IMS Database Utility Solution

IMS Database Administration Solution

Highlights

- Provides IMS database reorganization using parallel processing to achieve high performance and reduced IMS database unavailability
- Supports IMS Full Function databases including HALDBs, internal logical relationships and secondary indexes
- Automates all IMS offline database reorganization steps including Unload, Reload, Secondary Index Rebuilding, and Image Copying in a single job step
- Uses IMS I/T Operational Analytics to collect and monitor database statistics
- Program Number: 5655-DBU

IMS™ is IBM's premier transaction and hierarchical database management system. IMS was designed for high availability, superior performance, growth and capacity, and full database integrity. The ability to operate and manage this highly complex IMS system and database environment determines the Total Cost of Operation (TCO). The IBM® IMS Tools lowers TCO by equipping IMS system programmers and IMS database administrators (DBAs) with the facilities they need to effectively monitor and manage this mission-critical environment. The IBM IMS Tools provide automation, validation, and auditing of all database and transaction management activities.

The *IMS Database Utility Solution* provides a full solution for the IMS Database Administrator (DBA). As IMS databases increase in size and complexity, IMS DBA's need sophisticated tooling to manage and maintain them. They also need the ability to monitor and proactively make adjustments to prevent critical outages. The *IMS Database Utility Solution* provides a graphical user interface through the *IBM Management Console for IMS and DB2* that allows IMS DBA's to view historical information and database trends.

IMS Database Utility Solution

The *IMS Database Utility Solution* combines a number of sophisticated IMS database products into a single solution as shown in Figure 1.

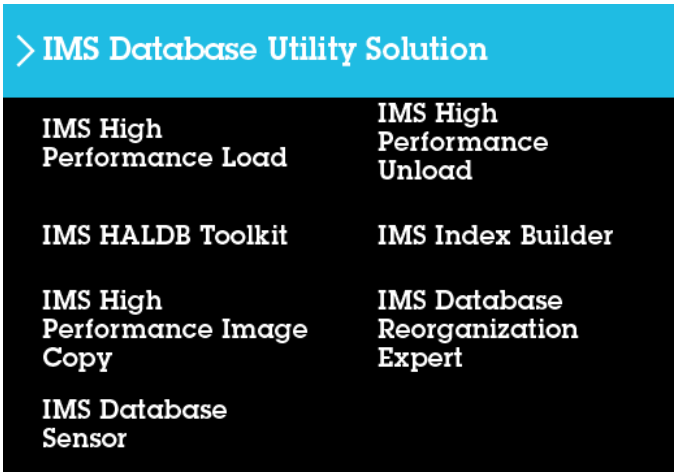

Figure 1: IMS Database Utility Solution Component Products

The *IMS Database Utility Solution* provides a subset of the full *IMS Database Solution Pack*. It provides support for IMS offline reorganizations and advanced HALDB database functionality. This smaller solution has full operational analytics support, however, it does not include the library management support or the ability to check and correct pointer and database errors. The larger *IMS Database Solution Pack* is shown in Figure 2.

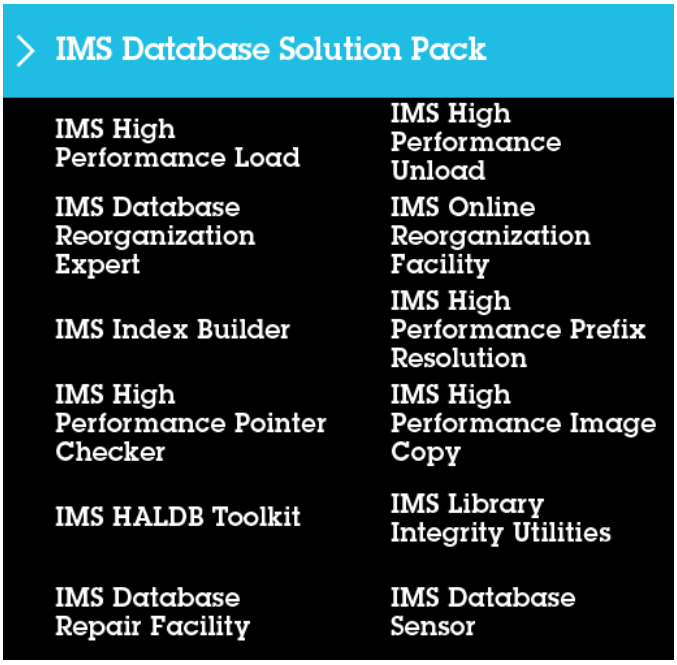

Figure 2: IMS Database Solution Pack Component Products

IMS Offline Reorganization

When IMS databases are changed frequently with record updates, deletions and insertions, the IMS databases loses their optimal structure. This is when IMS database reorganizations are required to restore data clustering and distribute free space evenly. An IMS database which is well-structured improves IMS application performance.

