White Paper

HyperBac Delivers High-Performance Database Backup for SQL Server and Oracle on Dell/EMC Infrastructure

Abstract

HyperBac® delivers a unique cross-platform solution for high performance, secure database backup and recovery. This article discusses the results of performance tests performed by Dell and HyperBac Technologies in the Dell Database and Applications Solutions Labs.

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Introduction

HyperBac® combines high performance, advanced compression and encryption with a unique architecture that clearly differentiates it from previous generation compressed backup solutions. HyperBac is available for Oracle 9i, 10g and 11g and SQL Server 2000, 2005, 2008 and other database and application platforms. The tests discussed in this article cover SQL Server 2005, Oracle 10gR2 on Microsoft® Windows® 2003 and Red Hat® Enterprise Linux® 4.

HyperBac integrates into the file I/O system on the target database server, allowing database administrators to use native commands, scripts, procedures and jobs to perform backup and restore operations – making it exceptionally simple to integrate and use with no new third-party user interfaces or command syntax required. HyperBac integrates the streaming compression and encryption functionality automatically by providing up to 95% compression and up to 75% time reduction for backup operations (as claimed by the vendor on their website)[1].

HyperBac also extends integrated, high-performance compression to ETL (Extract Transform Load) operations such as Bulk Copy (BCP) or Integration Services in SQL Server, Export Data Pump (EXPDP) in Oracle and file copy operations such as **xcopy** in Windows and **cp** in Linux, making it one of the most versatile and flexible components available.

[1] http://hyperbac.com/products/sqlserver/overview.asp

HyperBac Overview

HyperBac Architecture

HyperBac integrates at the operating system level as a file system driver that transparently compresses and encrypts backup data streams to local or remote disk, NAS or SAN. The HyperBac proprietary high-performance compression helps reduce backup storage requirements and reduce disk/network IO, making backup and restore operations much faster.

By default, HyperBac is configured to work with specified file extensions for backup or export storage files; .HBC for compressed operations, .HBE for compressed and AES-256-bit certificate-based encrypted operations and .ZIP for compressed backup operations direct to a ZIP or DEFLATE compatible archive.

The ZIP compatible option, available in the SQL Server version of the product, allows DBAs to use a standard RFC-compliant compressed storage format relieving any dependencies on third-party vendors to extract the data out to native format – HyperBac is currently the only solution on the market with this capability.

HyperBac is also unique in the way it integrates encryption into backup or ETL processes. HyperBac uses certificate-based encryption as opposed to many available solutions which use secret-key or password based encryption. When a HyperBac extension or directory registered for encryption is used for a backup or export output file, a unique certificate is created in the HyperBac certificate key store; if a key exists on the system this key will be used automatically. When the archive is extracted or restored, the key file must be present on the system or provided at that time. Certificate-based encryption ensures private key strength and eliminates the requirement to manage passwords.

HyperBac Configuration

The default configuration for the HyperBac Compression/Encryption service is shown in the HyperBac Configuration Manager in following figure.

