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Security Perception and Features of RDBMSs: A Comparative Study

خصائص وملامح سرية نظم ادارة قواعد البيانات العلائقية: دراسة مقارنة

A thesis submitted in partial fulfillment of the Requirements for the degree of M.Sc in Computer Science

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Agenda

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Motivation

- Today's businesses depend heavily on the database, with the large numbers of DBMS products, the users are need some kind of assurance that the products they use providing adequate security.
- Users have to be experts to be able to conduct standard and scientific comparative study between available DBMSs products and trade off between them.
- This study provides an in-depth comparative assessment of the security features available with (Oracle Database 11g), (Microsoft SQL 2008), and (MySql 5.1).

Research Problem

- Lack of scientific comparative study

Research Objectives

- Study and analysis of security features of the selected RDBMSs.
- Develop and employ common evaluation security criteria.
- Conduct a comparative study to examine and evaluate the chosen RDBMS based on the developed security criteria.

Previous Work

- David Litchfield have examined the differences between the security posture of Microsoft's SQL Server and Oracle's RDBMSs based upon faults reported by external security researchers.
- A general comparison is made covering Oracle 8, 9 and 10 against SQL Server 7, 2000 and 2005.
- The conclusion of David Litchfield's study that Microsoft SQL Server has a stronger security posture than the Oracle

The Developed Security Evaluation Criteria

Criteria		*Points*
High Availability	System Failures	6
	Data Failures	6
	Disaster Recovery	6
	Human Errors	6
	System Maintenance	6
	Data Maintenance	6
Access Control	Virtual Private Databases (VPD)	6
	View	6
	Role	6
	Privilege	6
	Authentication	6
Data Encryption	Advanced Encryption Standard (AES)	6
	Data Encryption Standard (DES)/ DES40	6
	Triple DES	6
	RC4	6
	SHA-1 Cryptographic Hash/(MAC)	6
Data Integrity	MD 5	6
	SHA-1	6

The Comparative Study

High Availability

- ***Data Failures***

Addressing Data Failures Criteria	*Oracle*	*SQL Server*	*MYSQL*
Built-in database failure detection, analysis, and repair	Support	Not support	Not support
Incrementally updated backup strategy	Support	Not support	Not support
Parallelize backup within a single file	Support	Not support	Not support
Automatic restore failover to next available backup during recovery	Support	Not support	Not support

The Comparative Study Cont

- ***System Failures***

Addressing System Failures Criteria	*Oracle*	*SQL Server*	*MYSQL*
Active-active clustering	Support	Not support	Not support
Transparent application scalability	Support	Not support	Not support
Dynamic addition/removal of nodes with no effects on data distribution	Support	Not support	Not support

The Comparative Study Cont

- ***Disaster Recovery***

Addressing Disaster Recovery Criteria	*Oracle*	*SQL Server*	*MYSQL*
Multiple standbys for non-stop protection after failover	**Support**	**Not support**	**Not support**
No performance impact while creating standby databases	**Support**	**Not support**	**Not support**
Standby apply process failure does not impact primary database or transmission of changes	**Support**	**Not support**	**Not support**
Pausing data transmission does not cause the primary database to stall	**Support**	**Not support**	**Not support**
Support for a number of mixed primary/standby configurations	**Support**	**Not support**	**Not support**

The Comparative Study Cont

- ***Human Errors***

Addressing Human Errors Criteria	*Oracle*	*SQL Server*	*MYSQL*
Retrieve data from the past using SQL queries	**Support**	**Not support**	**Not support**
Support Recycle Bin	**Support**	**Not support**	**Not support**
Examine and backout changes to the database at the transaction level	**Support**	**Not support**	**Not support**
View changes across row versions	**Support**	**Not support**	**Not support**
Flashback a table to a point in time in the past	**Support**	**Not support**	**Not support**
Flashback the database to a prior point in time without restoring a backup	**Support**	**Not support**	**Not support**

