Oracle Partitioning wird einfach nicht alt …

2018 DOAG Konferenz + Ausstellung

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Oracle Partitioning never gets old

1. Innovate with Oracle Partitioning
2. Improve your data maintenance
3. Manage your tables and indexes
4. Leverage read only capabilities
5. Look ahead - what’s coming in 19c

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Oracle Partitioning in Oracle Database today

	Core functionality	Performance	Manageability
Oracle 8.0	Range partitioning Local and global Range indexing	Static partition pruning	Basic maintenance: ADD, DROP, EXCHANGE
Oracle 8*i*	Hash partitioning Range-Hash partitioning	Partition-wise joins Dynamic partition pruning	Expanded maintenance: MERGE
Oracle 9*i*	List partitioning		Global index maintenance
Oracle 9*i* R2	Range-List partitioning	Fast partition SPLIT	
Oracle 10*g*	Global Hash indexing		Local Index maintenance
Oracle 10*g* R2	1M partitions per table	Multi-dimensional pruning	Fast DROP TABLE
Oracle 11g	Virtual column based partitioning More composite choices Reference partitioning		Interval partitioning Partition Advisor Incremental stats mgmt
Oracle 11g R2	Hash-* partitioning Expanded Reference partitioning	“AND” pruning	Multi-branch execution (aka table or-expansion)
Oracle 12c R1	Interval-Reference partitioning	Partition Maintenance on multiple partitions Asynchronous global index maintenance	Online partition MOVE Cascading TRUNCATE Partial indexing
Oracle 12c R2	Auto-list partitioning Multi-column list [sub]partitioning Partitioned external tables	Online partition maintenance operations Online table conversion to partitioned table Reduced cursor invalidations for DDL’s	Filtered partition maintenance operations Read only partitions Create table for exchange
Oracle 18c		Parallel partition-wise SQL operations Completion of online partition maintenance Enhanced online table conversions	

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How to get started with Oracle Partitioning

- Start with proper data modeling and growth assumptions
  - Plan for partitioning from the get-go for both performance and data maintenance

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- Not everybody thinks big and starts small …
  - … so tables can start off small as nonpartitioned ones
  - … and they grow and grow
  - … and performance can get impacted

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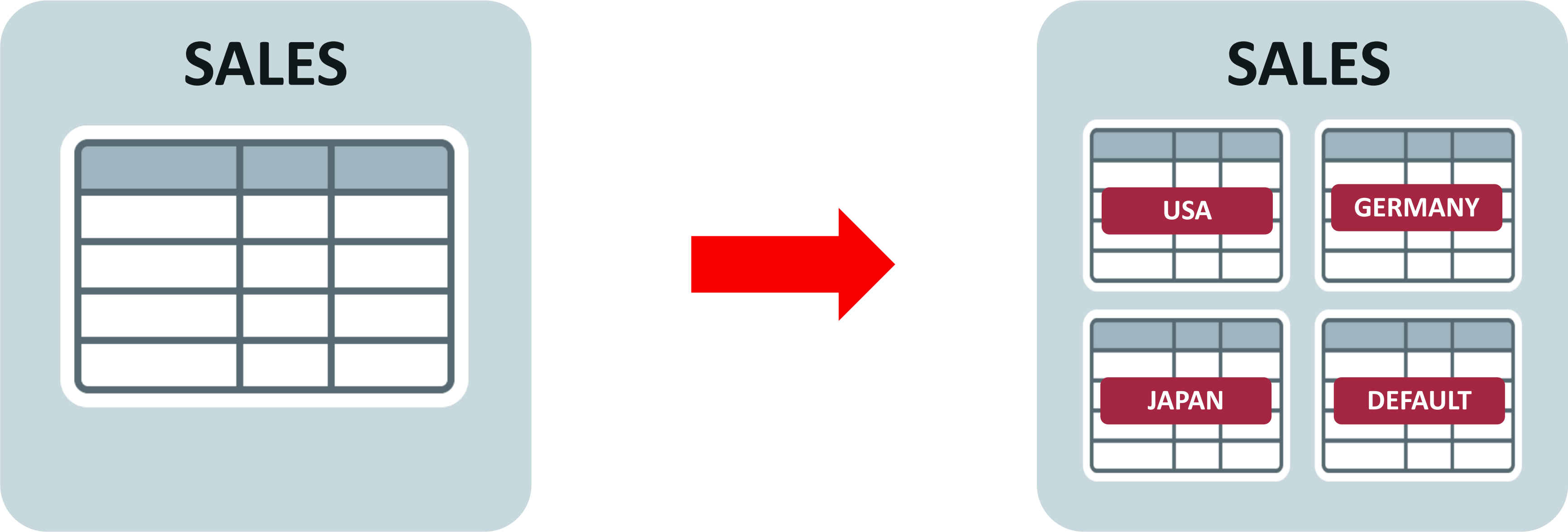
How to convert such tables without downtime?