The *IMS Database Utility Solution* provides offline reorganization. It is performed when the affected IMS databases are unavailable to applications. The *IMS Database Utility Solution* reorganizes the IMS databases in a single job step including unloading and reloading the data, rebuilding secondary indexing, and image copying the reorganized database.

The offline reorganization provided by the *IMS Database Reorganization Expert tool* which is in the *IMS Database Utility Solution* supports database pointer checking and logical relationship resolution. However, these two products are not included in the *IMS Database Utility Solution*. If these database functions are desired, the *IMS High Performance Pointer Checker* and *IMS High Performance Prefix Resolution* tools must be purchased separately.

IMS Parallel Reorganization

IMS Database Reorganization Expert uses the Parallel Reorganization Service to perform IMS database reorganizations. This facility invokes the *IMS High Performance Unload* tool, the *IMS High Performance Load* tool, and optionally, the *IMS Index Builder* tool, the *IMS High Performance Image Copy* tool, the *IMS High Performance Pointer Checker* tool, and the *IMS High Performance Prefix Resolution* tool concurrently in a single step allowing many of the reorganization processes to run in parallel with each other.

The *IMS Database Reorganization Expert* product uses the input database data sets and matching shadow data sets for the reorganized data. The IMS database records are unloaded and reloaded into the shadow data sets. If there are secondary indexes, they are reorganized by the *IMS Index Builder* tool as the primary IMS database is being reorganized.

If pointer checking is requested, the *IMS High Performance*

Pointer Checker tool performs the HASH check function while the reorganized database is being image copied by the *IMS High Performance Image Copy* tool.

During the database reorganization, IMS applications can maintain read access to both the primary database and the indexes, too. When the IMS database reorganization has completely transferred all of the data to the shadow data sets, the database is automatically taken offline and the shadow data sets are renamed to the production database data set names. When this renaming process is completed, the IMS databases are brought back online automatically by the *IMS Database Reorganization Expert* tool.

IMS Conditional Reorganization Mode

The *IMS Database Reorganization Expert* product brings a high level of intelligence to the database reorganization process. The tool analyzes IMS databases and evaluates their space management status against a set of user-defined policies to determine if the database should be reorganized. If the *IMS Database Reorganization Expert* determines that the database would benefit from a reorganization, it automatically drives the reorganization procedure.

However, if the tool determines that the reorganization does not meet the thresholds defined in the policies, then the reorganization is not done. An example of the Summary of Policy Evaluation report showing the before and after results of a database reorganization is shown in Figure 3.

The smart reorganization capability is also known as "Conditional Reorganization" and is now available with the *IMS Database Reorganization Expert* tool and the *IMS Online Reorganization Facility*.

```
IMS DB Reorg Expert - V4R1       Database Diagnosis Report          Page:     2
5655-S35                                        Date: 11/01/2014  Time: 00.05.14

Summary of Policy Evaluation (DBD: BKDB    )
-------------------------------------------------------------------
Name of Policy Applied..... SYS.DBDTYPE.HIDAM
Policy Locale..... Global
Reorganization Need..... Yes

Exceptions before Reorganization
-------------------------------------------------------------------------------

The number of available extents for a data set of BKDB is small
   Class: DATA_SET_EXTENTS_AVAILABILITY    Level: CRITICAL
   Rule:  G:IBM.DBDS_EXTENTS.10    Threshold Set: HIGH

The size of a data set in BKDB, which still has a certain amount of free space,
has increased
   Class: GROWING_DBDS_WITH_FREE_SPACES    Level: CRITICAL     -> REORG
   Rule:  G:IBM.DBDS_GROWTH.20     Threshold Set: HIGH

The fragmentation of free space in BKDB has increased
   Class: FRAGMENTED_FREE_SPACES           Level: CRITICAL     -> REORG
   Rule:  G:IBM.FRAGMENTATION.10   Threshold Set: HIGH

A data set of BKDB has many pointers that point to other bocks or CIs
   Class: EXCESSIVE_SEGMENT_SCATTERING     Level: SEVERE
   Rule:  G:IBM.SEGM_SPREAD.10     Threshold Set: MED

-------------------------------------------------------------------------------

Exceptions after  Reorganization
-------------------------------------------------------------------------------

BSN2800I GENERAL STATUS: RESOURCE=BKDB ACTION_NAME=REORG
EXECUTION_STATUS=SUCCESSFUL


The number of available extents for a data set of BKDB is small
   Class: DATA_SET_EXTENTS_AVAILABILITY    Level: CRITICAL
   Rule:  G:IBM.DBDS_EXTENTS.10    Threshold Set: HIGH

-------------------------------------------------------------------------------

Summary of Policy Evaluation and Action:
-------------------------------------------------------------------------------
BBE2904I BKDB     IN RECONID=RECON207 HAS BEEN REORGANIZED, BUT IS STILL IN A
CRITICAL STATE.
-------------------------------------------------------------------------------
```