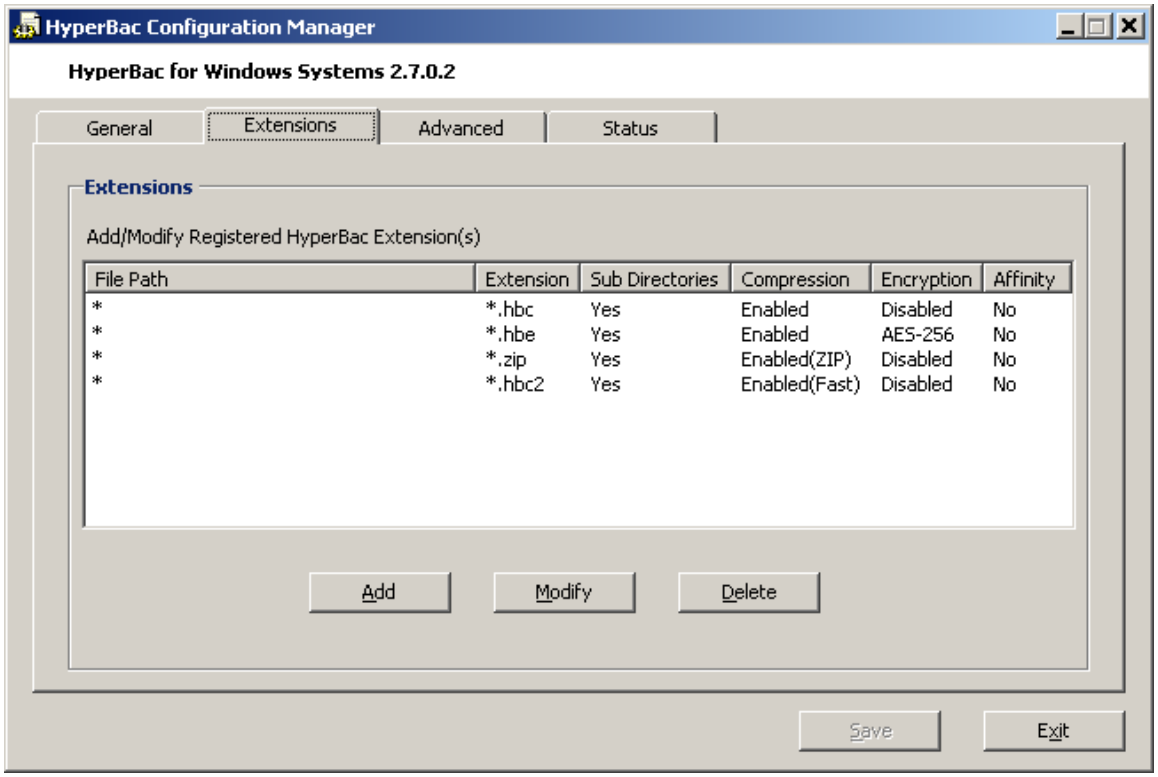

Figure 1 – Default HyperBac Configuration

HyperBac can be customized to use different file extensions (such as .BAK or .DMP) allowing it to be integrated directly into existing procedures. HyperBac can also be configured to work on a specific directory for all backup or export files written to that particular directory; for example the Flash Recovery Area for Oracle 10g and above systems (raw devices only) or a SQL Server backup directory used by Database Maintenance Plans. An example of this directory is provided in Figure 2.

