DATA SATURDAYS MADRID

Delta Lake Tables 101

30/11/2024

15:25-16:15

Kamil Nowinski

Microsoft® MVP Most Valuable Professional

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Founder of blog AzurePlayer

GitHub: **#adftools**, SCD Merge Wizard and more…
Member of the Data Community PL
Former co-organiser of SQLDay (PL), Data Relay (UK), volunteer at SQLBits (UK)

SQL Server Certificates:
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- Interviews (Podcast)
- YouTube Channel: www.AzurePlayer.net/YouTube

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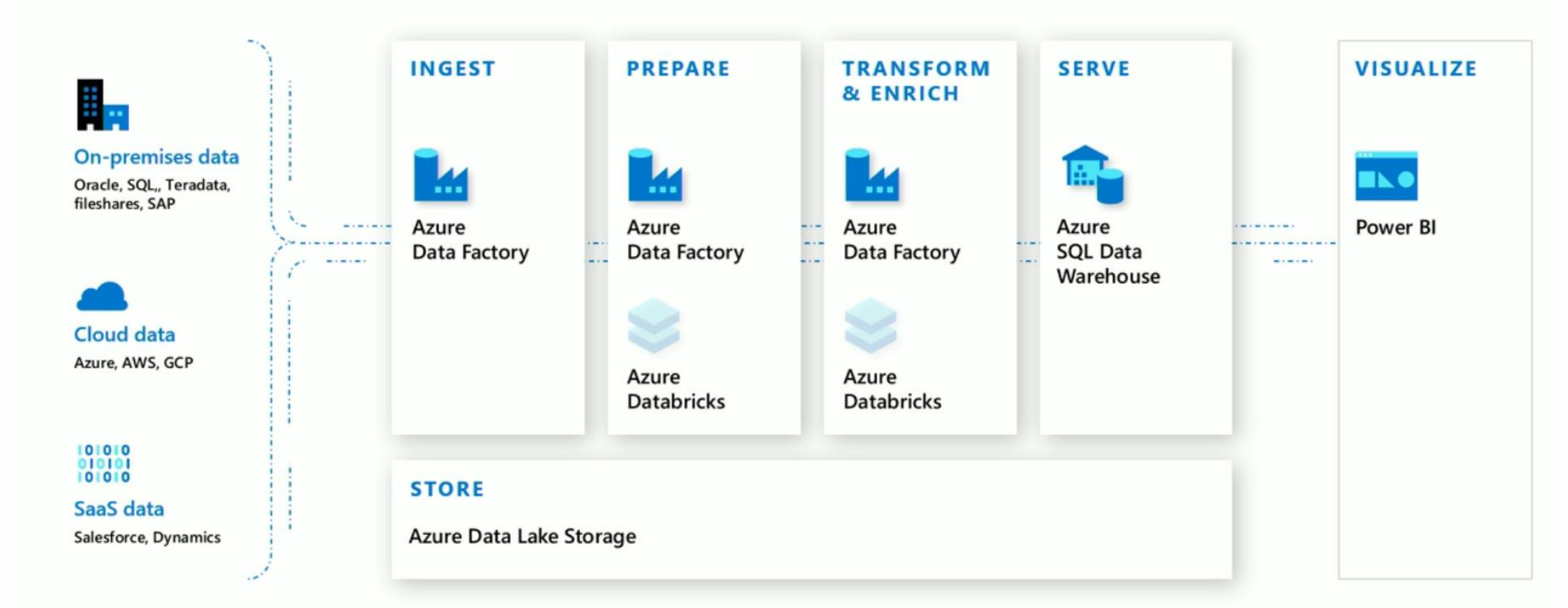
AGENDA

- A bit of theory…
- … and history
- Key features of Delta Lake Tables
- Let's practice: DEMO time
    - Delta Lake Tables in Lake Databases (Databricks)
- Key takeaways