NEW IN 12.2

Online Table Conversion for Nonpartitioned Tables



- Completely non-blocking (online) DDL for table and indexes

NEW IN 12.2

Online Table Conversion for Nonpartitioned Tables

Indexing

- Indexes are converted and kept online throughout the conversion process
- Default indexing rules to provide minimal to no access change behavior
  - All prefixed indexes will be converted to local partitioned indexes
  - Global partitioned indexes will retain the original partitioning shape unless prefixed
  - Non-prefixed indexes will become global nonpartitioned indexes
  - Bitmap indexes will become local partitioned indexes
- Full flexibility for indexes, following today’s rules
  - Override whatever you want to see being changed

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- Not everybody thinks big and starts small …
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How to convert such tables without downtime?

- I have partitioning …
  - … but I chose the “wrong” type/granularity (for whatever reason)

What now?

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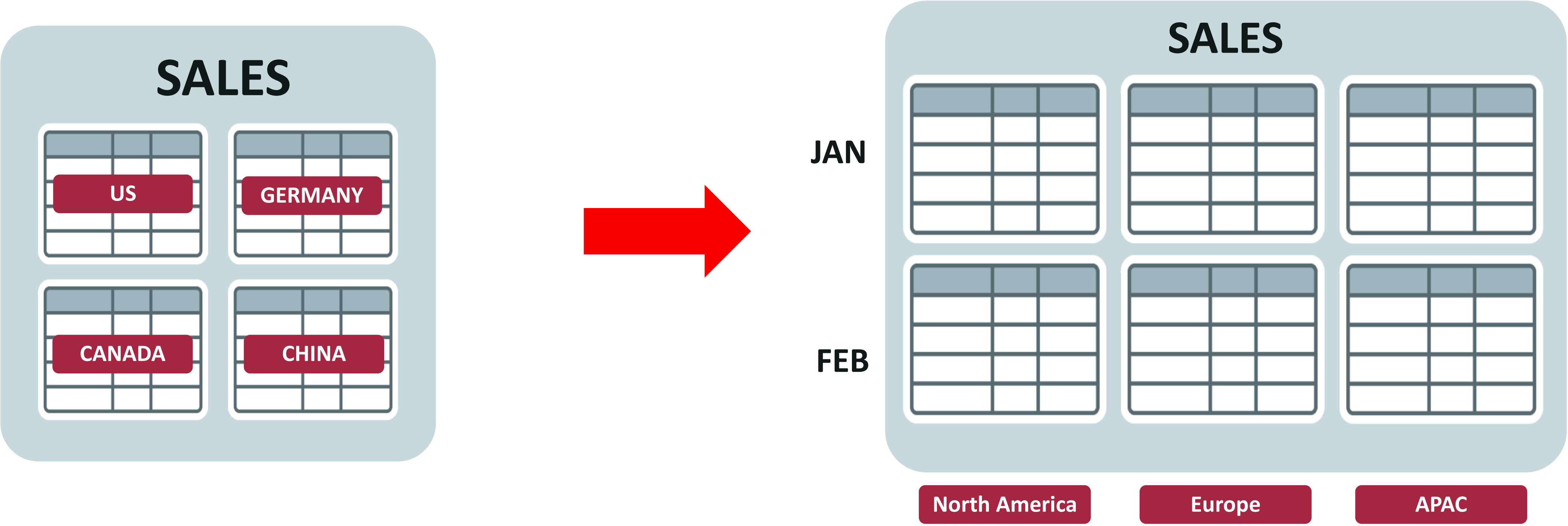
Online Table Conversion of Partitioned Tables



- Completely non-blocking (online) DDL for table and indexes

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NEW IN 18c

Online Table Conversion of Partitioned Tables

- Indexes are converted and kept online throughout the conversion process
- Default indexing rules to provide minimal to no access change behavior
  - Almost identical than rules for conversion of nonpartitioned table
  - Differences:
    - Local indexes stay local if any of the partition keys of the two dimensions is included
    - Global prefixed partitioned indexes will be converted to local partitioned indexes
- Full flexibility for indexes, following today’s rules
  - Override whatever you want to see being changed

NEW IN 18c

Online Table Conversion of Partitioned Tables

Syntax Example

```
CREATE TABLE sales ( order_num NUMBER,
                     region VARCHAR2 (10), … )
PARTITION BY LIST (…)
```

```
ALTER TABLE sales MODIFY
PARTITION BY RANGE (order_date)
SUBPARTITION BY LIST (region)…
UPDATE INDEXES



ONLINE;
```