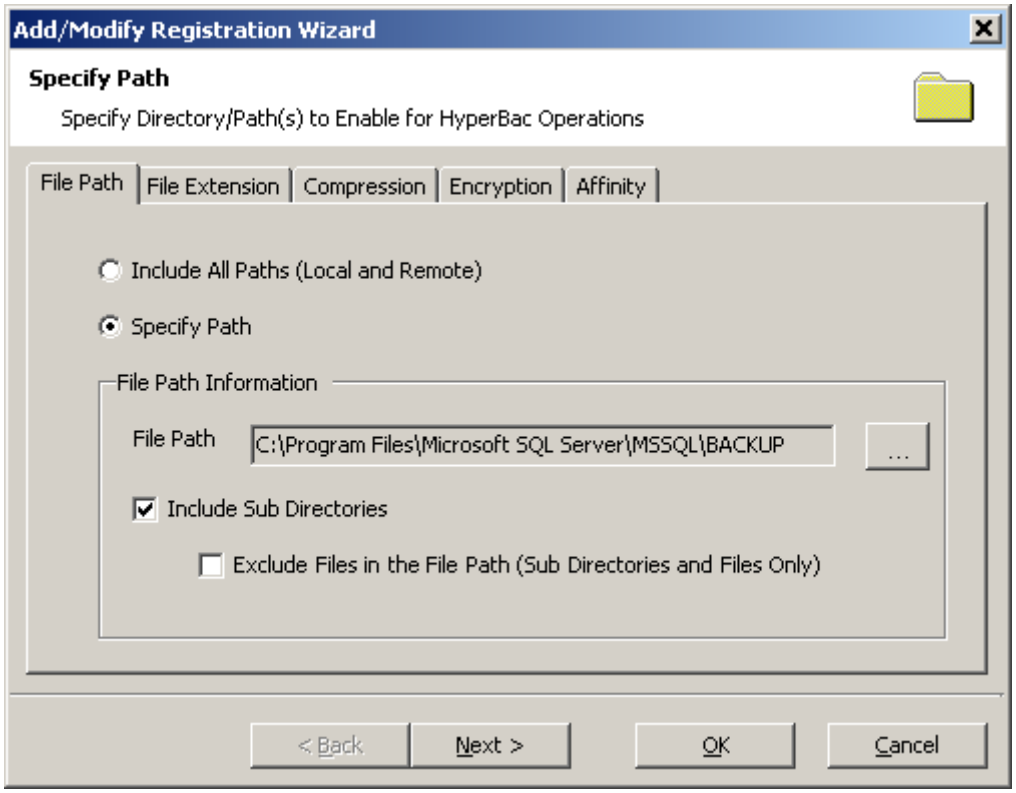

Figure 2 – Adding a custom registration for HyperBac operations

This article profiles tests conducted on three different systems in the Dell Solutions Engineering Labs in Austin, Texas: one configuration for SQL Server, and two configurations for an Oracle on Linux server and a Windows based server.

Test Overview

SQL Server 2005 Tests

The SQL Server tests were conducted on a 500GB TPC-E database[2]. Comparisons were done between HyperBac and native backup/restore and Bulk Copy (BCP) operations. All HyperBac backup formats were tested. This article describes the results of the ZIP (DEFLATE) compatible compressed storage format tests. The test configuration used for the HyperBac SQL Server tests is described in Table 1.

Test Configuration

Server	Dell™ PowerEdge™ 2950
Processors	Two Intel® Core™2 Quad 2.6 GHz
Memory	32 GB
HBA	Dual-port QLogic QLA2342
Switches	Dell PowerConnect™ 5324
Storage	Dell/EMC® CX3-20 Storage Array
Operating System	Microsoft® Windows Server® 2003 R2 Enterprise x64 Edition (Service Pack 2)
Software	• Microsoft® SQL Server 2005 Enterprise x64 Edition • EMC PowerPath® 5.0 • HyperBac for Windows Systems 2.7.0.2

Table 1 – HyperBac SQL Server Test Configuration

Test Description

Backup, recovery (restore) and export tests using BCP were performed on the 500GB TPC-E dataset using HyperBac and compared against results from the same system performed without HyperBac. The following scripts were used to perform the individual tests:

[2] The TPC-E specification is defined by Transaction Processing Performance Council (TPC) at http://tpc.org/tpce/default.asp

/* Backup Scripts ***/**

```
/* FULL NATIVE DATABASE BACKUP */
BACKUP DATABASE tpce
TO DISK = 'B:\backup\Native_Backup.BAK'
WITH INIT

/* FULL HYPERBAC (ZIP COMPATIBLE) COMPRESSED BACKUP */
BACKUP DATABASE tpce
TO DISK = 'B:\backup\HyperBac_Compressed_Backup.ZIP'
WITH INIT

/* FULL HYPERBAC COMPRESSED, AES-256 bit ENCRYPTED BACKUP*/
BACKUP DATABASE tpce
TO DISK = 'B:\backup\HyperBac_Encrypted_Backup.HBE'
WITH INIT
```

/* Restore Scripts ***/**

```
/* NATIVE RESTORE VERIFYONLY OPERATION */
RESTORE VERIFYONLY
FROM DISK = 'B:\backup\Native_Backup.BAK'

/* HYPERBAC RESTORE VERIFYONLY OPERATION */
RESTORE VERIFYONLY
FROM DISK = 'B:\backup\Native_Backup.ZIP'

/* HYPERBAC ENCRYPTED RESTORE VERIFYONLY OPERATION */
RESTORE VERIFYONLY
FROM DISK = 'B:\backup\Native_Backup.HBE'
```

