# Session 1- Day1- Snowpro Core certification Snowflake Deep Dive

Santosh Ubale & Robby Thomas GSI Sales Engineer 26 July 2021

# AGENDA

**Day1**

- SnowPro Core Certification exam overview
- Snowflake Data Cloud
- Architecture Overview
- Zero-copy Cloning
- Time Travel
- SnowPro Core Certification exam Sample Questions
- Snowflake hands lab on over view
- Q&A

# SnowPro Core Certification exam overview

# REQUIRED- SNOWPRO CORE CERTIFICATION

SnowPro Certification is the objective measure of Snowflake expertise. It is an industry certification, administered via a 3rd party. *Different than an accreditation*.

- **SnowPro** landing page
- **About SnowPro** (*Partner Academy*)
- Review the **Study Guide** to prep


**Course Overview**: SnowPro Core Certification

- Administered online by a 3rd party (*Webassessor*)
- 100 Multiple Choice Questions
- 2 hours
- $175/person/exam
- SnowPro FAQ

**The 4-Day Fundamentals** training is the primary course designed to set you up to pass the exam. It is not required but recommended.
Refer to **Snowflake Training Class Schedule** for information on registering for this course.

Services Partner Requirements

| | Requirement | Registered | Select | Premier | Elite |
|---|---|---|---|---|---|
| **Financial** | Annual Program Fee | | $2,500 | $5,000 | $7,500 |
| **Training & Certification** | Snowflake Sales Pro Accreditation: For Sales account execs | | 2 | 4 | 8 |
| | Snowflake Tech Sales Pro Accreditation: For Sales Engineers | | 2 | 4 | 8 |
| | Certification: SnowPro Core | | 2 | 4 | 6 |
| | Certification: SnowPro Advanced | | 1 | 2 | 2 |



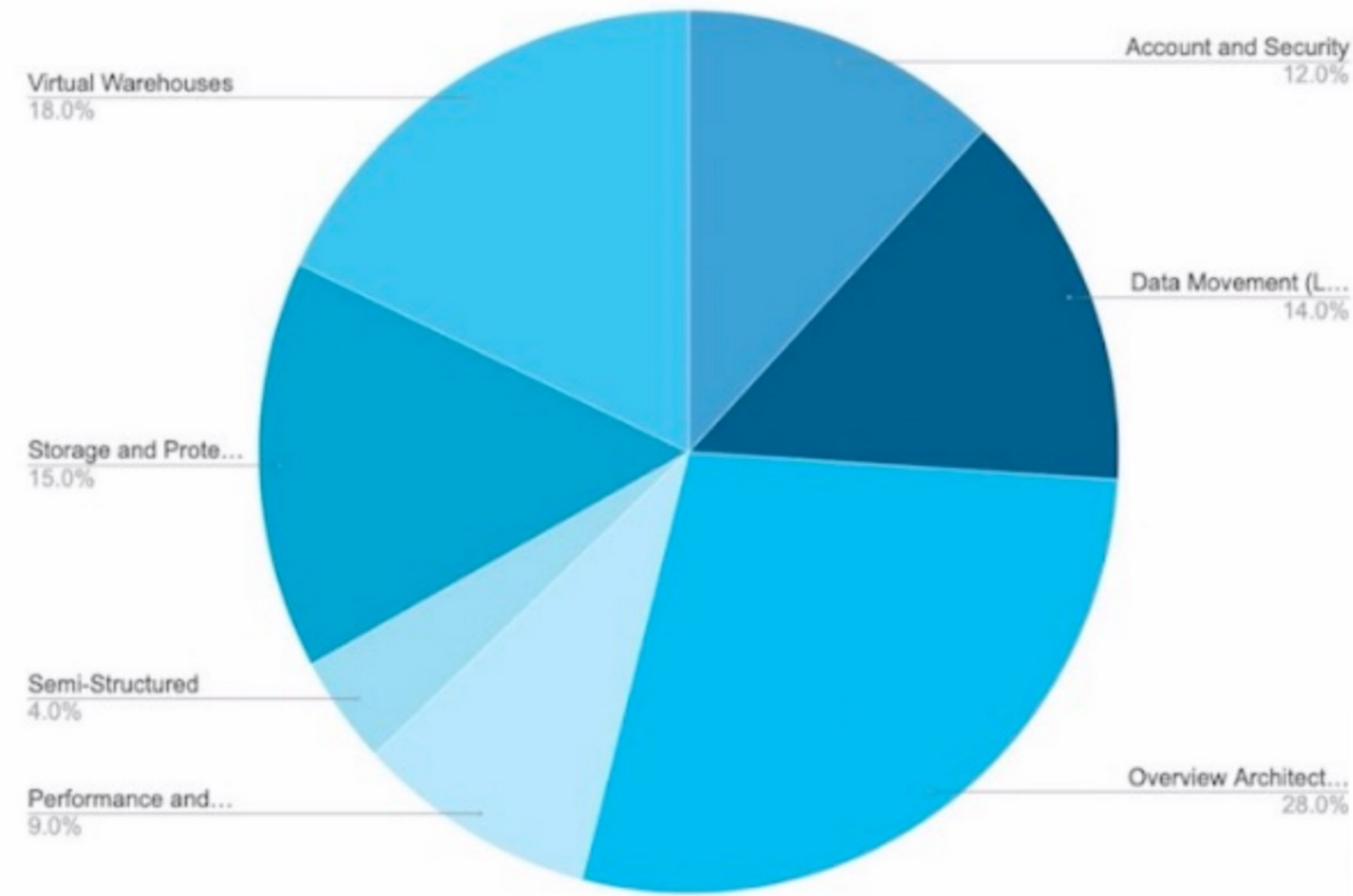
Back to Contents

# SNOWPRO CORE CERTIFICATION

## Target Audience


- Data Analyst
- Data Engineers
- Data Scientist
- Database Architect
- Database Administ
- Solution Architects

# SNOWPRO CORE CERTIFICATION



# Introduction To Snowflake & Data Cloud

# OUR MISSION & STORY

## Enable every organisation to be data-driven

Founded in 2012 by Oracle industry veterans

2015 general availability of "The Data Warehouse Built for the Cloud"