NEW IN 18c

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ALTER TABLE sales MODIFY
PARTITION BY RANGE (order_date)
SUBPARTITION BY LIST (region)…
UPDATE INDEXES
  (i1_ordernum GLOBAL, i2_region LOCAL,
   i3 GLOBAL PARTITION BY RANGE (rev)
      (PARTITION p1 VALUES LESS THAN   (1000),
       PARTITION p2 VALUES LESS THAN  (15000),
       PARTITION p3 VALUES LESS THAN (MAXVALUE)))
ONLINE;
```

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Improve Your Data Maintenance

- **Primary goal: make data maintenance operations**
- … as fast as possible
- … least intrusive as possible
- Data Management evolves into main key aspect of partitioning

Improve Your Data Maintenance

	As fast as possible	Least intrusive as possible	
Enhanced core PMOP	x	x	12cR1: PMOP with multiple partitions 12cR1: asynchronous global index maintenance 12cR1: cascade truncate for reference partitioning
Smart PMOP		x	12cR1: partial indexing 12cR1: filtered partition maintenance
PMOP fully online		x	12cR1: online partition move

Improve Your Data Maintenance

	As fast as possible	Least intrusive as possible	
Enhanced core PMOP	x	x	12cR1: PMOP with multiple partitions 12cR1: asynchronous global index maintenance 12cR1: cascade truncate for reference partitioning **12cR2: reduced cursor invalidation**
Smart PMOP	x	x	12cR1: partial indexing 12cR1: filtered partition maintenance **12cR2: conversion non-partitioned table** **12cR2: read only partitions**