/* Table Export (BCP) Scripts ***/**

Bulk Copy (BCP) operations were performed on a 40GB table in the tpce database, scripts are provided below as performed from the Windows command prompt:

```
@echo on
@echo ---------------------------------------
@echo Native BCP
@echo ---------------------------------------
bcp tpce..TRADE_HISTORY out  B:\Backup\TRADE_HISTORY_Export.BAK -
S(local) -T -n -b1000

@echo ---------------------------------------
@echo HyperBac ZIP Compatible BCP
@echo ---------------------------------------
bcp tpce..TRADE_HISTORY out  B:\Backup\TRADE_HISTORY_Export.ZIP –
b1000 -T –n -S(local) -T -n -b1000

@echo -------------------------------------------
@echo HyperBac Compressed, Encrypted BCP
@echo -------------------------------------------
bcp tpce..TRADE_HISTORY out  B:\Backup\TRADE_HISTORY_Export.HBE -
S(local) -T -n -b1000
```

Backup Test Results

Figure 3 show the elapsed time reduction and relative performance gains for backup operations. The HyperBac backup operation was nearly three times faster than the backup operation without using HyperBac, reducing the elapsed backup time from 2 hours, 26 minutes down to 46 minutes – a 66% time reduction or 294% faster.

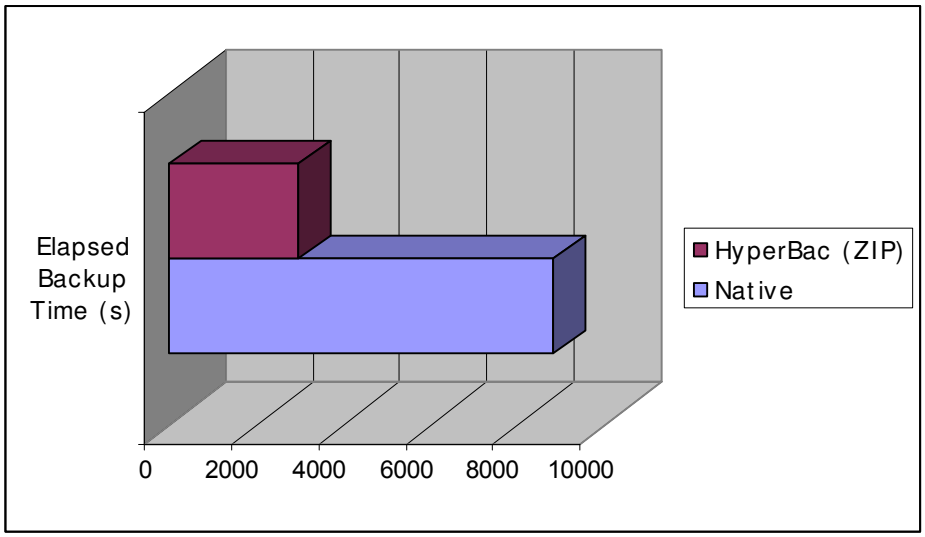

Figure 3 – HyperBac SQL Server Backup Time Comparison

Figures 4 shows the immediate storage reduction obtained from integrating HyperBac into the native backup operation. The native backup comparison using HyperBac yielded 67% compression.