$1.4B funding from leading investors on a $12.4B valuation

Gartner Data Management Solutions for Analytics leader

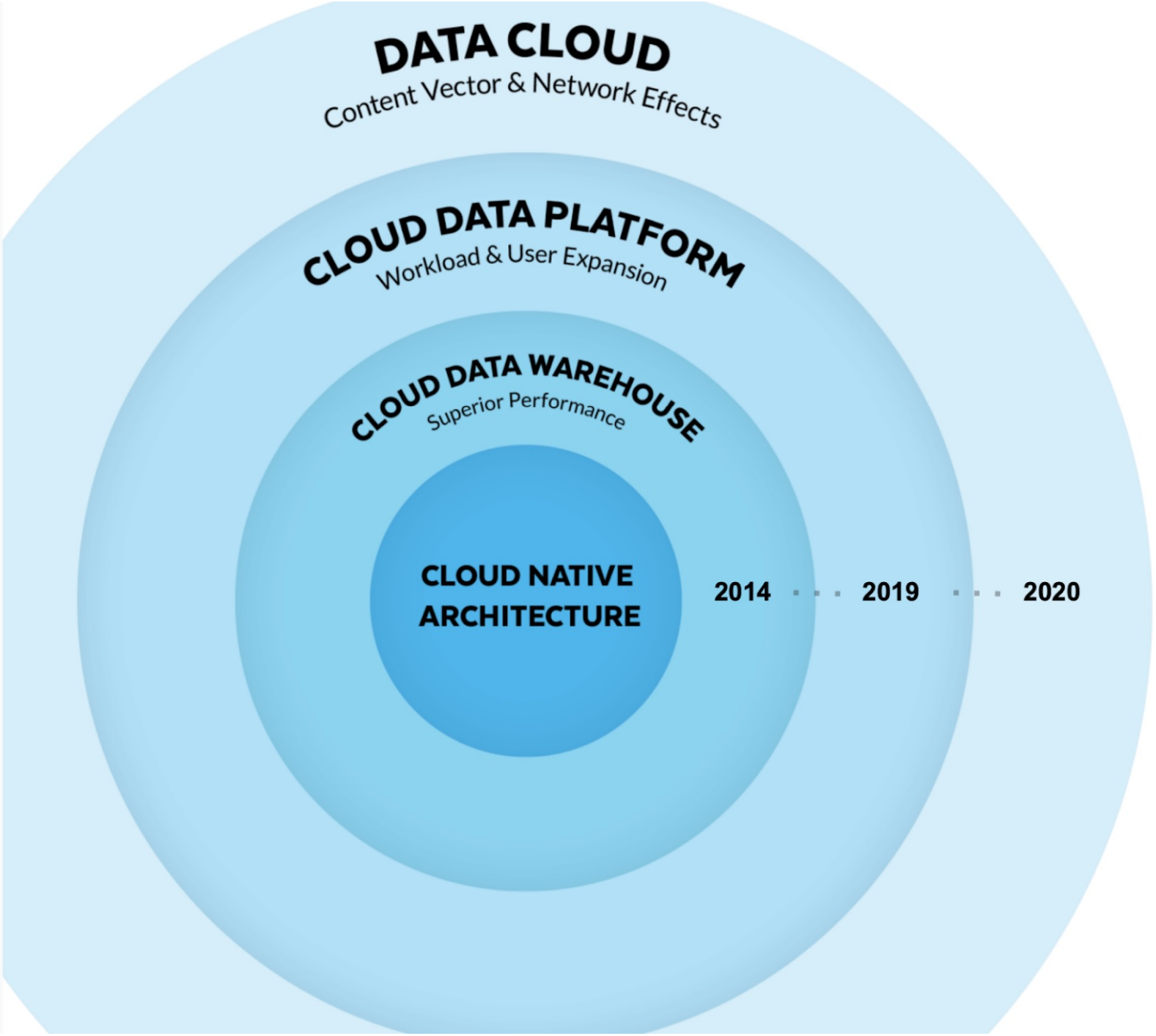
4,000+ active customers, "The Cloud Data Platform" launched and IPO