PMOP fully online		x	12cR1: online partition move **12cR2: online SPLIT** **12cR2: online conversion non-partitioned table**

Improve Your Data Maintenance

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PMOP fully online		x	12cR1: online partition move 12cR2: online SPLIT 12cR2: online conversion non-partitioned table **18c: online MERGE** **18c: online conversion partitioned table**

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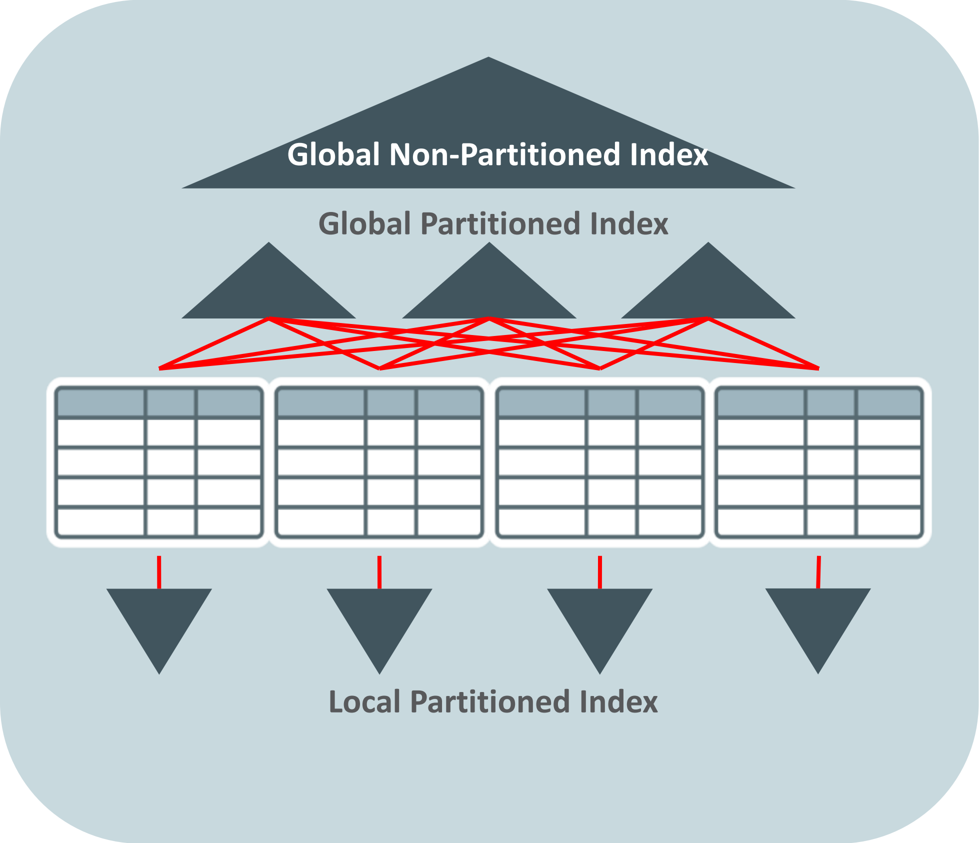
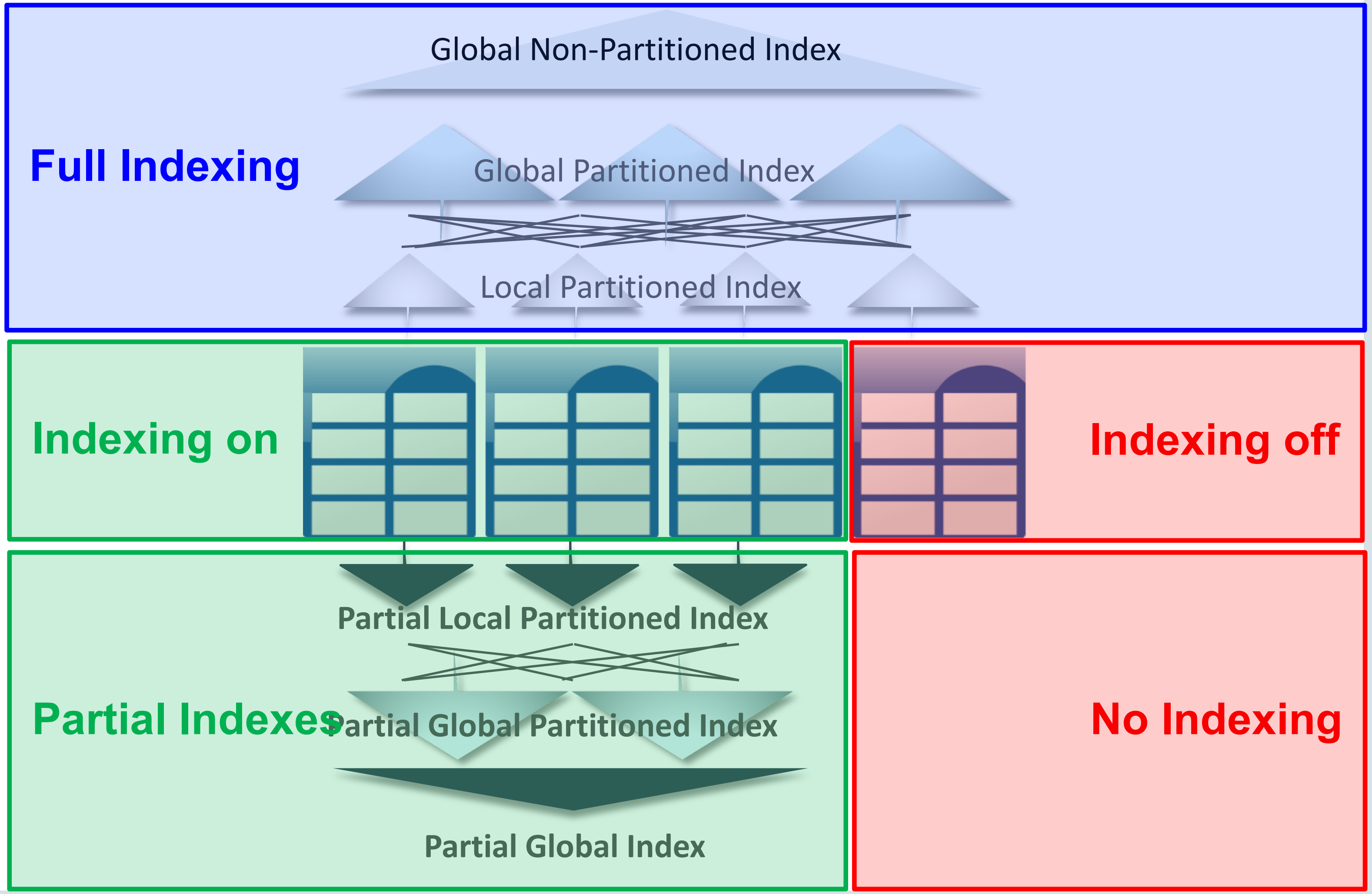
Indexing of Partitioned Tables

- GLOBAL index points to rows in any partition
  - Index can be partitioned or not
- LOCAL index is partitioned same as table
  - Index partitioning key can be different from index key

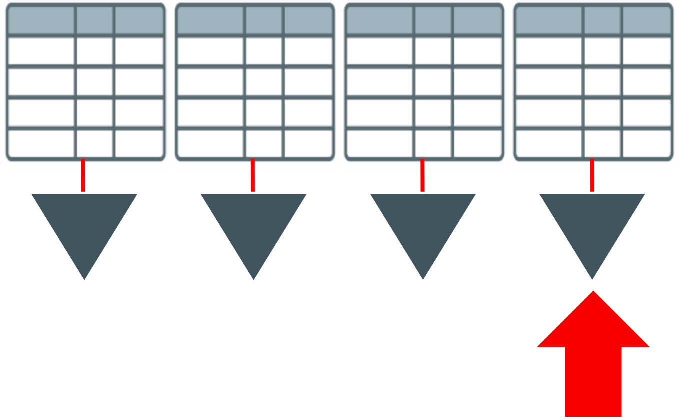


Indexing of Partitioned Tables

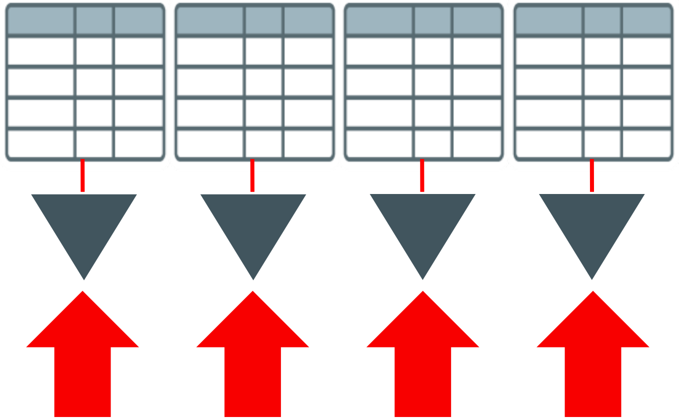
- Partial indexes span only some partitions
- Applicable to local and global indexes
- Complementary to full indexing
- Full support of online index maintenance



Data Access – Local Index and Global Partitioned Index

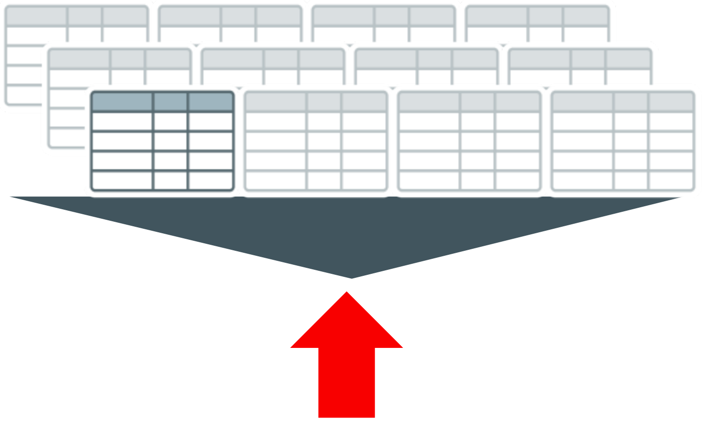


- Partitioned index access with single partition pruning

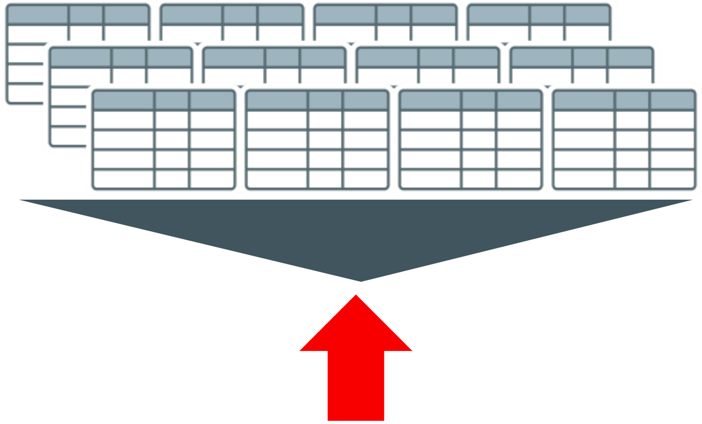


- Partitioned index access without any partition pruning

Data Access – Global Nonpartitioned Index



- Global index access with single partition pruning



- Global index access with no partition pruning

