



# **Exploring Oracle Database Partitioning**

# **New Features and Best Practices**

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#### **About Me**

Oracle ACE Director



- Oracle Certified Professional DBA (OCP)
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- Founder and CEO, DBAces
- President, Israel Oracle User Group



- Ambassador, EMEA Oracle User Group Community
- Oracle DBA consultant and instructor, specializing in Oracle database core technologies
- Frequent speaker at Oracle events and user group conferences around the globe



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#### Oracle Database 18c XE "Free Oracle Database for Everyone"

- Same powerful Oracle Database with a full-featured experience
- Use in any environment, plus the ability to embed and redistribute free!
- What is included:
  - Multitenant (multiple Pluggable Databases inside your Multitenant Container Database)
  - In-Memory (to support real-time analytics using In-Memory column store)
  - Partitioning
  - Advanced Analytics (Data Mining SQL, R programming and the Oracle Data Miner UI)
  - Advanced Security (TDE and Data Redaction)
  - Resources up to: 12GB of user data, 2GB DB RAM, 2 CPU threads, 3 PDBs

https://www.oracle.com/database/technologies/appdev/xe.html





#### **Database Application Development Hands On Labs**

- Install virtual appliance with pre-configured Oracle software for your use
- For testing purposes only, unsupported and should not be used in production. Includes:
  - Oracle Linux 7
  - Oracle Database 18.3
  - Oracle SQL Developer 18.3
  - Oracle Application Express 18.2
  - Hands On Labs (accessed via the Toolbar Menu in Firefox)
- Requirements: 2GB RAM (default 1GB), 15GB free space

https://www.oracle.com/technetwork/database/enterprise-edition/databaseappdev-vm-161299.html







#### Agenda

#### Oracle Partitioning:

- Basics
- Strategies
- Benefits
- Best Practices
- Customer Story

Oracle Database 11g/12c/18c Partitioning New Features Live Demo





#### **Oracle Partitioning**

- Since Oracle 8.0 in 1997, Oracle has enhanced the functionality of partitioning with every release
- Enhances database manageability, performance, and availability
- Allows tables and indexes to be subdivided into smaller more manageable pieces called partitions or even sub-partitions
- Each piece is a different database segment and can be managed individually and function independently of others
- One of the most important functionalities of the Oracle database
- Key tool for building large systems with high performance and availability requirements





#### **Partitioning Strategies – Single Level**

- Range (Oracle 8): ranges of partition key values for each partition
- Hash (Oracle 8i): hashing algorithm applied to a partitioning key
- List (Oracle 9i): list of discrete values for the partitioning column
- Interval (Oracle 11g): ranges that are automatically created for a specified interval
- **System** (Oracle 11g): allows applications to explicitly map rows to arbitrary partitions
- **Reference** (Oracle 11g): partitioning for a child table is inherited from the parent table through a primary key foreign key relationship
- Virtual Column Based (Oracle 11g): defined by any partition techniques where the partitioning key is based on a virtual column





#### **Composite Partitioning Techniques**

1 <sup>st</sup> Level Partitioning	2 <sup>nd</sup> Level Partitioning	Oracle Database Version
Range	Hash	Oracle 8i
	List	Oracle 9i
	Range	Oracle 11g
List	Range	Oracle 11g
	List	Oracle 11g
	Hash	Oracle 11g
Hash	Hash	Oracle 11g
	List	Oracle 11g
	Range	Oracle 11g
Interval	Range	Oracle 11g
	List	Oracle 11g
	Hash	Oracle 11g





## **Partitioning Benefits**

- Different partitions that belong to the same table/index can:
  - Reside in different tablespaces
  - Have distinct storage clauses
  - Be maintained by granular commands
- Transparent to existing applications
- Optimizer eliminates partitions that do not need to be scanned (Partition Pruning)
- Join operations can be optimized to perform the join "by the partition" (Partition-wise Joins)







## **Oracle Database 11g – Interval Partitioning**

- Automates the creation of range partitions
- Partition are created automatically as needed whenever data for a partition is inserted for the very first time
- Greatly improves the manageability of ranged partitioned table
- Available techniques are interval, interval-list, interval-hash, interval-range and interval-reference (12c only)
- You must specify at least one range partition
- Partitioning key column must be of NUMBER or DATE type





# **Oracle Database 11g – Virtual Column-Based Partitioning**

- Allows partitioning key to be defined by an expression
- Enables a more comprehensive match for various business requirements
- Supported with all basic partitioning strategies
- Can also be used with interval partitioning as well as the partitioning key for reference partitioned tables
- Virtual columns are treated as regular real columns except no DML operations are allowed





#### **Oracle Database 11g – Reference Partitioning**

- Allow to partition a table by leveraging an existing parent-child relationship
- Partitioning strategy of parent table is inherited to its child table without the necessity to store the parent's partitioning key column in the child table
- Transparently inherits all partitioning maintenance operations that change the logical shape of a table from the parent table to the child table
- Automatically enables partition-wise joins for the equal-partitions of the parent and child tables





#### **Partitioning Best Practices**

- EXCHANGE PARTITION:
  - One of the best features in partitioning tables
  - Swap-out standard tables and partitioned tables
  - Ability to load data quickly and easily with minimal impact on current users
     ALTER TABLE ... EXCHANGE PARTITION ... WITH TABLE ...;
- Using Compression:
  - Compress some or all partitions using table compression (defined at either tablespace, table or partition level)
  - Compress some or all partitions of a B-tree index using key compression to eliminate repeated occurrences of key column prefix values