500m jobs per day

250+ PB total storage, biggest table 68TN rows

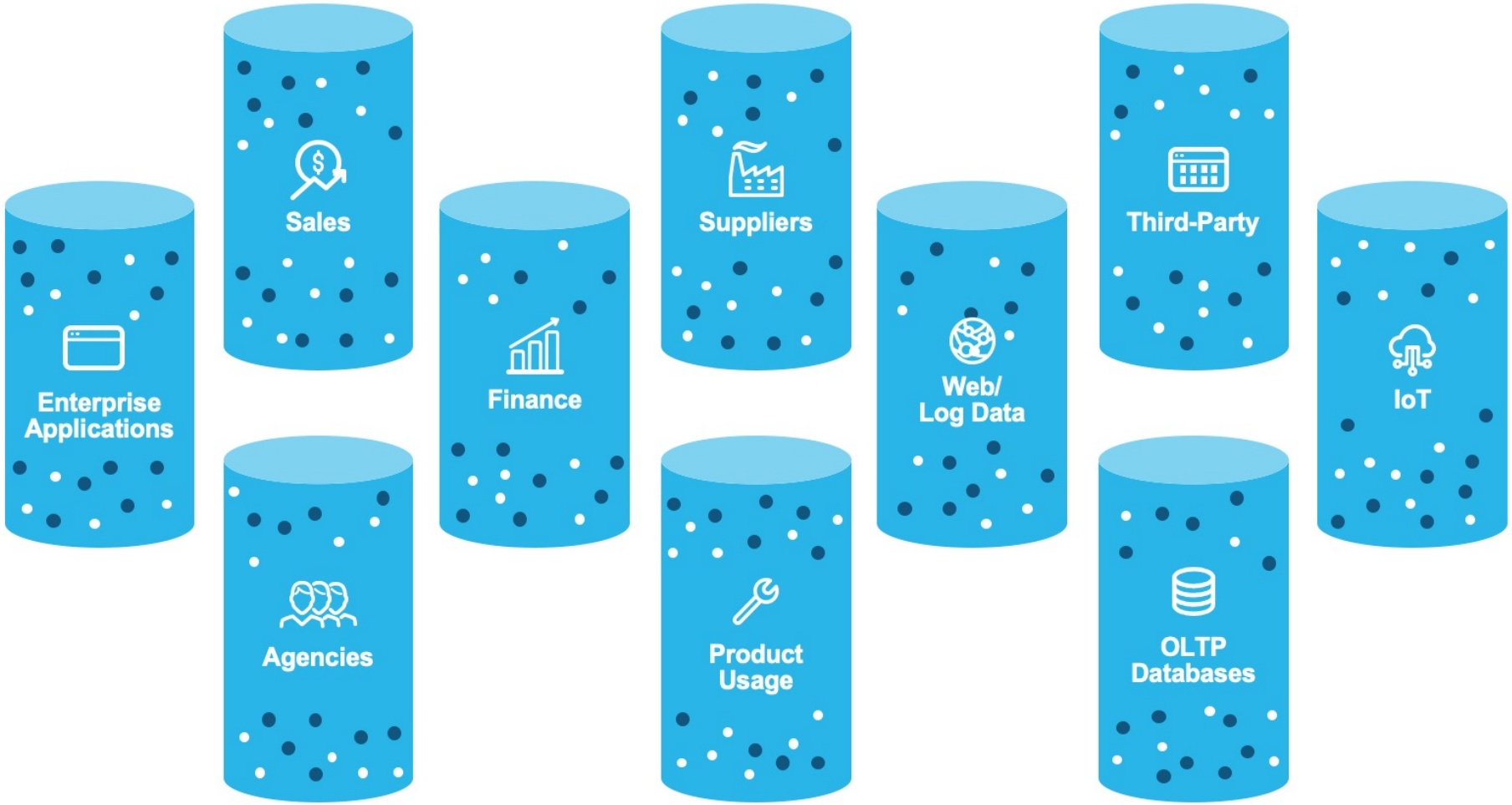
1.2k data providers

NPS - 71, industry average 21




# RISE OF THE DATA CLOUD

# DATA SILOS PREVENT VALUE REALIZATION

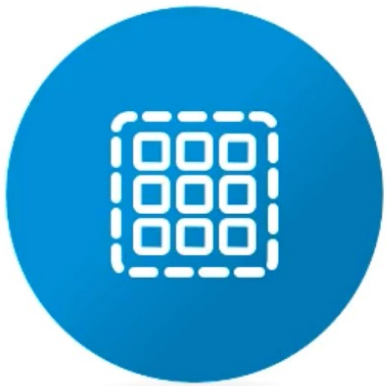



**87%**

Decision makers want to expand their ability to use external data[1]

[1] "The Insights Professional's Guide To External Data Sourcing" Forrester, 2020

# REQUIREMENTS OF A CLOUD DATA PLATFORM



One Platform
One Copy of Data,
Many Workloads

Secure &
Governed Access
to All Data

Near-zero
Maintenance,
as a Service

Unlimited
Performance
and Scale

# WHAT IS THE DATA CLOUD?


**The Data Cloud = Platform plus Data**

## THE SOLUTION:

The Data Cloud is a global network where thousands of organizations mobilize data with near-unlimited scale, concurrency, and performance.

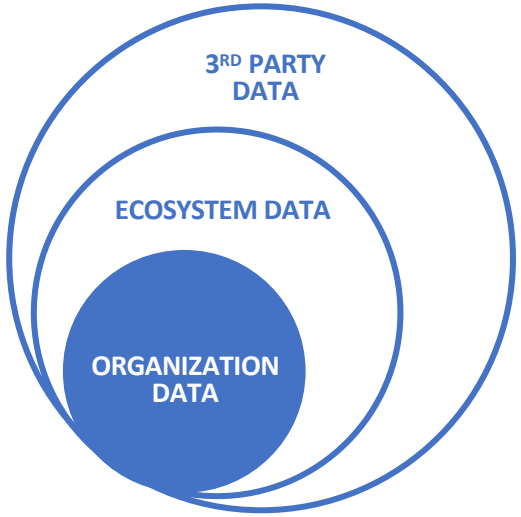
Snowflake's platform is the engine that powers and provides access to the Data Cloud.