The Comparative Study Cont

- ***System Maintenance***

Addressing System Maintenance criteria	*Oracle*	*SQL Server*	*MYSQL*
Add a node to a cluster online	**Support**	**Not support**	**Not support**
Add or drop disks online	**Support**	**Not support**	**Not support**

The Comparative Study Cont

- ***Data Maintenance***

Addressing Data Maintenance criteria	*Oracle*	*SQL Server*	*MYSQL*
Online add, drop, exchange, move partitions	Support	Not support	Not support
Online reorganization of individual tables, including relocating table to a different tablespace	Support	Not support	Not support
Online reorganization of individual table partitions	Support	Not support	Not support
Extensive online table redefinition capabilities, including data transformations	Support	Not support	Not support
Fast online add column, with default value	Support	Not support	Not support
Online rename and merge columns	Support	Not support	Not support

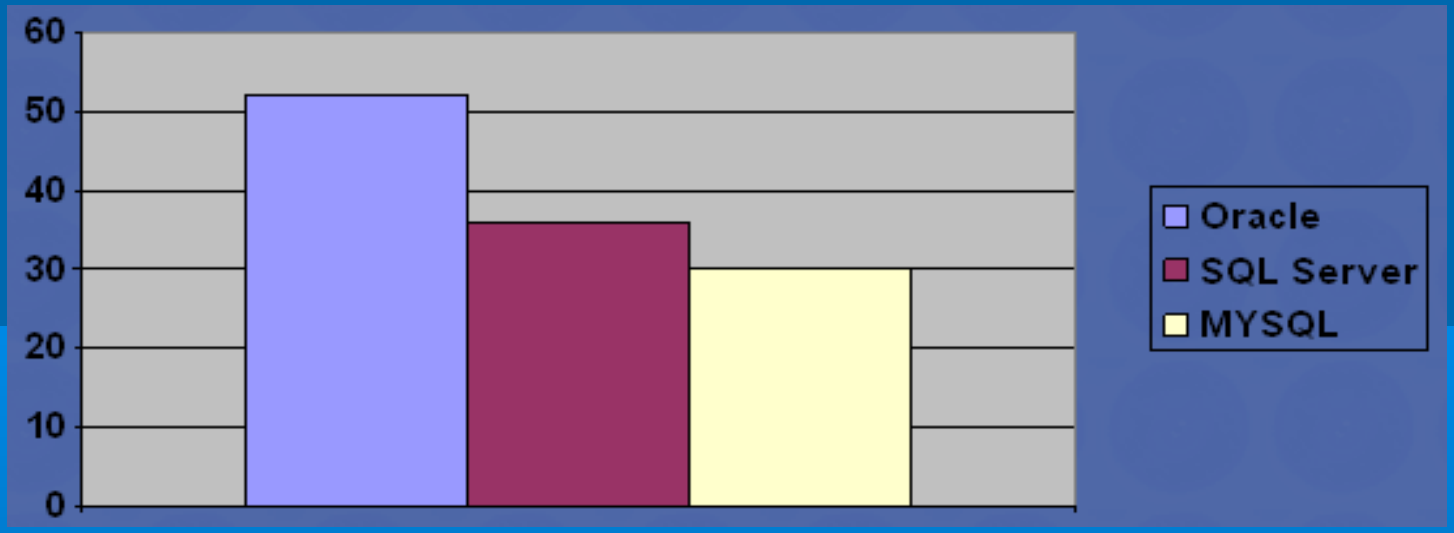
The Comparative Study Cont

- ***High Availability tools Comparison***

Oracle	*SQL Server*	*MYSQL*
Real application Clusters	**N-Way Clustering**	**My SQL Cluster**
Data Guard	**Database Mirroring**	**DRBD(Distributed Replication Block Device)**
Oracle Flashback	**Fast Recovery**	**MySqldump**
Flashback Query	**Database Snapshots**	**Mysqlhotcopy/OS Backup**
Flashback Version Query	**File Group Restore**	
Flashback Transaction Query	**Database Replication**	
Flashback Table	**Log Shipping**	
Flashback Drop		