Index Maintenance and Partition Maintenance

- Online index maintenance available for both global and local indexes
  - Global index maintenance since Oracle 9i, local index maintenance since Oracle 10g
- Fast index maintenance for both local and global indexes for DROP and TRUNCATE
  - Asynchronous global index maintenance added in Oracle 12c Release 1
- Index maintenance necessary for both local and global indexes for all other partition maintenance operations

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- Index maintenance necessary for both local and global indexes for all other partition maintenance operations
- **Index maintenance based on performance versus availability requirement**
  - Rebuild of index always faster when more than 5%-10% of data are touched
- Consider partial indexing for both old and new data
  - Not all data has to be indexed to begin with

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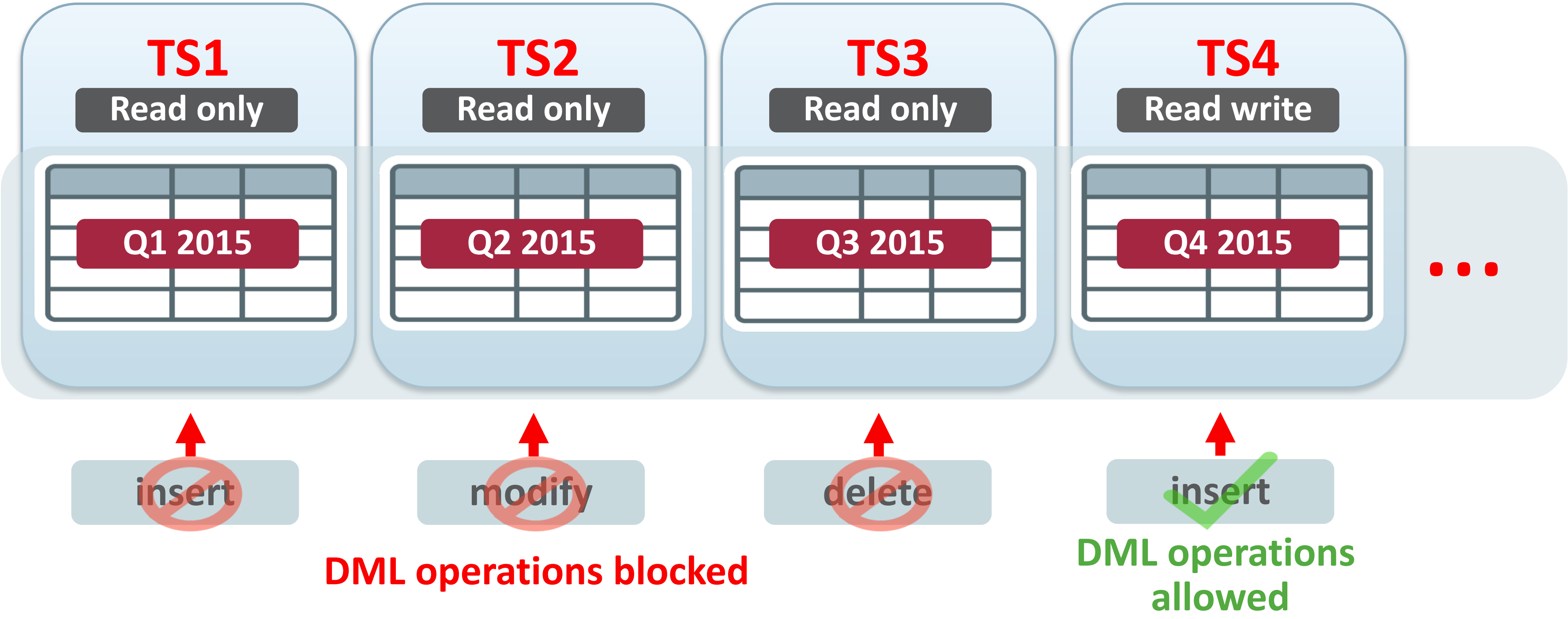
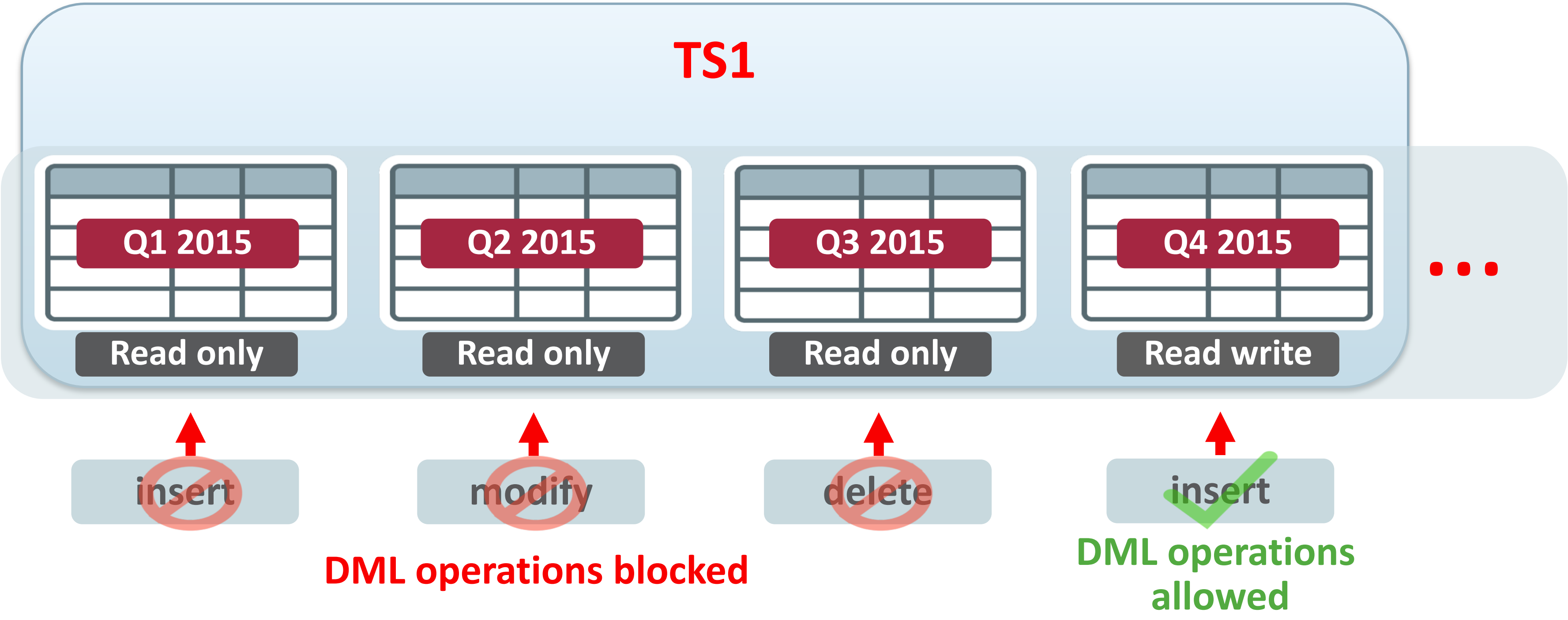
Read Only Tablespaces and Partitioned Tables



- **Partitions and subpartitions can be placed in read only tablespaces**
- Any attempt to alter data in a read only tablespace will result in an error

NEW IN 12.2

Read Only Partitions



- **Partitions and subpartitions can be set to read only or read write**
- Any attempt to alter data in a read only partition will result in an error

NEW IN 12.2

Read Only Partitions