#### **Partitioning Best Practices**

- Copy Statistics:
  - Available since 10.2.0.4
  - Can be used to copy statistics of the source [sub] partition to the destination [sub] partition
- Sub-Partition Templates:
  - Used for composite partitioned table
  - Simplifies the specification of sub-partitions by not requiring that a sub-partition descriptor be specified for every partition in the table





#### **Customer Story**

- Privately held financial software and data company
- Providing financial software tools such as analytics and equity trading platform
- Existing table "OLD\_TRADES" partitioned by date column (range partitions), over 4 billion rows (~80 partitions)
- New table "TRADES" partitioned by firm number (list partitions), sub-partitioned by date column (range partitions), ~360 subpartitions in total
- Copying data from OLD\_TRADES using EXCHANGE SUBPARTITION
- Using PARTIAL indexes





#### **Oracle Database 12c R1 Partitioning New Features**

- Partial Indexes for Partitioned Tables
- ONLINE Move Partitions
- Partition Maintenance Operations on Multiple Partitions
- Asynchronous Global Index Maintenance for DROP and TRUNCATE Partition
- Interval Reference Partitioning



Oracle white paper: Partitioning with Oracle Database 12c

http://www.oracle.com/technetwork/database/options/partitioning/partitioning-wp-12c-1896137.pdf





## **Oracle Database 12c R1 – Interval Reference Partitioning**

- Referenced partitioned table leverages interval partitioning as the top partitioning strategy
- Enhances Oracle's partitioning capabilities to model the database schema according to real business needs

```
CREATE TABLE parent_table_name
(column_name..., column_name..., ...)
PARTITION BY RANGE (column name) INTERVAL(n)...;
```

```
CREATE TABLE child_table_name
(column_name..., column_name..., FOREIGN KEY...)
PARTITION BY REFERENCE (fk_constraint_name)...;
```







# **Oracle Database 12c R1 – Multiple Partition Operations**

- Partition maintenance operations can be performed on multiple partitions as part of a single partition maintenance operation (one atomic operation)
- Simplifies application development and leads to more efficient partition maintenance using less system resources
- For example:

ALTER TABLE table\_name ADD PARTITION partition\_name..., PARTITION partition\_name..., PARTITION partition\_name...;







#### **Oracle Database 12c R1 – Partial Indexes**

- New index attribute only applicable to indexes on partitioned tables
- Indexes can be created on a subset of the partitions of a table
- Provide more flexibility in index creation for partitioned tables
- For example, you can choose not to index the most recent partition to avoid any index maintenance work at data insertion time, therefore maximizing data load speed
- Bug# 25591773: SUPPRESS ORA-1502 ON PARTIAL INDEX WITH INDEXING OFF (SQL Error: ORA-01502: index 'xxx.xxxxxxxx' or partition of such index is in unusable state)
- Bug fixed in version 18.1
- Patch 25591773: SUPPRESS ORA-1502 ON PARTIAL INDEX WITH INDEXING OFF

Partial Indexes.sg





# **Oracle Database 12c Release 2 New Features (12.2)**

#### Online Conversion of Non-Partitioned Table to Partitioned Table

- Adopt partitioning without application downtime
- No impact on the ongoing DML operations
- Indexes are maintained

#### **Table Creation for Partition Exchange**

- New DDL command for creating a table that exactly matches a partitioned table and is eligible for EXCHANGE operation
- Ensures both tables are identical so partition exchange command will always succeed







## **Oracle Database 12c Release 2 New Features (12.2)**

#### **Auto-List Partitioning**

- Automatically creates new partition for every distinct key value
- Removes the burden to manually maintain a list for large number of distinct key values that require individual partitions

#### Multi-Column List Partitioning

- Data is organized in lists of multiple values (multiple columns)
- Ideal for segmentation of distinct value pairs (firm, source)

Recommended reference guide: "Get the best out of Oracle Partitioning" a practical guide and reference by Hermann Baer, Senior Director, Oracle <u>http://www.oracle.com/technetwork/database/partitioningguidev43-2703320.pdf</u>





# **Oracle Database 12c R2 Partitioning New Features (12.2)**

#### Automatic List Partitioning

- Automatically creates new list partitions on the fly, for every distinct key value
- No need to manually maintain a list of distinct key values that require individual partitions

CREATE TABLE ... PARTITION BY LIST ('column name') AUTOMATIC ... ;

- Only for partitions, cannot be used with subpartitions
- Refer to the partition by the value it contains:

ALTER TABLE ... RENAME PARTITION FOR (`list value') TO new\_name;





#### **Oracle Database 18c Partitioning New Features**

#### Online Merging of Partitions and Subpartitions

- Use ONLINE keyword with ALTER TABLE MERGE PARTITION and SUBPARTITION SQL statement to enable online merge operations allowing concurrent DMLs
- Increases application availability and simplifies application development

#### Modifying the Partitioning Strategy

- Change partitioning strategy using ALTER TABLE MODIFY PARTITION SQL statement
- Enables applications to adjust partitioning for new business requirements
- No need to manually recreate tables
- Can be performed offline or online
- Indexes are maintained







THANK YOU

# **Exploring Oracle Database Partitioning**

# **New Features and Best Practices**

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