Figure 3: IMS Database Reorganization Expert Summary of Policy Evaluation Report

IMS Unconditional Reorganization Mode

The *IMS Database Reorganization Expert* product also allows the IMS database to be unconditionally reorganized. This means that the user-defined policies are not checked to determine if the reorganization is needed. This option is a good idea when the user knows that the IMS database should be reorganized.

IMS Reorganization Diagnosis Mode

When the *IMS Database Reorganization Expert* tool performs conditional reorganization and parallel reorganization in diagnosis mode, the tool shows the comparison of the database space management status before and after the reorganization.

IMS Diagnosis-only Mode

The *IMS Database Reorganization Expert* tool can also run only in diagnosis mode. This means the IMS database will evaluate and report on the status of the IMS database, but it will not run the parallel reorganization even if it would benefit the performance of the IMS database. An example of a report showing a database that needs to be reorganized is shown in Figure 4.

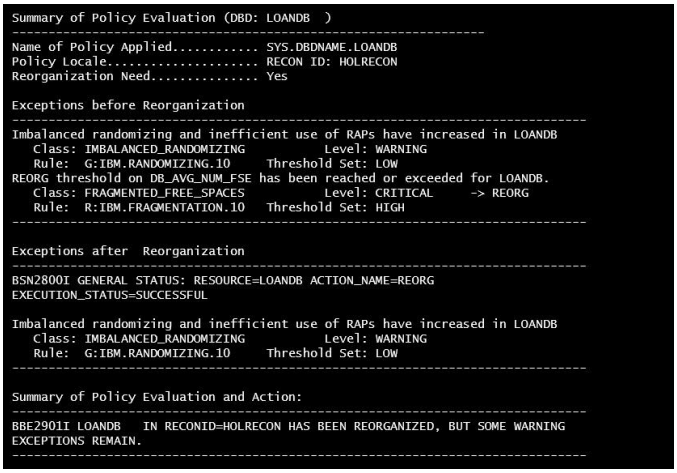

Figure 4: IMS Database Reorganization Expert Database Diagnosis Report

Additional IMS DBA Functionality

The *IMS Database Utility Solution* includes additional advanced features to allow IMS DBA's to migrate IMS Full-Function databases to IMS HALDB databases and to intelligently redesign existing IMS HALDB databases.

IMS HALDB Toolkit

The *IMS HALDB Toolkit* provides the IMS Database Administrator (DBA) with all of the tools they need to manage and maintain IMS High Availability Large Databases (HALDB) databases. This tool helps convert existing IMS Full Function databases into IMS HALDB databases. It allows IMS DBA's to simulate changes to partition settings to ensure they are correct before implementation as shown in Figure 5.

The *IMS HALDB Toolkit* supports partition consolidation and partition splitting to accommodate growth or shrinkage in an IMS application. The *IMS HALDB Toolkit* is fully integrated with other IMS High Performance tooling to provide special capabilities in the management of IMS HALDB databases.

IMS Smarter Tooling

IMS Smarter Tooling is the art of applying data analytics to IT operations to extract insights and provide automation to IMS database administration tasks. The *IMS Database Utility Solution* fully exploits Smarter Tooling by capturing and consolidating information from multiple resources. This complex data is simplified through visual displays allowing IMS DBA's to make intelligent tuning and performance optimization decisions.

By monitoring these key conditions, the *IMS Database Utility Solution* allows the IMS DBA to proactively identify critical and impending problems where corrective action can result in reducing costly failure situations. For example, information is gathered to anticipate degrading application performance and out of space conditions that require database reorganizations.