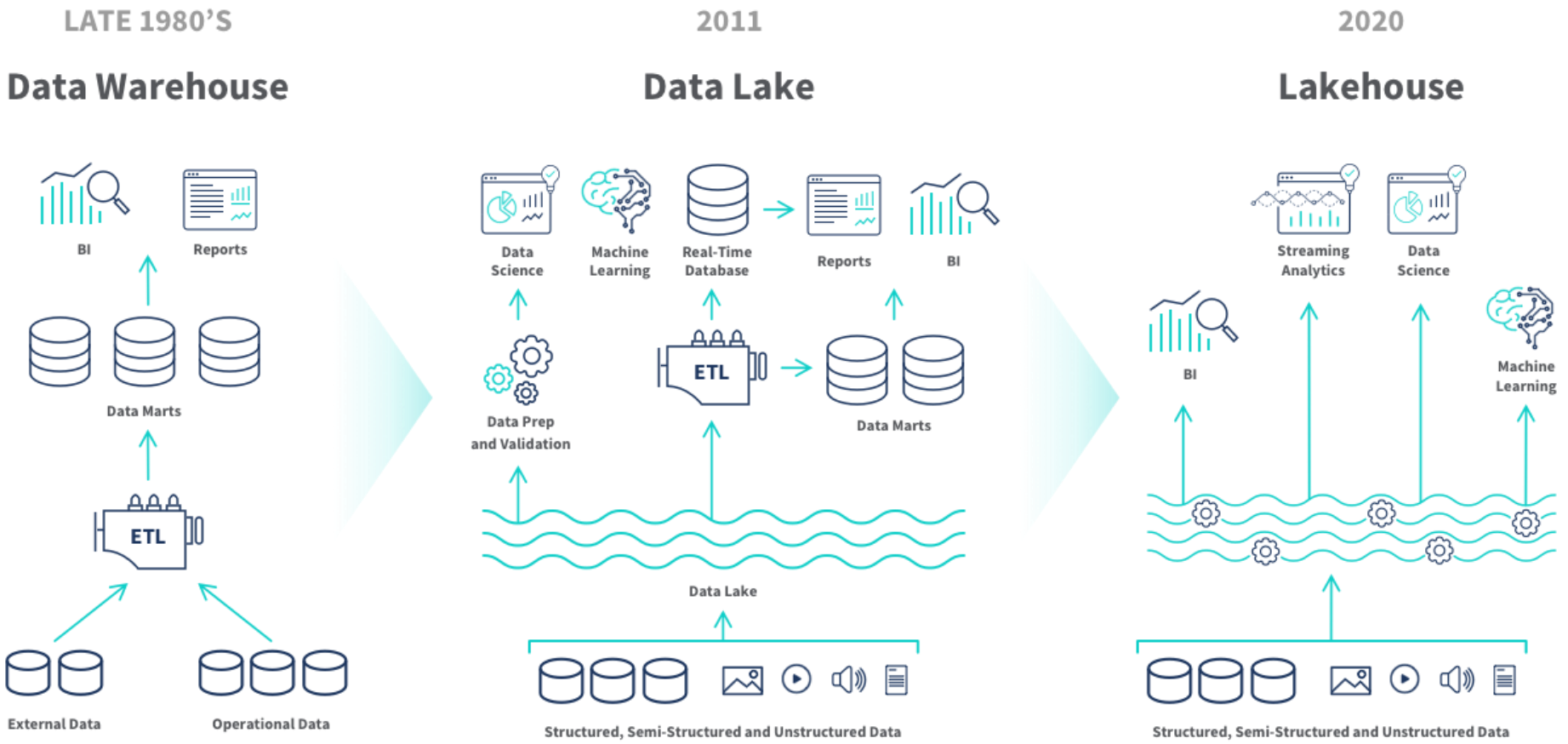
Modern Data Warehouse



Data Lake + Warehouse = Lakehouse

[> What Is a Lakehouse?]

Data Warehouse evolution



https://www.qlik.com/us/data-lake/data-lakehouse

Parquet format

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What is Parquet?

Apache Parquet is an open source, column-oriented data file format designed for efficient data storage and retrieval. It provides efficient data compression and encoding schemes with enhanced performance to handle complex data in bulk. Apache Parquet is designed to be a common interchange format for both batch and interactive workloads.