The Comparative Study Cont

- ***High Availability tools supported***



The Comparative Study Cont

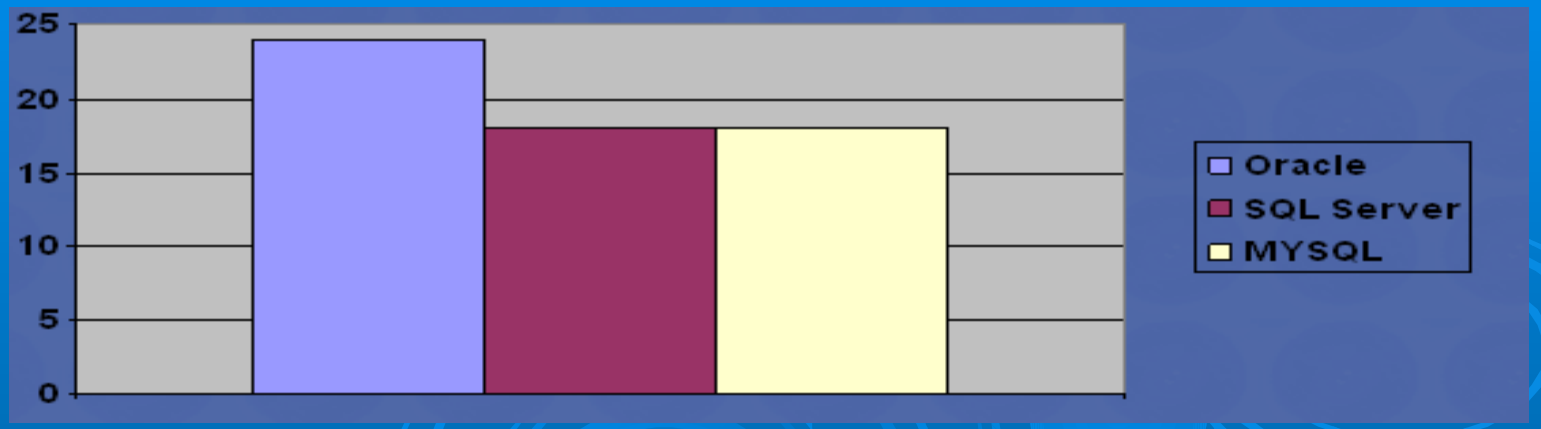
- ***Access Control***

Access Control Features	*Oracle*	*SQL Server*	*MYSQL*
Virtual Private Database (VPD)	Support	Not Support	Not Support
Privilege	Support	Support	Support
Views	Support	Support	Support
Roles	Support	Support	Support
Authentication	Support	Support	Support

