT_IX, WAREHOUSES_PK,		
					OK		

Tools: Swingbench



SwingBench 2.6.0.1137 (//10.22.21.187/plug1)

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Password		Simple Select	com.dom.benchmarking.	swingbench.stresstest.StressTestSelect	S	40	
Connect String	6	Delete Transaction	com.dom.benchmarking.	swingbench.stresstest.StressTestOpdate	D	10	
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Tools: AWR snapshots





Tools: We need more ...



• This was not enough (only swingbench and WAR)

• so more tools ...

Tools: nmon

- nmon (Nigel's performance Monitor for Linux) the better top
- Installation: yum install nmon
- two operation modes: interactive and capture
- capture creates textfile(s): <hostname>_YYYYMMDD_HHMM.nmon
- the measured values in the text files are stored comma seperated
- e.g. load values for CPU (T0010 is the tenth measurement): CPU001, T0010, 1.9, 1.0, 43.8, 53.5, 0.0
- possible setting for output with environment variable: export NMON="cdt5-"









Tools: nmon







Tools: nmon

	Sie sehen den Bildschirm von Martin Klier	Ansicht Optionen 🗸
Primary	Axel vom Stein	Standby
nmon-16k-kkkkk-111111111111kkkHostname=ora-bench1——Refresh= 1secs ——10:48.16-8888888 CPU Utilisation —	38888888888888888888888888888888888888	<pre>dostname=ora-bench1—_Refresh= 1secs10:48.17-222222222222222222222222222222222222</pre>
CPU User* Systematic Idte 0 25 50 175 100 1 22.8 4.0 0.0 73.3 Underformulation > 2 54.9 2.9 0.0 42.2 Underformulation > 3 7.9 3.0 0.0 89.1 Uude > 4 11.8 4.9 0.0 68.9 Underformulation > 5 27.2 3.9 0.0 68.9 Underformulation > 6 11.9 5.0 0.6 83.2 Underformulation > 7 35.0 2.9 1.9 66.2 Underformulation > 8 48.5 3.0 1.0 47.5 Underformulation > Avg 27.5 3.6 0.4 68.6 Underformulation >	IPU User% Sys% Mail Idle 1 3.0 3.0 0.0 93.9 1 2 3.2 1.1 0.0 95.8 1 3 2.0 2.0 0.0 96.0 1 4 3.1 1.0 0.0 95.9 1 5 1.0 1.0 0.0 98.0 6 6 1.0 2.0 0.0 96.0 1 7 2.0 2.0 0.0 96.0 1 8 2.1 2.1 0.0 95.8 1	25 50 75 100 >
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Tools: nmonchart

- Tools for displaying the results ("nmon" data) graphically, for instance:
 - NMONVisualizer
 - nmon Analyser Excel Spreadsheet
 - nmonchart

• nmonchart is a shell script and creates a html - document

• unzip tar – file and just start: nmonchart <your-data>.nmon

• Graphics and/or statistics with "zoom in option" in smaller periods of time (CPU, network, disk read, disk write, etc.)



Tools: nmonchart



CPU Util. CPU Use RunQ Blocked pSwitch ForkExec Memory Swap

Network Net Packet Disk Busy Unstacked Disk Read Unstacked Disk Write Unstacked Disk BSize Disk Xfers Unstacked JFS



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Agenda ...



1.) Motivation

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4.) Summary



- It was a lot of fun even though I swore a lot
- I have learned a lot about Data Guard, especially about its architecture (@ORACLE: a new diagram please)
- Where ever possible collect data for each project
- Never trust the first measurement, execute several measurements
- To prepare two presentations belonging together, it is quite a challenge
- Thanks Martin for the good cooperation, the setup, the patience, the quotes and a lot of laughter

So: It will be continued – with RAC instead of Data Guard ...

Summary: Links and Notes



• Data Guard Concepts and Administration:

https://docs.oracle.com/en/database/oracle/oracle-database/19/sbydb/oracle-data-guard-concepts.html#GUID-F78703FB-BD74-4F20-9971-8B37ACC40A65

https://docs.oracle.com/en/database/oracle/oracle-database/19/refrn/V-DATAGUARD_PROCESS.html#GUID-F07EA03A-F3EF-4A2E-9250-A28AF3CEF5CF

• ORADEBUG:

http://www.juliandyke.com/Diagnostics/Tools/ORADEBUG/ORADEBUG.php

• ORION:

https://docs.oracle.com/en/database/oracle/oracle-database/19/tgdba/IO-configuration-and-design.html#GUID-355C99D8-29C1-421F-8B65-47A3C48324A2

• Swingbench:

https://www.dominicgiles.com/swingbench.html

• nmon and nmonchart:

http://nmon.sourceforge.net/pmwiki.php

http://nmon.sourceforge.net/pmwiki.php?n=Site.Nmonchart

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Summary: Last slide



• A presentation doesn't have to be always a technical deep dive

• To all speakers:

Please talk about YOUR "Making Of"





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