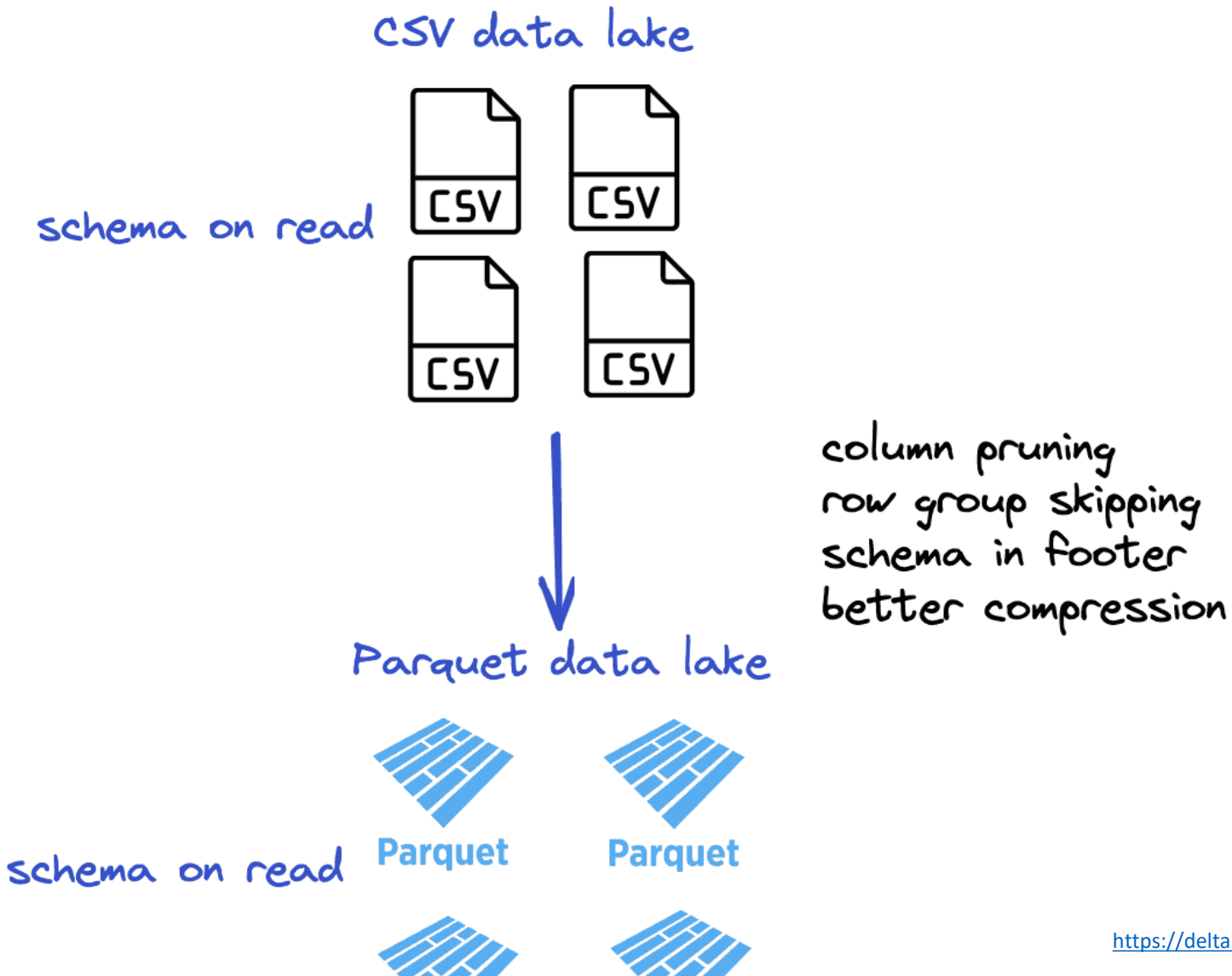
Characteristics of Parquet:

- **Free and open-source** file format
- Language **agnostic**
- Column-based format
- Used for analytics (**OLAP**) use cases
- **Highly efficient** data compression and decompression