## CORE BENEFITS:

**Access | Governance | Action**

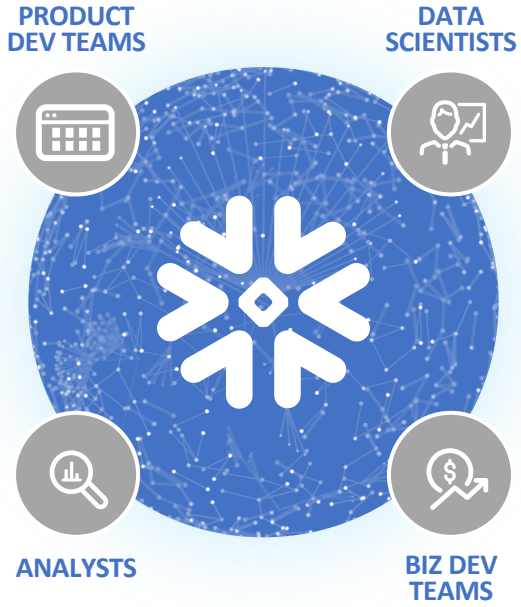
# BENEFITS OF THE DATA CLOUD

## ACCESS




## GOVERNANCE


## ACTION



# ACCESS

- Any Format
- Near-Unlimited Scale
- Sharing Without Copying or Moving

All of Your Organization's Data, on One Platform

Your Ecosystem - Partners, Suppliers, Customers

Snowflake Data Marketplace - Industry Datasets, Data Services, Applications

# GOVERNANCE

## Know Your Data

Understand and classify data across your entire ecosystem

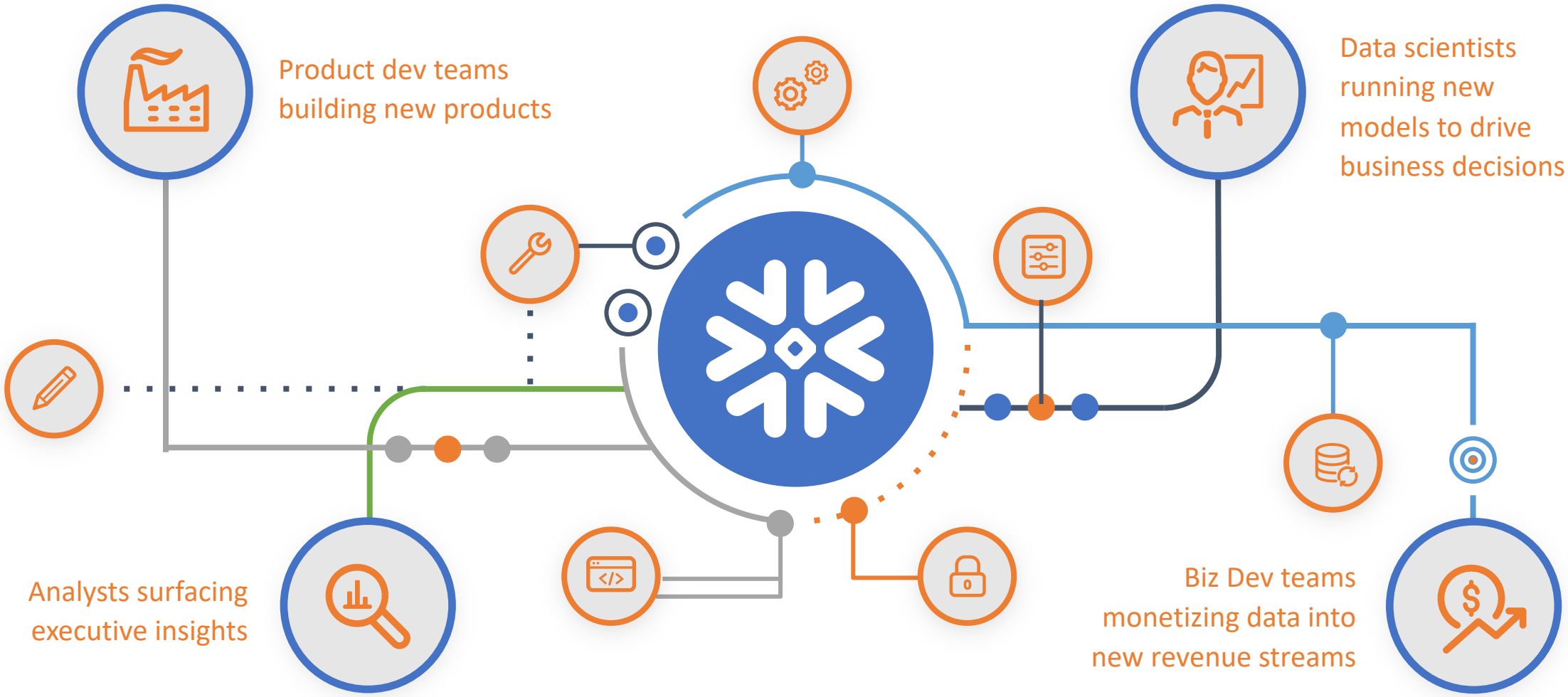
## Unify Security & Governance

Simplify governance across workloads with centralized controls

## Control your Data

Implement flexible governance and security policies, that don't hinder innovation

# ACTION



# SNOWFLAKE PLATFORM

Under the hood


**DATA SOURCES**

OLTP DATABASES

ENTERPRISE APPLICATIONS

THIRD-PARTY

WEB/LOG DATA

IoT

**DATA CONSUMERS**

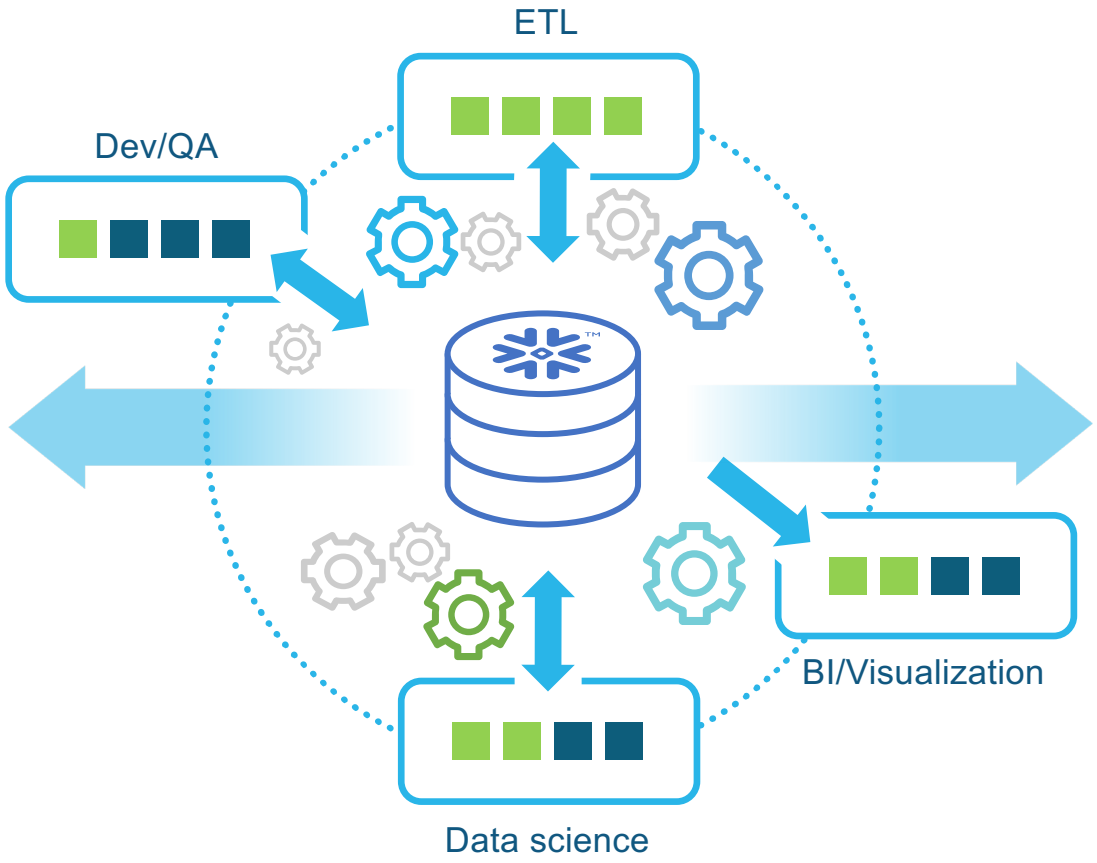
DATA MONETIZATION

OPERATIONAL REPORTING

AD HOC ANALYSIS

REAL-TIME ANALYTICS

# ELASTIC PERFORMANCE ENGINE




## One engine for every workload

Simplify your architecture. Power complex pipelines, analytics, data science, interactive applications, and more.