```
CREATE TABLE orders ( order_id number,
                      order_date DATE,   … ) READ WRITE

PARTITION BY RANGE(order_date)
( partition q1_2015 values less than (‘2014-10-01’) READ ONLY,
  partition q2_2015 values less than (‘2015-01-01’) READ ONLY,
  partition q3_2015 values less than (‘2015-04-01’),
  partition q4_2015 values less than (‘2015-07-01’)
);
```

NEW IN 12.2

Read Only Partitions

- Read only attribute guarantees data immutability
  - “SELECT <column_list> FROM <table>” will always return the same data set after a table or [sub]partition is set to read only
- Data immutability does not prevent all structural DDL for a table
  - ADD and MODIFY COLUMN are allowed and do not violate data immutability of existing data
  - Others like DROP/RENAME/SET UNUSED COLUMN are forbidden
  - DROP [read only] PARTITION forbidden, too - violates data immutability of the table

Read Only Object versus Read Only Tablespace

- Read Only Tablespaces protect physical storage from updates
  - DDL operations that are not touching the storage are allowed
    - E.g. ALTER TABLE SET UNUSED, DROP TABLE
  - No guaranteed data immutability
- Read Only Objects protect data from updates
  - ‘Data immutability’
  - Does not prevent changes on storage
    - E.g. ALTER TABLE MOVE COMPRESS, ALTER TABLE MERGE PARTITIONS

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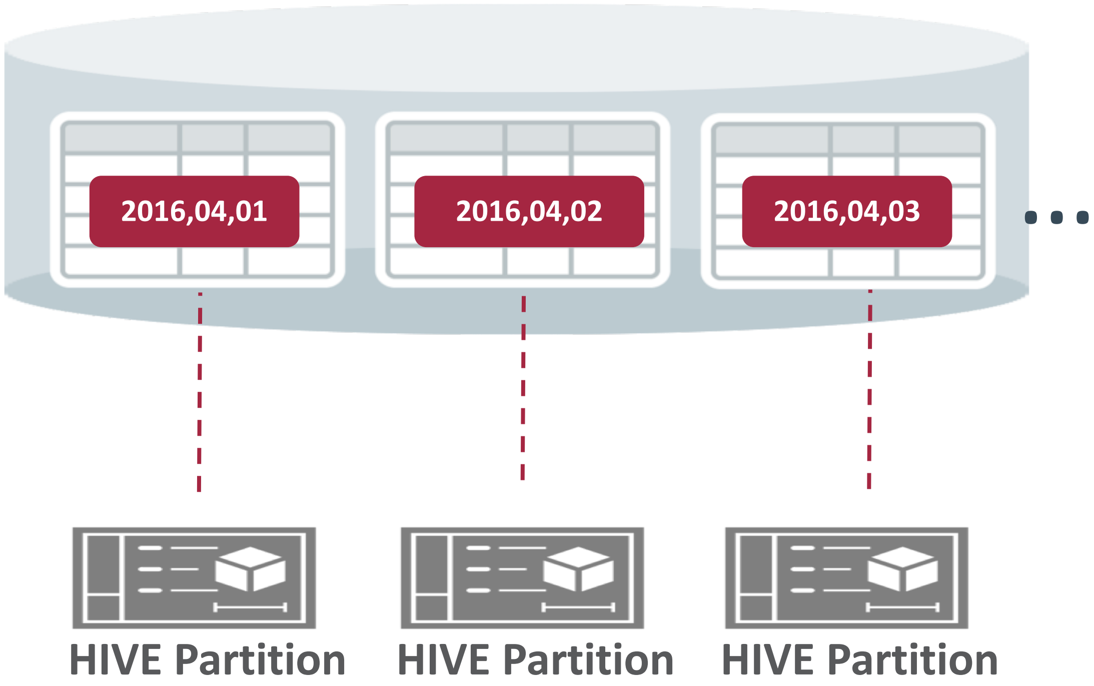
Partitioned External Tables



- Map partitioned Hive & HDFS tables into the Oracle ecosystem
- Exposes the power of Oracle partitioning for external HDFS-based data stores
  - Partition pruning and maintenance
  - Big Data aware optimization
- Enables order-of-magnitudes faster query performance and enhanced data maintenance.

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Partitioned External Tables – initial creation