- **Supports complex data types** and advanced nested data structures

Problems with Parquet format

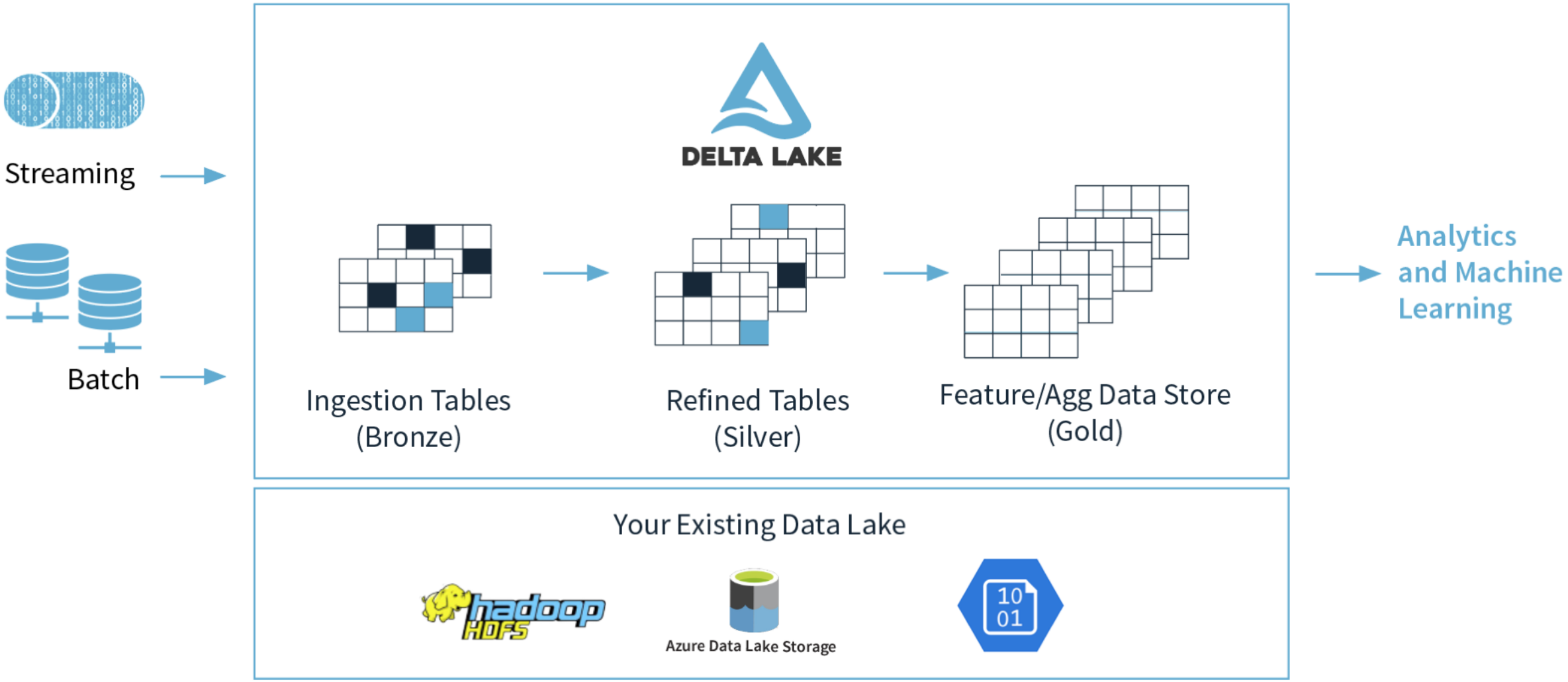
- No schema enforcement
- Updates – rewrite entire file/all files
- Transactions inconsistency
- No interoperability between batch & streaming workloads
- No versioning