The Comparative Study Cont

- ***Encryption Algorithms***

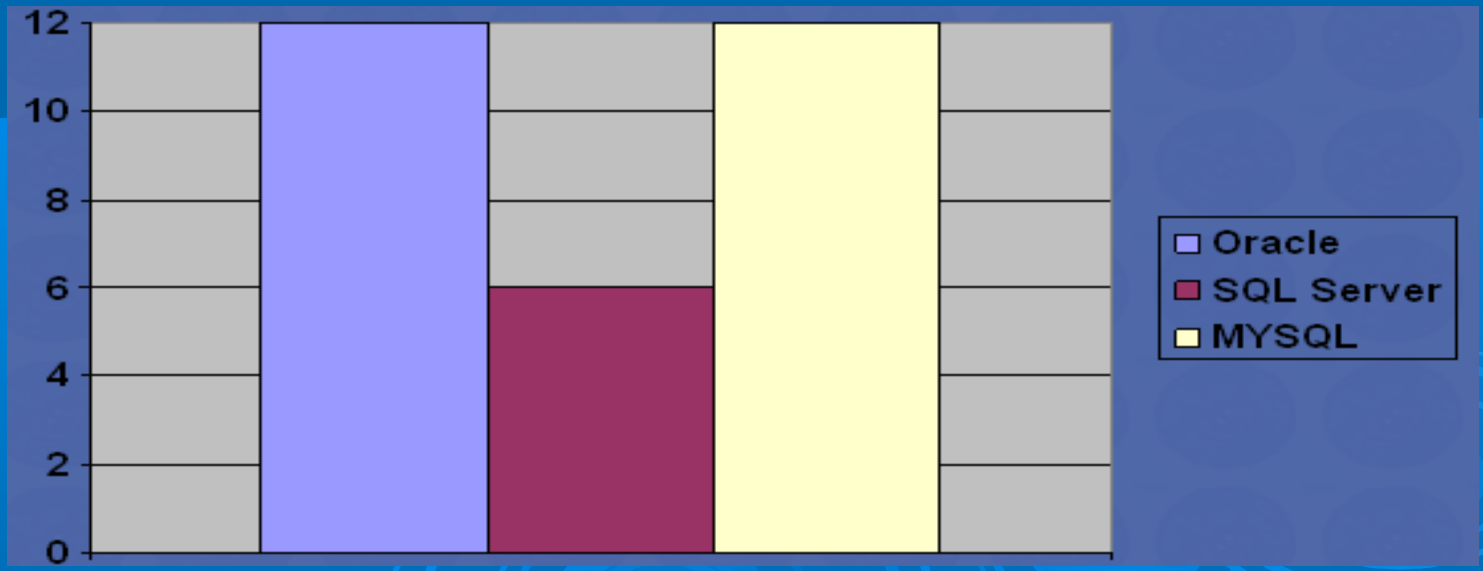
Encryption Algorithms	*Oracle*	*SQL Server*	*MYSQL*
Advanced Encryption Standard (AES)	Support	Support	Support
Data Encryption Standard (DES)	Support	Support	Support
RC4	Support	Support	Not Support
SHA-1 Cryptographic Hash	Support	Not Support	Support



The Comparative Study Cont

- *Data Integrity*

Data Integrity Algorithms	*Oracle*	*SQL Server*	*MYSQL*
Message Digest 5 (MD5)	Support	Support	Support
Hash Algorithm (SHA-1)	Support	Not Support	Support



Results Analyses

Features	*Oracle*	*SQL Server*	*MYSQL*
High Availability	Real application Clusters	N-Way Clustering	My SQL Cluster
	Data Guard	Database Mirroring Log Shipping	DRBD
	Oracle Flashback	Fast Recovery	MySqldu mp
	Flashback Query	Database Snapshots File Group Restore	Mysqlhotcopy /OS Backup
	Flashback Version Query	Database Replication	
	Flashback Transaction Query		
	Flashback Drop		
Total	52	36	30
Access Control	Virtual Private Databases(VPD)	Not Support	Not Support
	Privileges	Privileges	Privileges
	Views	Views	Views
	Roles	Roles	Roles
Total	30	25	20