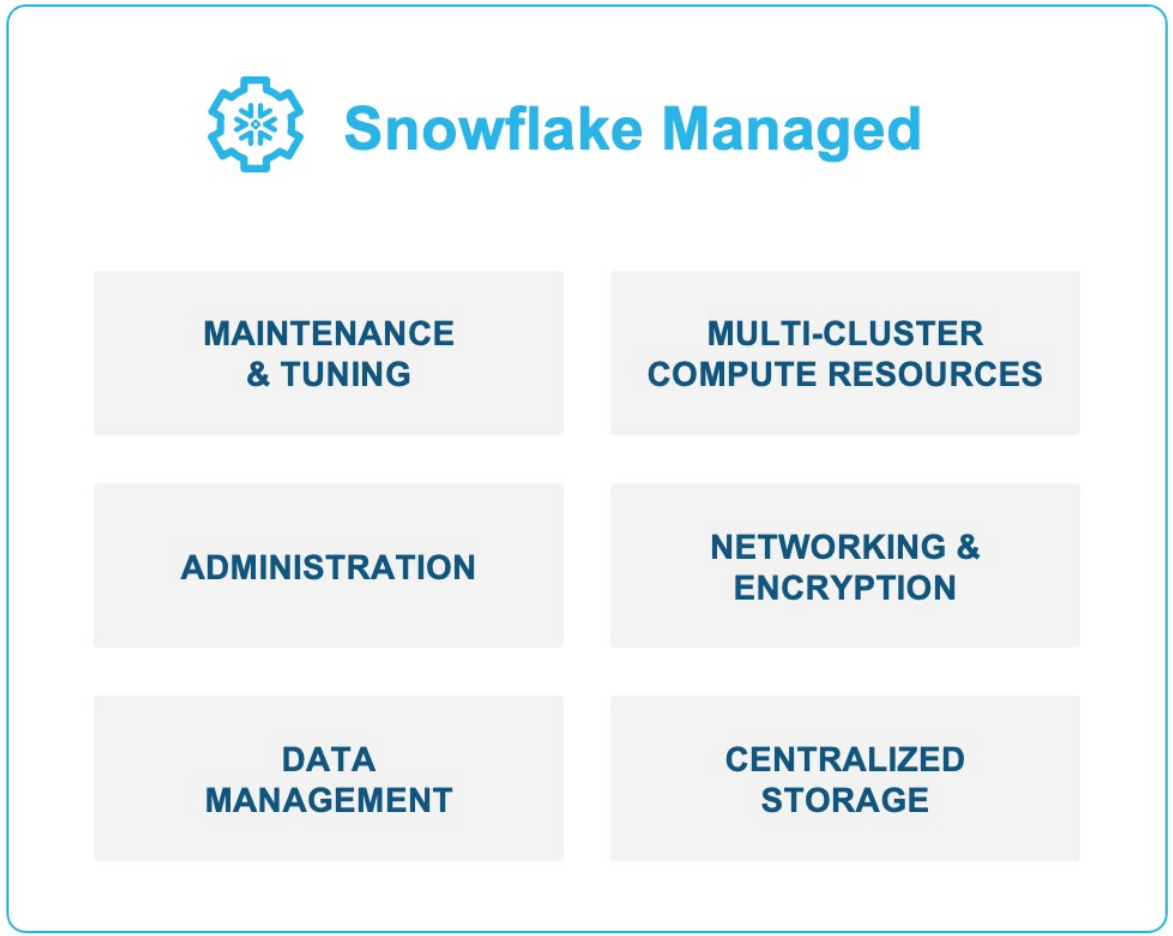
## Leading performance and concurrency

Fast, reliable performance every time with no tuning or contention. Instantly and cost-efficiently scale to any amount of users, jobs, or data.

## Support any user or skillset

Get the accessibility of SQL, with the flexibility to support Java, Scala, and more. Run external tools directly for extended capabilities.

# INTELLIGENT INFRASTRUCTURE




## Automated and fully managed for you

Focus on what matters. Fully managed with automations that encrypt data, control access, and eliminate manual maintenance and troubleshooting.

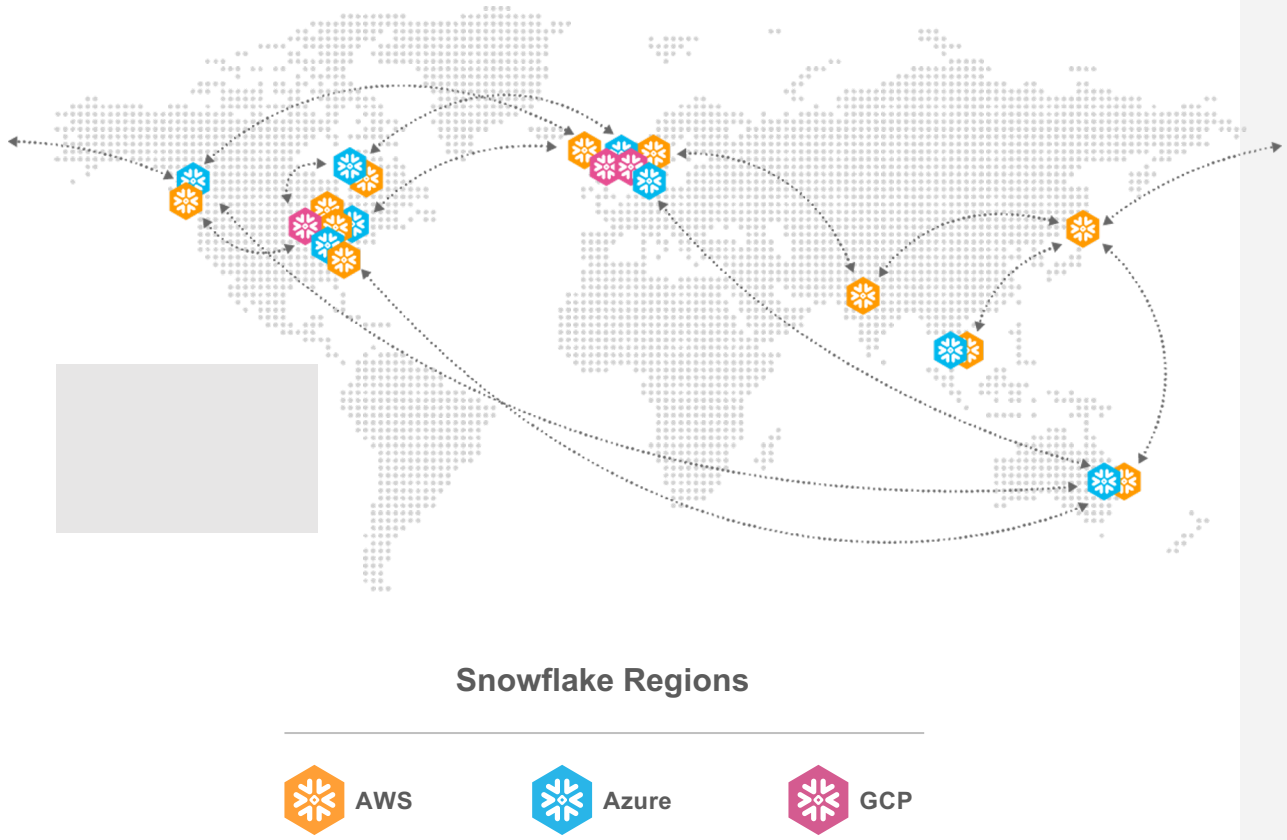
## High availability, high reliability

Automate complex replication and failover cross-clouds and cross-regions. Stay up-and-running no matter what happens.

## Optimized costs for all data

Usage-based model paired with patented compression and fine-grained controls to right-size costs. Continual improvements for new efficiencies.

# SNOWGRID




### Maintain global business continuity

Eliminate disruptions, deliver better experiences, and comply with changing regulations through unique cross-cloud, cross-region connectivity.

### Share data with no ETL or silos

Remove the barriers to data, regardless of cloud, region, workload, or organizational domains. Get instant access and distribution through a single copy of data.