All partitions

Segment Name	Pref-length before	Pref-length after	Segment Count	Prefix Bytes	Data Bytes	Total Bytes
ROOT	18	18	30	540	1920	2460
DEP01	22	22	235	5170	235000	240170
DEP02	18	18	1402	25236	402000	1427236
Total			1667	30946	1638920	1669866
ILE records			265			

Partition 1

Segment Name	Pref-length before	Pref-length after	Segment Count	Prefix Bytes	Data Bytes	Total Bytes
ROOT	18	18	7	126	448	574
DEP01	22	22	51	1122	51000	52122
DEP02	18	18	298	5364	298000	303364
Total			356	6612	349448	356060
ILE records			58			

Partition 2

Segment Name	Pref-length before	Pref-length after	Segment Count	Prefix Bytes	Data Bytes	Total Bytes
ROOT	18	18	23	414	1472	1886
DEP01	22	22	184	4048	184000	188048
DEP02	18	18	1104	19872	1104000	1123872
Total			1311	24334	1289472	1313806
ILE records			207			

Database record distribution

Part	Roots	%	Data	%
1	7	23.33	356060	21.32
2	23	76.66	1313806	78.67

Figure 5: IMS HALDB Toolkit Partition Selection Test Tool Report

The *IMS Database Utility Solution* keeps historical records of utility executions, real time statistics, and impending database conditions. This data is used for trend analysis which is another key component of Smarter Tooling. The historical information when combined with current conditions allows the IMS DBA to predict future database behavior. While some actions can trigger self-managing responses, other actions may require execution during specified periods of time. The *IMS Database Utility Solution* provides scheduling functionality that is based on rules and thresholds to drive actions and utilities to resolve critical conditions. The IMS Smarter Tooling capabilities are all

incorporated into the *IMS Smarter Tooling Server* component of the *IMS Database Utility Solution*.

IMS Smarter Tooling Server

The *IMS Smarter Tooling Server* automates the collection of sensor data, initiates policy evaluations, and allows users to schedule maintenance operations during appropriate time periods. The *IMS Smarter Tooling Server* is fully integrated with the *IMS Database Reorganization Expert* product to provide conditional reorganizations that are based on user-defined policy thresholds.

IMS Database Sensor Data Collection

The *IMS Database Sensor* utility is a key component of the *IMS Smarter Tooling Server*. It is responsible for collecting database activity and key conditions that can be used in Smarter Tooling. It runs during image copy and pointer checker processing. It can also run as standalone utility. The *IMS Database Sensor* utility scans databases, analyzes space utilization, and collects statistics that are stored in the *IMS Tools Knowledge Base (ITKB)* sensor data repository for use by other tools in the *IMS Database Utility Solution*. The data categorization is shown in Figure 6.

IMS ITOA Data Categorization
Root segments distribution and synonyms
Database records
IMS segment occurrence and free space
IMS segment fragmentation and split segments
Estimated I/O occurrences
Usage of overflow area
Data set space used and allowable size
Data set space size, free space, extensions
Data set space CI and CA splits

Figure 6: IMS Database Sensor Utility Smarter Tooling Data Categorization

IMS Policy Services

The *IMS Smarter Tooling Server* allows users to set policies to determine when specific conditions are met in the IMS database system environment. A policy is a rules-based condition or threshold. When the policy is met or the threshold is reached, a notification can be sent to the IMS DBA or a corrective action can be initiated. These policies provide conditional control over maintenance operations which can reduce the total cost of operations (TCO). For example, the policies may reduce the number of reorganizations for rarely changed databases.

IMS Smarter Tooling Graphical User Interface (GUI)

The *IMS Smarter Tooling Server* is fully integrated with the *IBM Management Console for IMS and DB2* to provide a graphical user interface (GUI) for the IMS Smarter Tooling data. Data is displayed on a web browser and IMS DBA's can view interactive charts showing historical data and database trends. The *IMS Smarter Tooling Server* detects database exceptions and automatically displays them on the browser along with recommended actions to resolve the issues.

IMS Tool Knowledge Base for Reports

The *IMS Database Utility Solution* generates many statistical reports. These reports are stored in the *IMS Tool Knowledge Base (ITKB)* repository for centralized viewing and historical analysis.

For more information

To learn more about the IBM IMS Tools product line, please contact your IBM representative or IBM Business Partner, or visit: ibm.com/software/data/db2imstools/products/ims-tools.html

IBM Corporation
Route 100
Somers, NY 10589

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