Advantages of Delta Lake over CSV



https://delta.io/blog/2023-03-22-convert-csv-to-delta-lake/

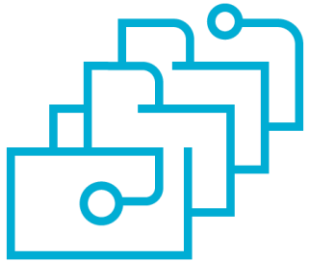
Medallion Architecture



Delta Lake – Key Features

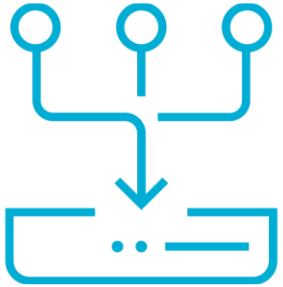
ACID Transactions

Scalable Metadata

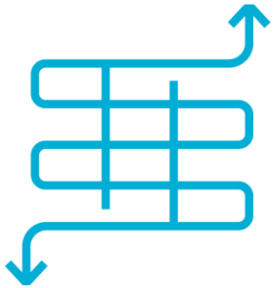


Time Travel

Open Source

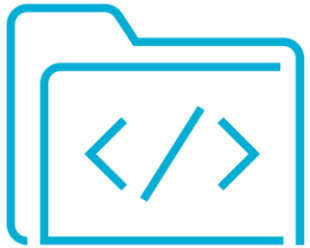


Unified Batch/Streaming



Schema Evolution / Enforcement

Audit History

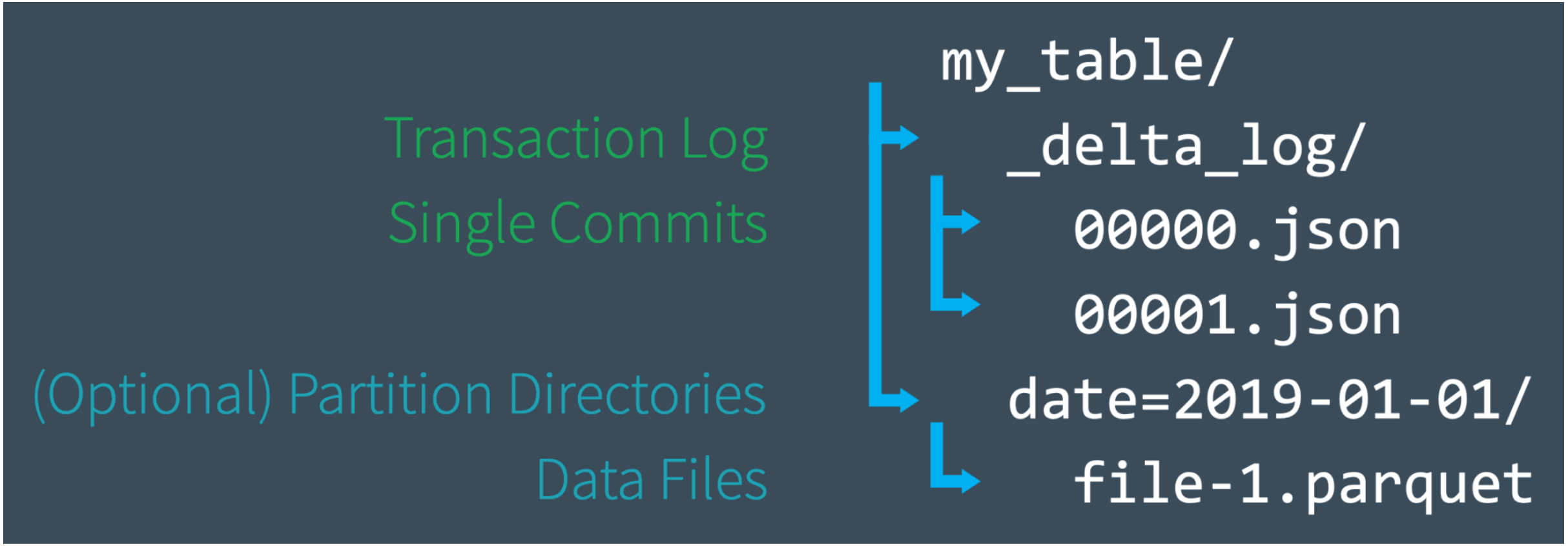


DML Operations

CONVERT

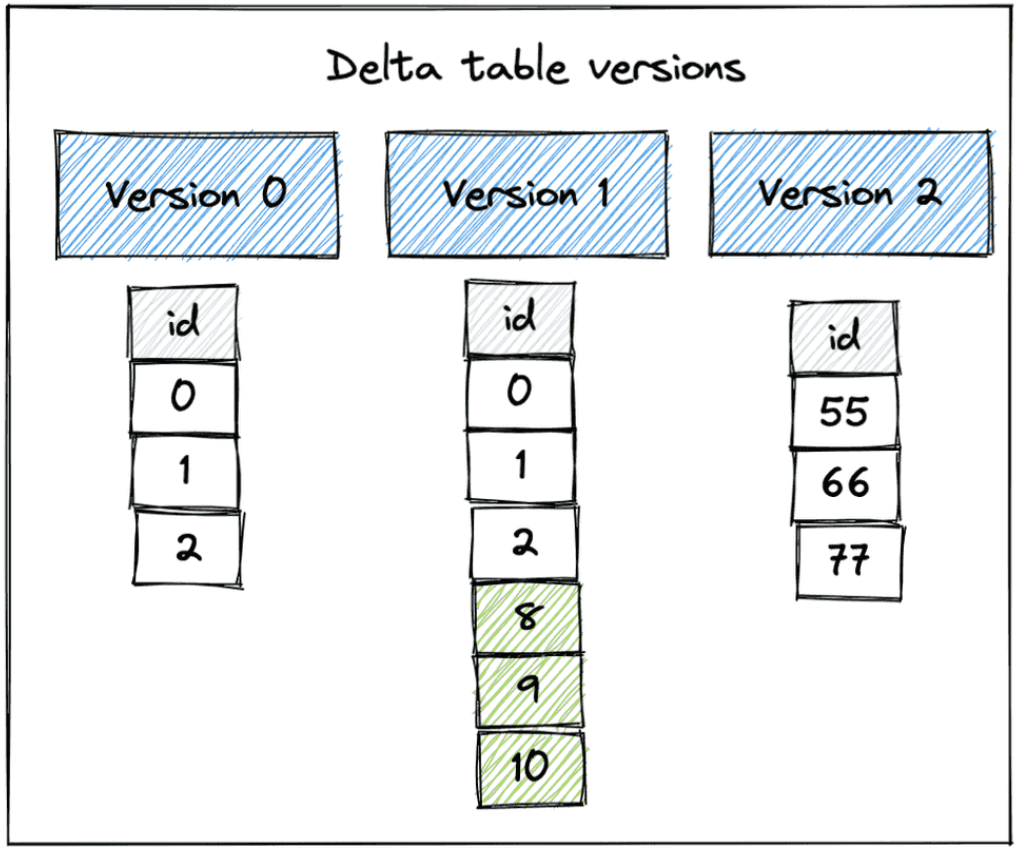

```
CONVERT TO DELTA database_name.table_name; -- only for Parquet tables

CONVERT TO DELTA parquet.`s3://my-bucket/path/to/table`
  PARTITIONED BY (date DATE); -- if the table is partitioned

-- Uses Iceberg manifest for metadata
CONVERT TO DELTA iceberg.`s3://my-bucket/path/to/table`;
```