```
CREATE TABLE orders ( order_id number,
                      order_date DATE,   … )
ORGANIZATION EXTERNAL
(  TYPE oracle_loader DEFAULT DIRECTORY data_dir
   ACCESS PARAMETERS (..)
) REJECT LIMIT unlimited
PARTITION BY RANGE(order_date)
( partition q1_2015 values less than (‘2014-10-01’)
  DEFAULT DIRECTORY old_data_dir LOCATION (‘q1_2015.csv’),
  partition q2_2015 values less than (‘2015-01-01’)
  LOCATION (‘q2_2015.csv’),
  partition q3_2015 values less than (‘2015-04-01’)
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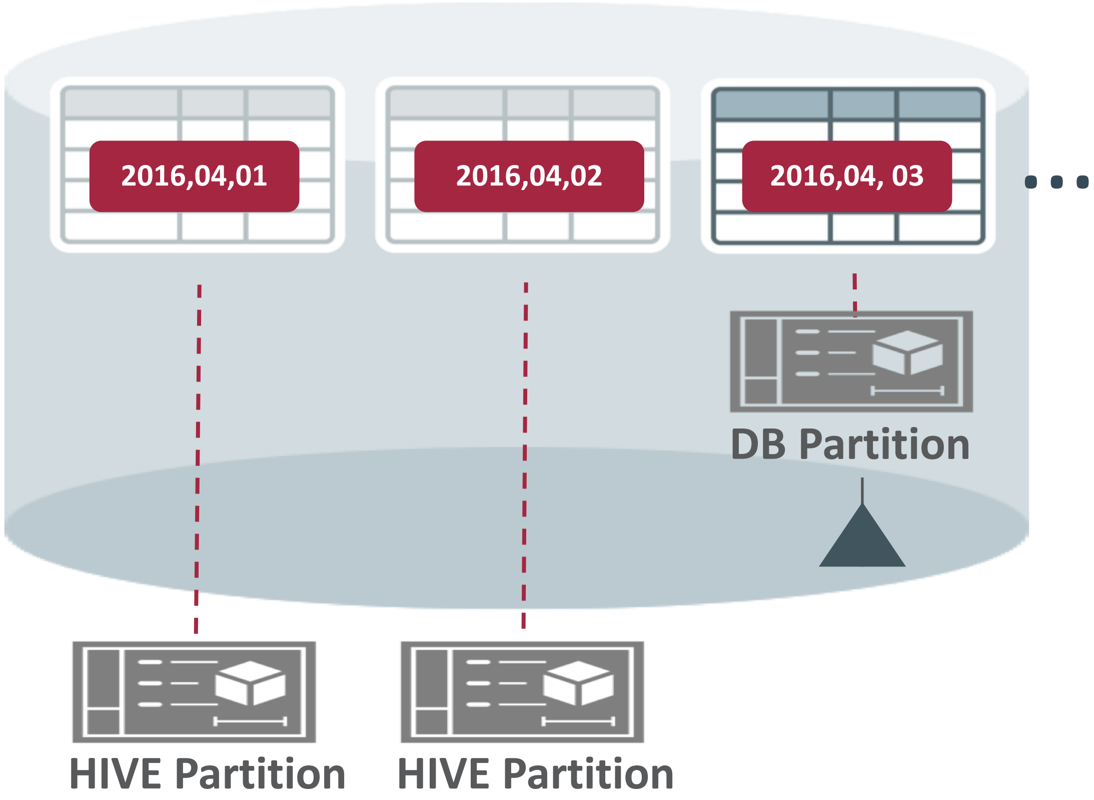
);
```

NEW IN 19c

Hybrid Partitioned Tables



- Single table contains both internal (RDBMS) and external partitions
  - Full functional support, such as partial indexing, partial read only, constraints, materialized views, etc.
- Optimized hybrid processing
  - Full leverage of both RDBMS and external processing capabilities
- Partition maintenance for information lifecycle management
  - Currently limited support

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Hybrid Partitioned Tables – initial creation