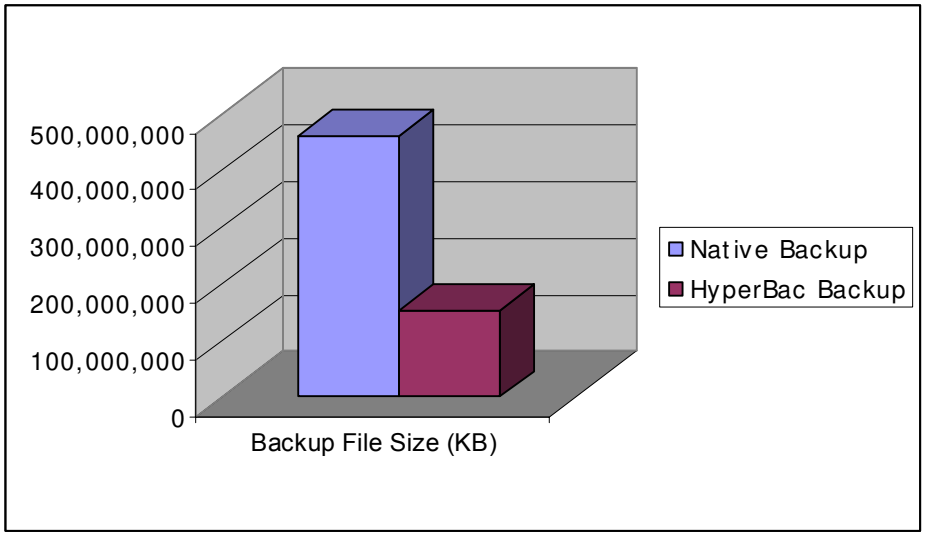

Figure 4 – HyperBac SQL Server Backup File Size Comparison

Restore Test Results

Figure 5 shows the restore operation was over 36% faster than the restore of the equivalent conventional backup file.

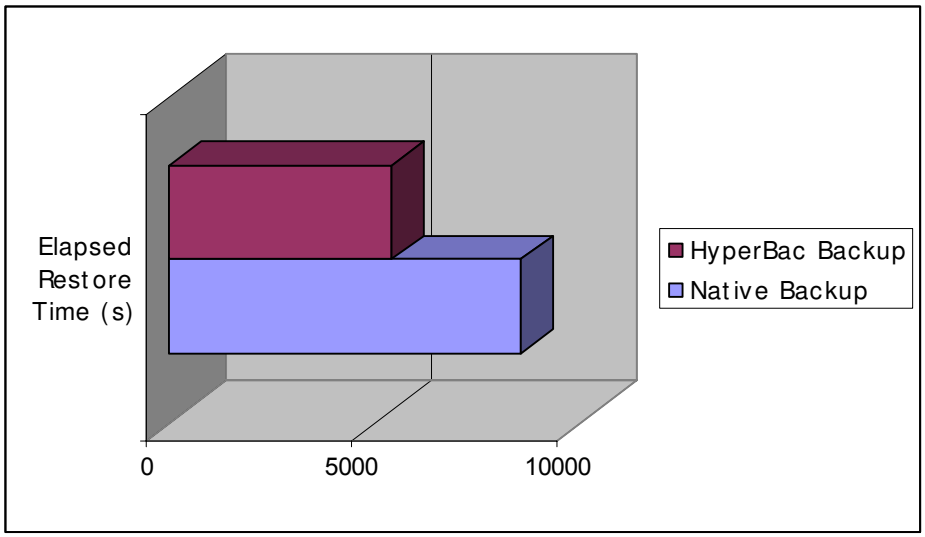

Figure 5 – HyperBac SQL Server Restore Time Comparison

Export (BCP) Test Results

Figure 6 shows the Bulk Copy (BCP) operation using HyperBac yielded over 74% compression, making HyperBac useful for logical data migration operations as well as physical backup operations.