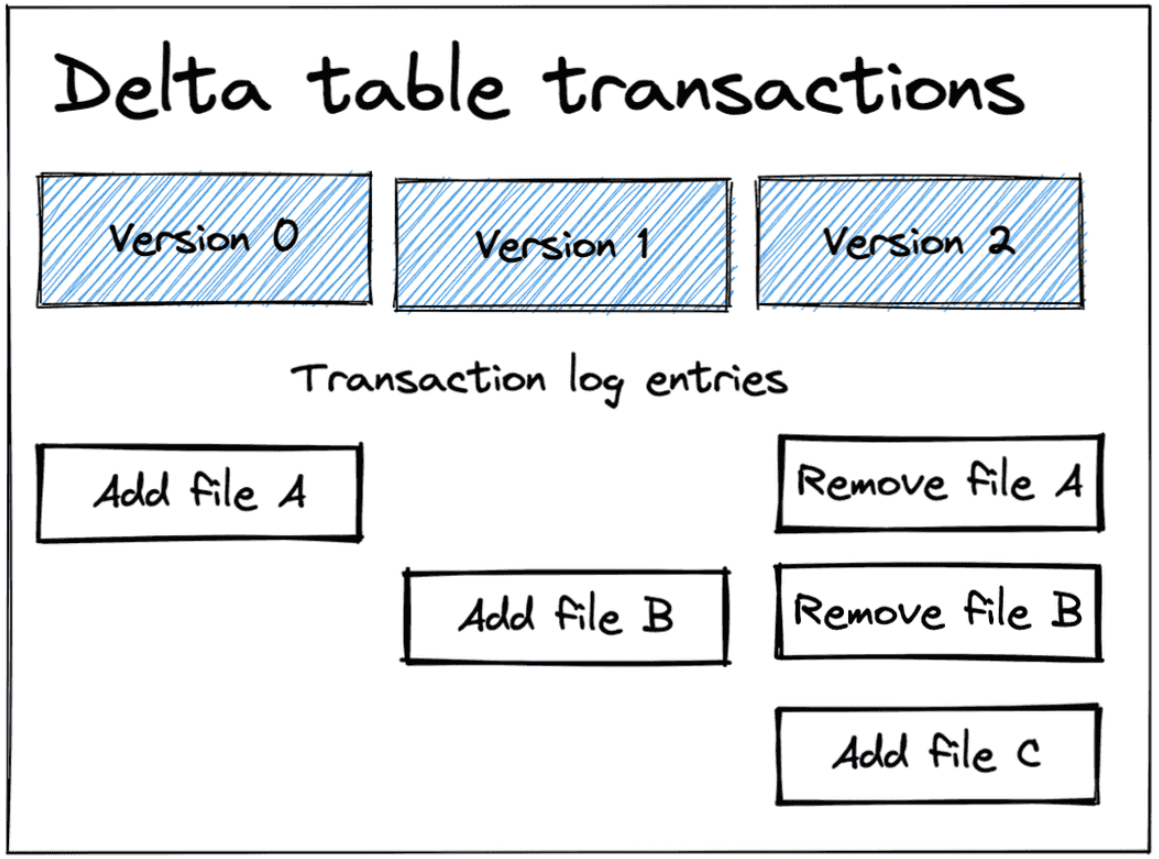
Transaction Log



Transaction Log

Time Travel





Metadata Tools

Command	Result
`DESCRIBE TABLE`	Schema of a table
`DESCRIBE EXTENDED`	Schema of a table + table details
`DESCRIBE HISTORY`	Table's changes & versions

DESCRIBE TABLE

- `DESCRIBE TABLE Lakedb.deltaUsers`

	col_name	data_type	comment
1	UserId	int	null
2	DisplayName	string	null
3	LastAccessDate	date	null
4	Reputation	int	null

DESCRIBE TABLE EXTENDED

- `DESCRIBE EXTENDED Lakedb.deltaUsers`

	col_name	data_type	comment
1	UserId	int	null
2	DisplayName	string	null
3	LastAccessDate	date	null
4	Reputation	int	null
5			
6	# Detailed Table Information		
7	Catalog	spark_catalog	
8	Database	Lakedb	
9	Table	deltaUsers	
10	Type	EXTERNAL	
11	Location	dbfs:/datarelay2023/delta/deltausers	
12	Provider	delta	
13	Owner	root	
14	Table Properties	[delta.minReaderVersion=1,delta.minWriterVersion=2]	

View Table Details

- `DESCRIBE DETAIL '/delta/deltausers/'`
- `DESCRIBE DETAIL Lakedb.deltaUsers`

Column	Type	Description
format	string	Format of the table, that is, `delta`.
id	string	Unique ID of the table.
name	string	Name of the table as defined in the metastore.
description	string	Description of the table.
location	string	Location of the table.
createdAt	timestamp	When the table was created.
lastModified	timestamp	When the table was last modified.
partitionColumns	array of strings	Names of the partition columns if the table is partitioned.
numFiles	long	Number of the files in the latest version of the table.
sizeInBytes	int	The size of the latest snapshot of the table in bytes.

format	id	name	description	location	createdAt	lastModified	partitionColumns
delta	4a67f614-32f2-465f-85fa-5e466983393c	spark_catalog.lakedb.deltausers	null	dbfs:/datarelay2023/delta/deltausers	2023-09-30T01:20:30.202+0000	2023-09-30T01:21:46.000+0000	[]

numFiles	sizeInBytes	properties	minReaderVersion	minWriterVersion	tableFeatures	statistics
2	2409	{}	1	2	["appendOnly",	{}

minReaderVersion	int
	Minimum version of readers (according to the log protocol) that can d the table.
	imum version of writers (according to the log protocol) that can te to the table.