### Cross-cloud governance controls

Simplify governance at scale with flexible policies that follow the data for consistent enforcement across users and workloads.

### Tap into the extended ecosystem

Enrich insights with a network of third-party data. Discover and run new functions for extended workflows.

# SNOWGRID UNLOCKS DATA SHARING

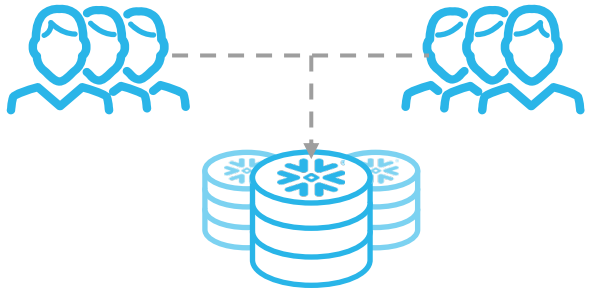
## Traditional Methods

**FTP | APIs | ETL | Cloud buckets**

- ✗ Copy and move data
- ✗ Data is delayed (Not real time)
- ✗ Costly to manage and maintain
- ✗ Unsecure, once data is moved
- ✗ Error prone; pipelines break

## Snowflake

**Secure Data Sharing**



- ✓ Single copy of live data, no delays
- ✓ No costs of moving, copying, ingestion
- ✓ No more data lake silos
- ✓ Privacy compliant
- ✓ Governed, revocable access

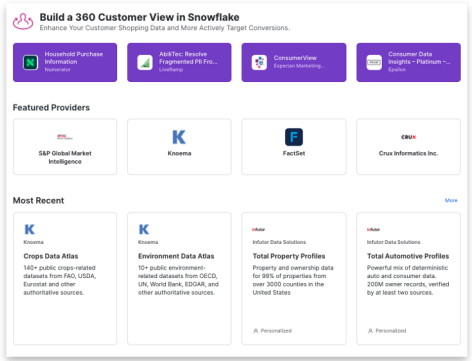
# SHARE AND COLLABORATE IN THE DATA CLOUD

## DISCOVER AND BE DISCOVERED IN THE DATA CLOUD

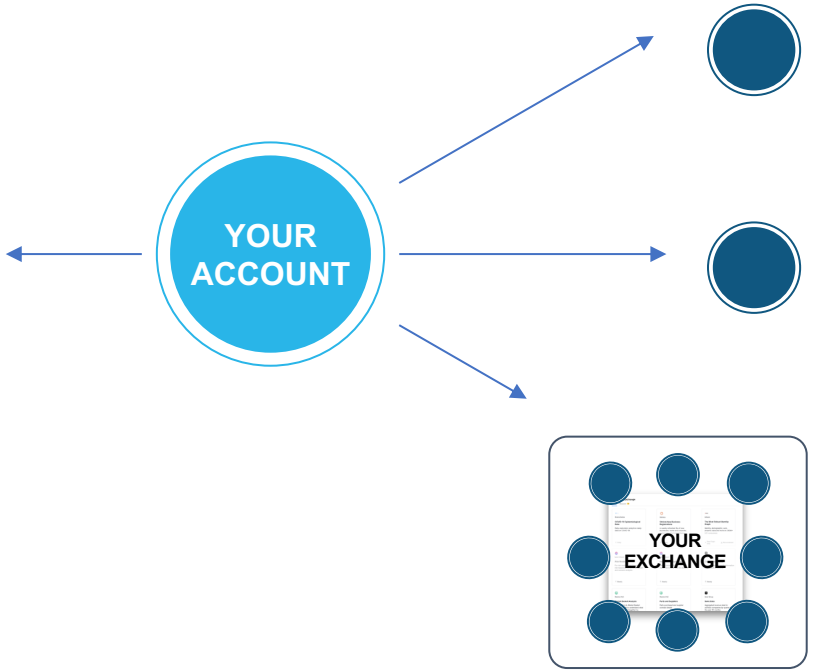
Access data and services from 150+ providers