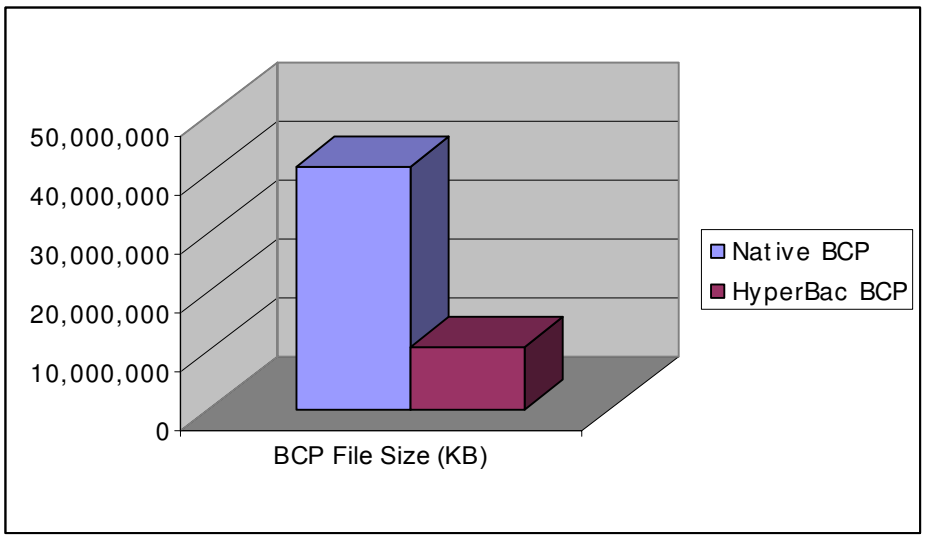

Figure 6 – HyperBac SQL Server BCP File Size Comparison

It is noteworthy that using HyperBac a full backup and restore verify operation can be performed in less than half of the time otherwise required to simply perform a backup. Using HyperBac affords DBAs extra time in their maintenance window to perform other value-added database maintenance tasks.

In the example provided the backup files are in an industry-standard, well-known compression format (ZIP/DEFLATE) which means these files can be restored directly or extracted using HyperBac, but can also be extracted on any system using widely available decompression utilities such as WinZip, WinRAR and others.

Oracle 10g Tests

The Oracle tests were conducted on a 100GB Dell DVD Store Release 2 database. The Dell DVD store database specification is defined at http://linux.dell.com/dvdstore/. The DVD Store application (DS2) is available for Oracle on Linux and Windows systems, as well as SQL Server and MySQL systems. The 100GB (large) specification consists of 200,000,000 customer records, 1,000,000 products and 10,000,000 orders per month.

Comparisons were performed between HyperBac and Oracle 10g Recovery Manager (RMAN) Backupset and Image Copy operations and Export Data Pump (EXPDP) operations. The test configurations for the Oracle Windows and Oracle Linux systems used for the HyperBac Oracle tests are described in Table 2.

Test Configuration

	Oracle Windows	Oracle Linux
Server	Dell PowerEdge 2900	Dell PowerEdge 2950
Processors	Two Intel® Core™ Duo 2.9 GHz	Two Intel® Core™2 Quad 2.6 GHz
Memory	8 GB	16 GB
HBA	Dual-port QLogic QLA2342	Dual-port QLogic QLE2342
Switches	Dell PowerConnect 5324	Dell PowerConnect 5324
Storage	Dell/EMC CX3-20 Storage Array	Dell/EMC CX3-20 Storage Array
Operating System	Microsoft Windows Server 2003 R2 Enterprise x64 Edition (Service Pack 2)	Red Hat Enterprise Linux RHEL4.5 (2.6.9-55.ELlargesmp)
Software	• Oracle Database 10g Release 2 (10.2.0.3) x86_64 for Windows • EMC PowerPath 4.6.1 • HyperBac for Windows Systems 2.7.0.2	• Oracle Database 10g Release 2 (10.2.0.3) x86_64 for Linux • EMC PowerPath EMCpower.LINUX-4.5.3-003 • HyperBac for Linux Systems 2.7.0.2

Table 2 – HyperBac Oracle Test Configurations

Test Description

In the Recovery Manager (RMAN) tests, HyperBac was compared against native Oracle 10g RMAN backupsets (using compression) and native uncompressed RMAN Image Copy operations. All HyperBac operations performed in the Oracle tests include compression and AES-256 bit integrated data encryption. The following scripts were used to perform the individual tests on the Oracle systems comparing HyperBac to equivalent conventional operations:

RMAN Backup Scripts (Backupset and Image Copy):

```
/* FULL NATIVE COMPRESSED DATABASE BACKUP */
RMAN> BACKUP AS COMPRESSED BACKUPSET DATABASE FORMAT
'I:\oracle\product\10.2.0\flash_recovery_area\NAVDB\BACKUPSET\%U_
NATIVE_COMP.BAK';

/* FULL HYPERBAC COMPRESSED/ENCRYPTED DATABASE BACKUP */
RMAN> BACKUP DATABASE FORMAT
'I:\oracle\product\10.2.0\flash_recovery_area\NAVDB\BACKUPSET\%U_
NATIVE.HBE';

/* NATIVE UNCOMPRESSED IMAGE COPY */
RMAN> BACKUP AS COPY DATABASE FORMAT
'I:\oracle\product\10.2.0\flash_recovery_area\NAVDB\BACKUPSET\%U_
NATIVE.BAK';

/* HYPERBAC COMPRESSED/ENCRYPTED IMAGE COPY */
RMAN> BACKUP AS COPY DATABASE FORMAT
'I:\oracle\product\10.2.0\flash_recovery_area\NAVDB\BACKUPSET\%U_
NATIVE.HBE';
```