History

- `DESCRIBE HISTORY Lakedb.deltaUsers`
- `DESCRIBE HISTORY delta.`/delta/users``

	version	timestamp	userId	userName	operation	operationParameters	job
1	2	2023-09-30T01:21:46.000+0000	4809069939003851	kamil@nowinski.net	MERGE	{"predicate": "[\"(UserId#14978 = UserId#14982)\"]", "matchedPredicates": "[{\"actionType\":\"update\"}]", "notMatchedPredicates": "[{\"actionType\":\"insert\"}]", "notMatchedBySourcePredicates": "[]"}	null
2	1	2023-09-30T01:21:10.000+0000	4809069939003851	kamil@nowinski.net	MERGE	{"predicate": "[\"(UserId#13638 = UserId#13646)\"]", "matchedPredicates": "[{\"actionType\":\"update\"}]", "notMatchedPredicates": "[{\"actionType\":\"insert\"}]", "notMatchedBySourcePredicates": "[]"}	null

notebook	clusterId	readVersion	isolationLevel	isBlindAppend	operationMetrics	userMetadata
{"notebookId": "2353687493752337"}	0926-221804-4448n59m	1	WriteSerializable	false	{"numTargetRowsCopied": "2", "numTargetRowsDeleted": "0", "numTargetFilesAdded": "2", "numTargetBytesAdded": "2409", "numTargetBytesRemoved": "1247", "numTargetDeletionVectorsAdded": "0", "numTargetRowsMatchedUpdated": "1", "executionTimeMs": "8325", "numTargetRowsInserted": "0", "numTargetRowsMatchedDeleted": "0", "scanTimeMs": "1742", "numTargetRowsUpdated": "1", "numOutputRows": "3", "numTargetDeletionVectorsRemoved": "0", "numTargetRowsNotMatchedBySourceUpdated": "0", "numTargetChangeFilesAdded": "0", "numSourceRows": "1", "numTargetFilesRemoved": "1", "numTargetRowsNotMatchedBySourceDeleted": "0", "rewriteTimeMs": "6485"}	null
{"notebookId": "2353687493752337"}	0926-221804-4448n59m	0	WriteSerializable	false	{"numTargetRowsCopied": "0", "numTargetRowsDeleted": "0", "numTargetFilesAdded": "1", "numTargetBytesAdded": "1247", "numTargetBytesRemoved": "0", "numTargetDeletionVectorsAdded": "0", "numTargetRowsMatchedUpdated": "0", "executionTimeMs": "3056", "numTargetRowsInserted": "3", "numTargetRowsMatchedDeleted": "0", "scanTimeMs": "1979", "numTargetRowsUpdated": "0", "numOutputRows": "3", "numTargetDeletionVectorsRemoved": "0", "numTargetRowsNotMatchedBySourceUpdated": "0", "numTargetChangeFilesAdded": "0", "numSourceRows": "3", "numTargetFilesRemoved": "0", "numTargetRowsNotMatchedBySourceDeleted": "0", "rewriteTimeMs": "970"}	null
{"notebookId": "2353687493752337"}	0926-221804-4448n59m	null	WriteSerializable	true	{}	null


Azure Player
Play with data & have fun!
DEMO 1

DEMO Agenda

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- Convert CSV to Parquet and to Delta
- Read, insert & update data (DML)
- Transaction Log & DESCRIBE command
- Time Travel

Schema Validation

- All DataFrame **columns** must exist in the target table
- DataFrame column **data types** must match
- DataFrame **column names** cannot differ **only by case**

Schema Evolution

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Delta Lake allows for schema evolution

1: Suppose you have this Delta table

```
+----------+---+
|first_name|age|
+----------+---+
|       bob| 47|
|        li| 23|
|   leonard| 51|
+----------+---+
```

2: Data to append

```
+----------+---+-------+
|first_name|age|country|
+----------+---+-------+
|     frank| 68|    usa|
|   jordana| 26| brasil|
+----------+---+-------+
```

Extra column of data

3: Schema enforcement will prevent the mismatched append

```
df.write.format("delta").mode("append").save("tmp/fun_people")
```

👮🛑 Exception: no data appended!

4: Use mergeSchema to enable schema evolution 🥰

```
df.write.option("mergeSchema", "true").mode("append").format("delta").save(
    "tmp/fun_people"
)
```

```
spark.read.format("delta").load("tmp/fun_people").show()
```

```
+----------+---+-------+
|first_name|age|country|
+----------+---+-------+
|   jordana| 26| brasil|
|     frank| 68|    usa|
|   leonard| 51|   null|
|       bob| 47|   null|
|        li| 23|   null|
+----------+---+-------+
```

So amazingly cool!

Schema Evolution - Automatic

Columns that are present in the DataFrame but missing from the table are automatically added as part of a write transaction when:

- write or writeStream have .option("**mergeSchema**", "true")
- spark.databricks.delta.**schema.autoMerge.enabled** is true

Update Table Schema

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Columns	Query (in SQL)	Behaviour without schema evolution (default)	Behaviour with schema evolution

Target columns: key, value
 	
Source columns: key, value, new_value
	`MERGE INTO target_table t`
	`USING source_table s`
	`ON t.key = s.key`
	`WHEN MATCHED`
	`THEN UPDATE SET *`
	`WHEN NOT MATCHED`
	`THEN INSERT *`
		The table schema remains unchanged; only columns key, value are updated/inserted.	The table schema is changed to (key, value, new_value). Existing records with matches are updated with the value and new_value in the source. New rows are inserted with the schema (key, value, new_value).