**SNOWFLAKE DATA MARKETPLACE**

Market and deliver your products to customers




## SHARE ACROSS YOUR BUSINESS ECOSYSTEM




### DIRECT SHARE

Share with other Snowflake customers

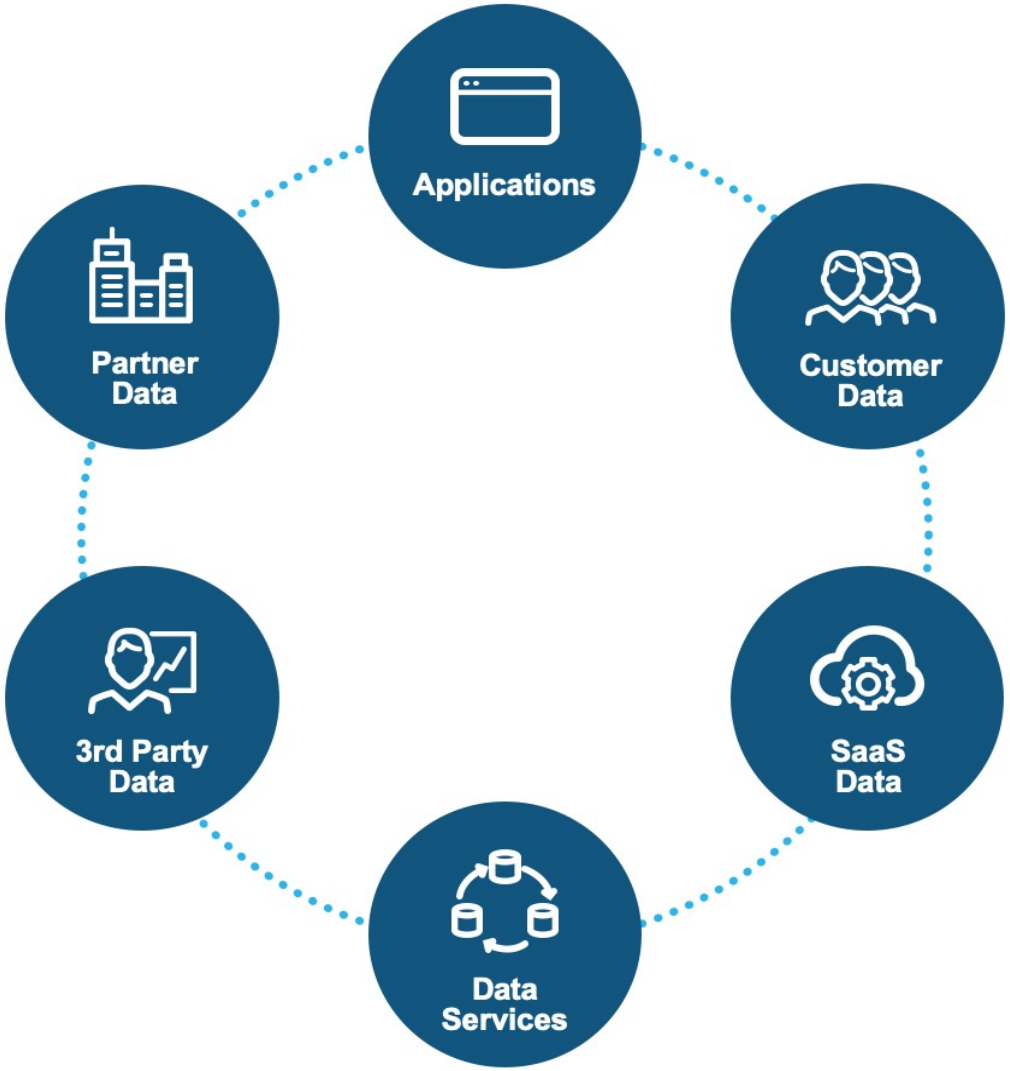
### READER ACCOUNTS

Share with companies not yet on Snowflake

### DATA EXCHANGE

Administer group sharing and data discovery across business units

# CONNECT TO THE MOST RELEVANT CONTENT




## SNOWFLAKE DATA MARKETPLACE

Discover and be discovered with data and services from 150+ providers across 16+ categories.

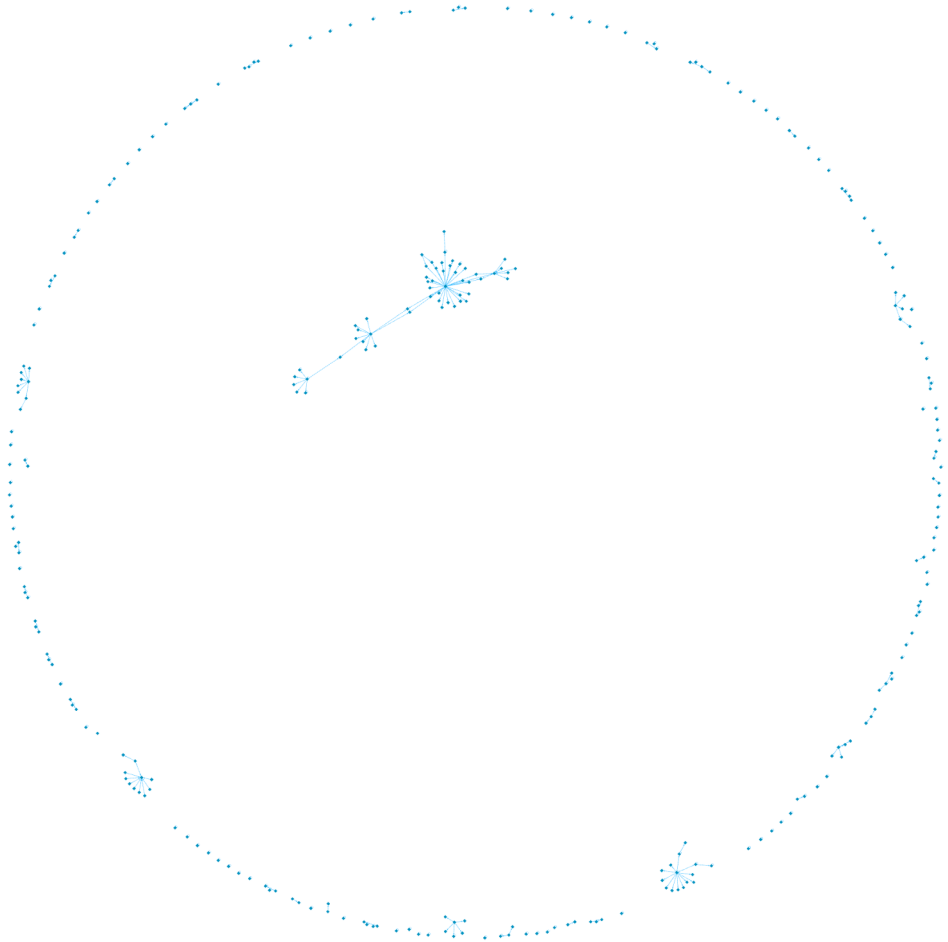
## SNOWFLAKE CUSTOMERS

Thousands of companies share data with suppliers, partners, or other business units.