```
CREATE TABLE orders ( order_id number,
                      order_date DATE,   … )
EXTERNAL PARTITION ATTRIBUTES
(  TYPE oracle_loader DEFAULT DIRECTORY data_dir
   ACCESS PARAMETERS (..) REJECT LIMIT unlimited
)
PARTITION BY RANGE(order_date)
( partition q1_2015 values less than (‘2014-10-01’)
  EXTERNAL LOCATION (‘order_q1_2015.csv’),
  partition q2_2015 values less than (‘2015-01-01’),
  partition q3_2015 values less than (‘2015-04-01’),
  partition q4_2015 values less than (‘2015-07-01’)
);
```

NEW IN
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Evolving to Hybrid Partitioned Tables

```
ALTER TABLE orders
ADD EXTERNAL PARTITION ATTRIBUTES
(  TYPE oracle_loader
   DEFAULT DIRECTORY data_dir
   ACCESS PARAMETERS
       (records delimited by newline
        badfile 'cdxt_%a_%p.bad’
        logfile 'cdxt_%a_%p.log’
        fields terminated by ',’
        missing field values are null
       )
   REJECT LIMIT unlimited
);
```

Summary

- **We are not done with Partitioning yet!**
  - And we always need your input to steer the direction
- Oracle wants to hear from you!
  - Interesting use cases and implementations
  - Enhancement requests
  - Complaints
  - hermann.baer@oracle.com

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