RMAN Restore Scripts (Backupset and Image Copy):

```
/* RESTORE COMMAND USED FOR ALL BACKUPS */
RMAN> RESTORE DATABASE VALIDATE;
```

Export Data Pump (EXPDP) Scripts:

```
/* NATIVE EXPORT DATA PUMP OPERATION */
EXPDP FULL=Y DIRECTORY=EXPDPDIR DUMPFILE=Native_Export.DMP
LOGFILE = Native_Export_log.log

/* HYPERBAC COMPRESSED/ENCRYPTED EXPORT DATA PUMP OPERATION */
EXPDP FULL=Y DIRECTORY=EXPDPDIR DUMPFILE=HyperBac_Export.HBE
LOGFILE = HyperBac_HBE_Export_log.log
```

RMAN Backupset Test Results

Table 3 illustrates the comparative speed increase between native Oracle 10g compressed backupsets and HyperBac compressed/encrypted backupsets of the same database. HyperBac averaged 4.4 times faster backup operations as compared to native compressed across the Windows and Linux platforms on the Dell DVD Store application.

	Elapsed Backup Time (s)	% Faster
Oracle Windows Native	3365	
HyperBac - Windows	762	442% (4.4x)

	Elapsed Backup Time (s)	% Faster
Oracle Linux Native	3045	
HyperBac - Linux	1085	280% (2.8x)

Table 3 - HyperBac Comparative Compressed Backupset Speed Results

RMAN Image Copy Test Results

The storage saving benefits of HyperBac are illustrated in Figure 7, which shows the aggregate size of a native uncompressed Oracle RMAN Image Copy operation compared to an equivalent operation performed using HyperBac compression and encryption. The HyperBac operation yielded over 70% integrated compression, reducing the total backup size from 97GB to 28.8GB.

In this case, the HyperBac compressed/encrypted Image Copy operation was over 77% faster than the same operation performed without using HyperBac.

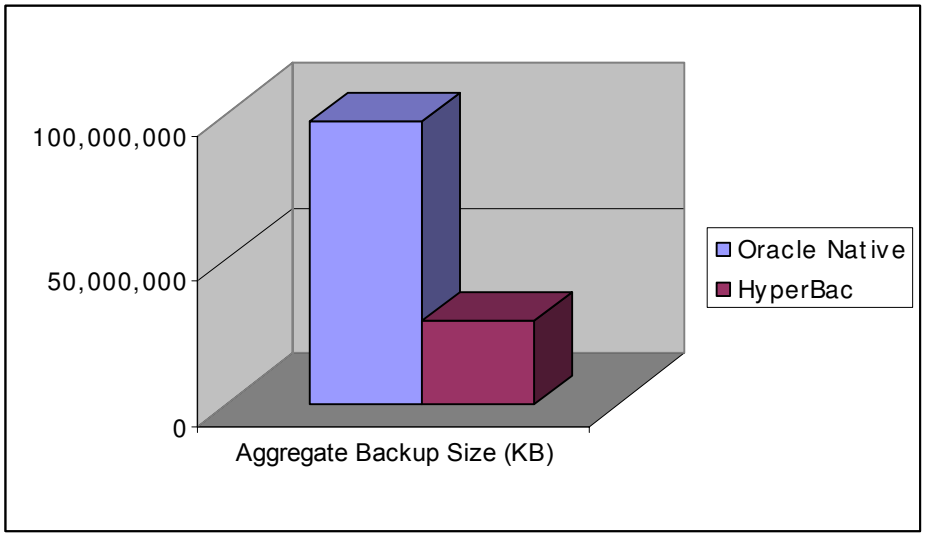

Figure 7 - HyperBac Comparative Aggregate Image Copy Backup File Size (Windows)

In Table 4 and Figure 8, the total backup and validation times of an RMAN Image Copy backup are compared between native and HyperBac operations. In this example a HyperBac Image Copy backup and validation operation can be performed in less time than it would take to simply perform the native Image Copy operation itself. The sum total of HyperBac compressed/encrypted Image Copy backup and validation times is nearly half of the total time to perform the same backup and validate operation without HyperBac.