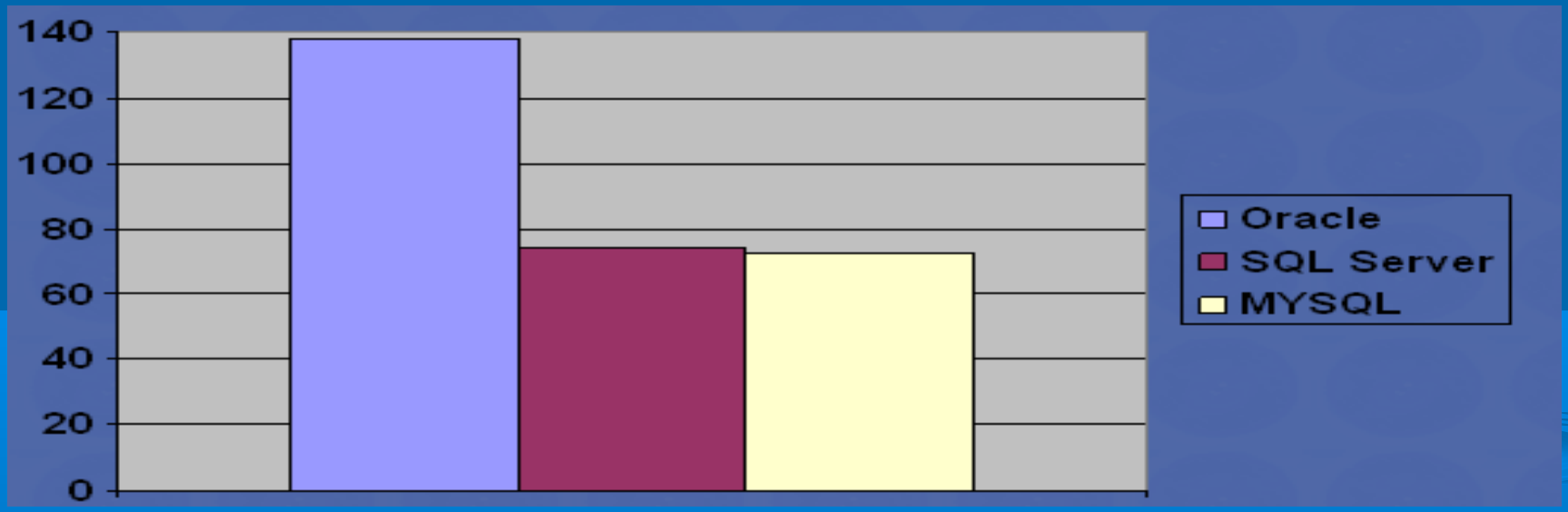
Results Analyses

Auditing	Statement auditing	Windows Security Event Log	Trigger
	Privilege auditing	SQL Profiler	
	Schema Object Auditing	SQL Trace	
	Fine-Grained Auditing	data definition language (DDL) trigger	
Total	6	5	4

Results Analyses

Encryption Algorithms	Advanced Encryption Standard (AES)	Advanced Encryption Standard (AES)	(AES)
	Data Encryption Standard (DES)	Data Encryption Standard (DES)	(DES)
	Triple DES	Triple DES	Triple DES
	DES40	DES40	DES40
	RC4	RC4	Not Support
	SHA-1 Cryptographic Hash	Not Support SHA-1	SHA-1
	SHA-1 Message Authentication Code (MAC)	Not Support SHA-1	SHA-1 (MAC)
Total	24	18	18
Data Integrity Algorith	-MD5	-MD5	-MD5
	-SHA-1		-SHA-1
Total	12	6	12
All Total	138	74	72

Results Analyses



Conclusion

- The result of the study has classified and graded the three chosen RDBMSs according to the developed security evaluation criteria, which ranks Oracle on the topmost.
- The comparative study have confirmed that Oracle provides comprehensive, unique, powerful, and simple-to-use capabilities that protect businesses against unauthorized users, system faults, data corruption, disasters, human errors and so forth.
- SQL Server and MySQL offers a basic set of database security features and lacks the completeness and depth of database security functionality required by most businesses today.

Limitations

The proposed comparative study have conducted based on the standard security evaluation criteria, there are additional decisive factors have not taken into account. For instance:

- the reported security breaches, vulnerability incidents, and survey findings or upshot for the chosen RDBMSs.
- However, such factors are strategic; their influence is trivial to the overall evaluation due to the autonomous implementation.

Future Work

There are two dimensions open for future research, first: considering the additional strategic security factors, and lastly: accomplishing the other evaluation criteria such as transaction handling, scalability, cost, vender support and stability.