Target columns: key, old_value
 	
Source columns: key, new_value
	`MERGE INTO target_table t`
	`USING source_table s`
	`ON t.key = s.key`
	`WHEN MATCHED`
	`THEN UPDATE SET *`
	`WHEN NOT MATCHED`
	`THEN INSERT *`
		UPDATE and INSERT actions throw an error because the target column old_value is not in the source.	The table schema is changed to (key, old_value, new_value). Existing records with matches are updated with the new_value in the source leaving old_value unchanged. New records are inserted with the specified key, new_value, and NULL for the old_value.

Target columns: key, old_value
 	
Source columns: key, new_value
	`MERGE INTO target_table t`
	`USING source_table s`
	`ON t.key = s.key`
	`WHEN MATCHED`
	`THEN UPDATE`
	`  SET new_value = s.new_value`
		UPDATE throws an error because column new_value does not exist in the target table.	The table schema is changed to (key, old_value, new_value). Existing records with matches are updated with the new_value in the source leaving old_value unchanged, and unmatched records have NULL entered for new_value. See note (1).

Target columns: key, old_value
 	
Source columns: key, new_value
	`MERGE INTO target_table t`
	`USING source_table s`
	`ON t.key = s.key`
	`WHEN NOT MATCHED`
	`THEN INSERT (key, new_value)`
	`  VALUES (s.key, s.new_value)`
		INSERT throws an error because column new_value does not exist in the target table.	The table schema is changed to (key, old_value, new_value). New records are inserted with the specified key, new_value, and NULL for the old_value. Existing records have NULL entered for new_value leaving old_value unchanged. See note (1).

DEMO 2:
Schema validation & enforcement

Release 3.2

- https://github.com/delta-io/delta/releases/tag/v3.2.0
- Support for Apache Spark 3.5.

Release 4.0 (preview)

- https://github.com/delta-io/delta/releases/
- Documentation: https://github.com/delta-io/delta/releases/tag/v4.0.0rc1
- Built on top of Apache Spark 4.0.0!

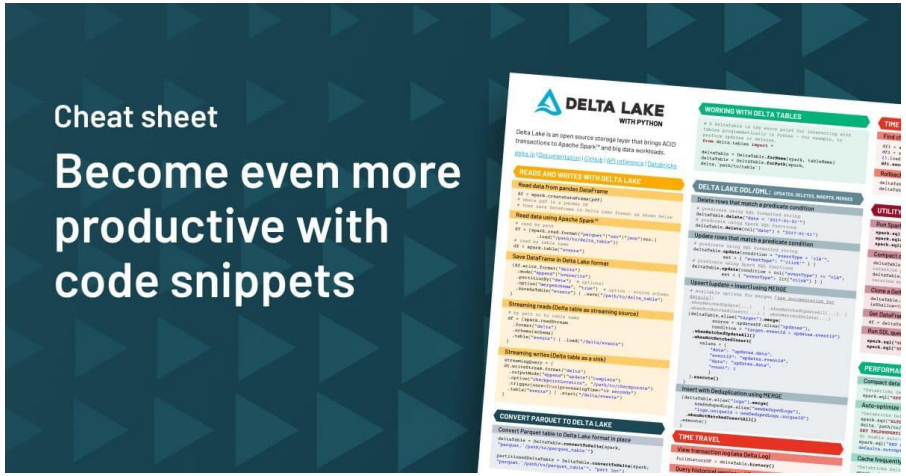
Summary

Summary

- Delta Lake is optimized storage layer
- Delta Lake operates on Parquet files underneath
- File-based transaction log for ACID transactions
- Open Source
- Supported by MS Fabric, Databricks, Synapse & ADF
- Default storage format for all operations on Azure Databricks

Resources

- https://delta.io/
  - https://docs.delta.io/latest/releases.html
  - https://github.com/delta-io/delta/
  - https://github.com/delta-io/delta/releases/
  - https://github.com/delta-io/delta-examples/
  - Table batch reads and writes
- Lambda Architecture
- Delta Lake Blogs
- What is Delta Lake? (Microsoft)
- Getting Started with Delta Lake (Databricks)
- Follow on LinkedIn: Delta Lake
- Unpacking The Transaction Log
- Cheat sheets on Learn with AzurePlayer (free)



Resources – cont.

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How to engage?

DELTA LAKE

delta.io

delta-users
Slack

Delta Lake
YouTube channel

delta-users
Google Group

Delta Lake
GitHub Issues

Delta Lake RS
Bi-weekly meetings

data-ai-online

Thank you
for your feedback

Thank you!

¡Gracias


kamil@azureplayer.net


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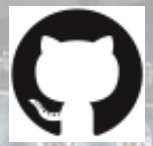
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