	Elapsed Backup Time (s)	%Faster	Elapsed Validation Time (s)	%Faster	%Faster Overall
Native Oracle	2518		1177		
HyperBac	1207	209% (2.0x)	837	141% (1.4x)	180%

Table 4 – Image Copy Comparative Backup and Restore Times

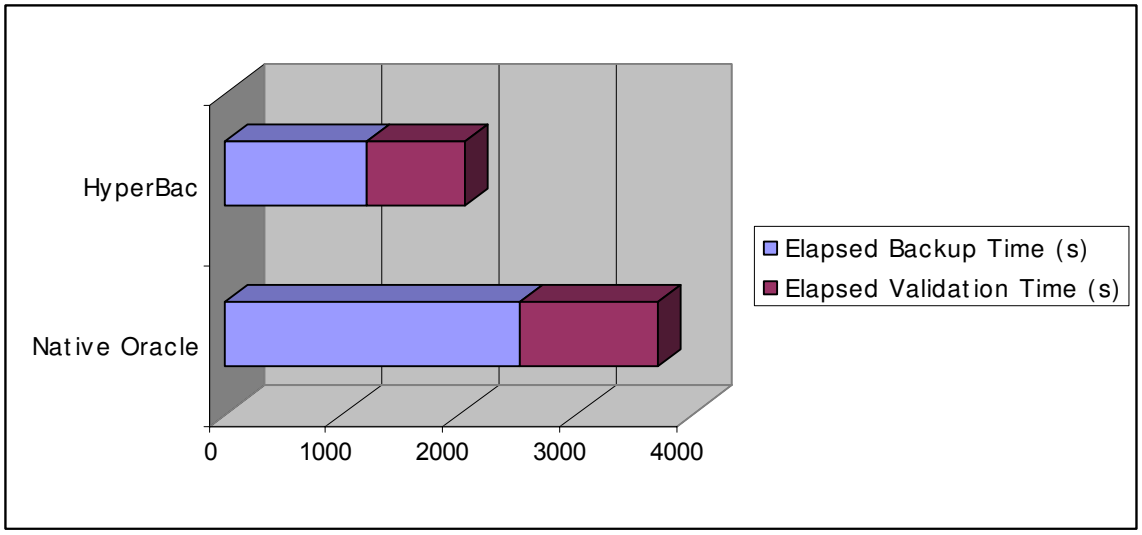

Figure 8 - HyperBac Comparative Aggregated Backup/Restore Validation Times (Windows)

Export Data Pump (EXPDP) Test Results

The Export Data Pump compression tests using HyperBac provided a 64% storage savings benefit compared to an equivalent native uncompressed Export Data Pump (EXPDP) operation. Table 5 shows the EXPDP test results or a full export of the Dell DVD Store database on the Windows platform. Note that the compression results were delivered without extending the elapsed export operation time; in fact the EXPDP operation using HyperBac was 10% faster than the equivalent operation without HyperBac.

Full Export Data Pump		
Backup Type	**File Size (KB)**	**Compression**
Native EXPDP	59,566,534	
HyperBac EXPDP Compressed	21,487,893	64%
HyperBac EXPDP Compressed-Encrypted	21,494,762	64%

Table 5 – Export Data Pump (EXPDP) Compression Results Using HyperBac

Conclusions

In summary, Database Systems running on Dell/EMC Hardware can benefit from HyperBac's unique alternative to conventional and other third-party backup solutions by leveraging from of the DBMS inbuilt backup and ETL capabilities and delivering fast, efficient and secure database backup/recovery or export/import operations. HyperBac backup and restore speed and performance improvements are specifically relevant for customer requirements to reduce backup and recovery windows and relieve I/O bottlenecks and storage capacity issues on DASD, NAS and SAN systems.

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