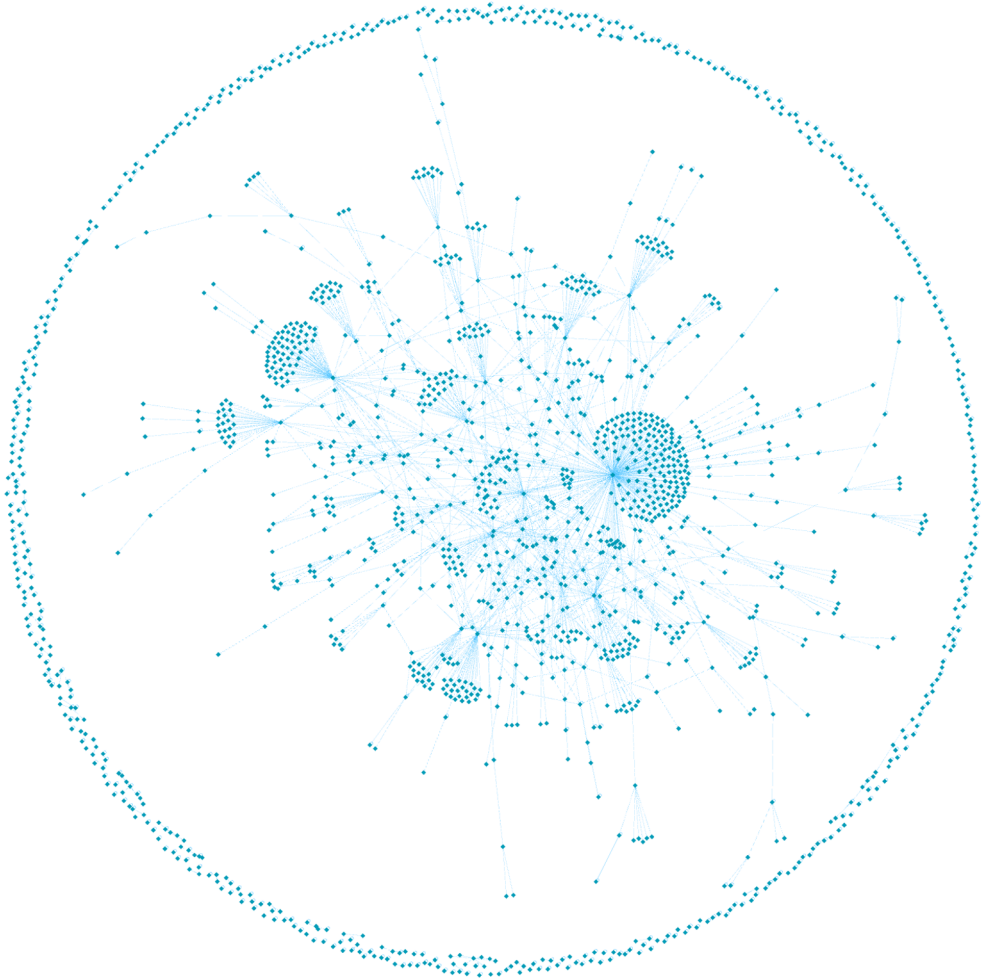
## POWERED BY SNOWFLAKE APPLICATIONS

Hundreds of applications that businesses rely on run in the Data Cloud.

# DATA CLOUD GROWTH



April 2020



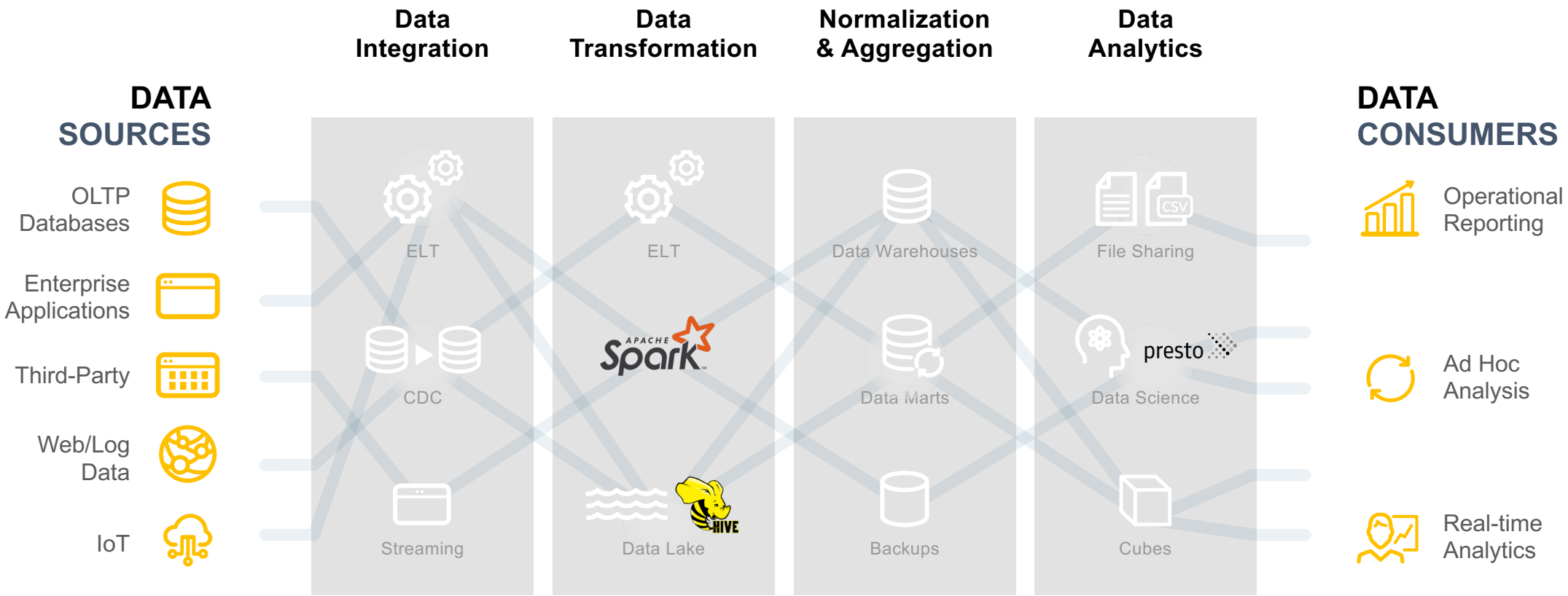
April 2021



*Visualizations based on actual Data Cloud sharing activity as of April 30, 2020 and April 30, 2021

# TRADITIONAL DATA ARCHITECTURE

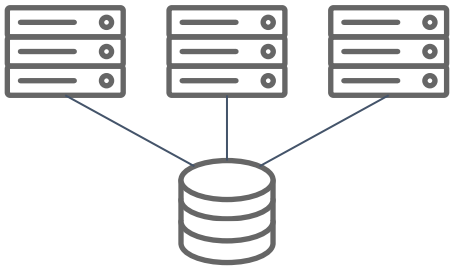
Complex, Costly, and Constrained



# ARCHITECTURE REVIEW

# NEXT EVOLUTION OF DATA WAREHOUSE ARCHITECTURE
# COMPUTE & STORAGE SEPARATED

## Traditional architectures

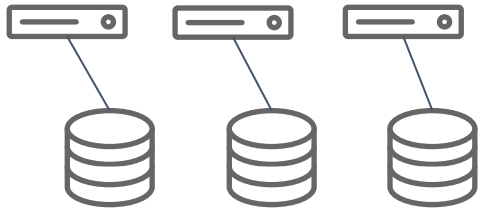


"Shared-disk"

Shared storage

Single Server

SMP



"Shared-nothing"

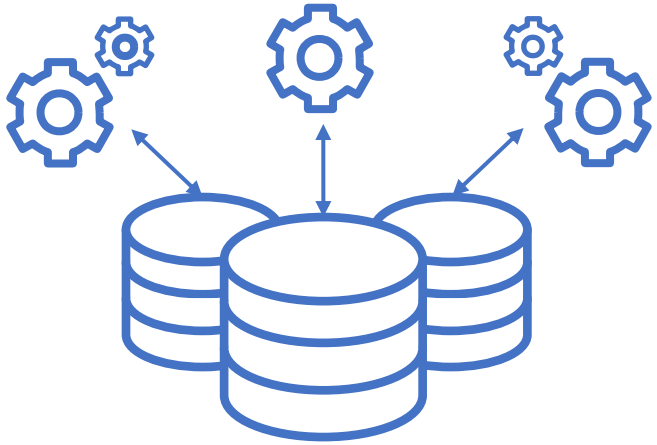
Decentralized, local storage

Single cluster

MPP APPLIANCE

Teradata, Netezza, Vertica, GreenPlum, Redshift (ParAccel)

## Data Cloud



MCSD

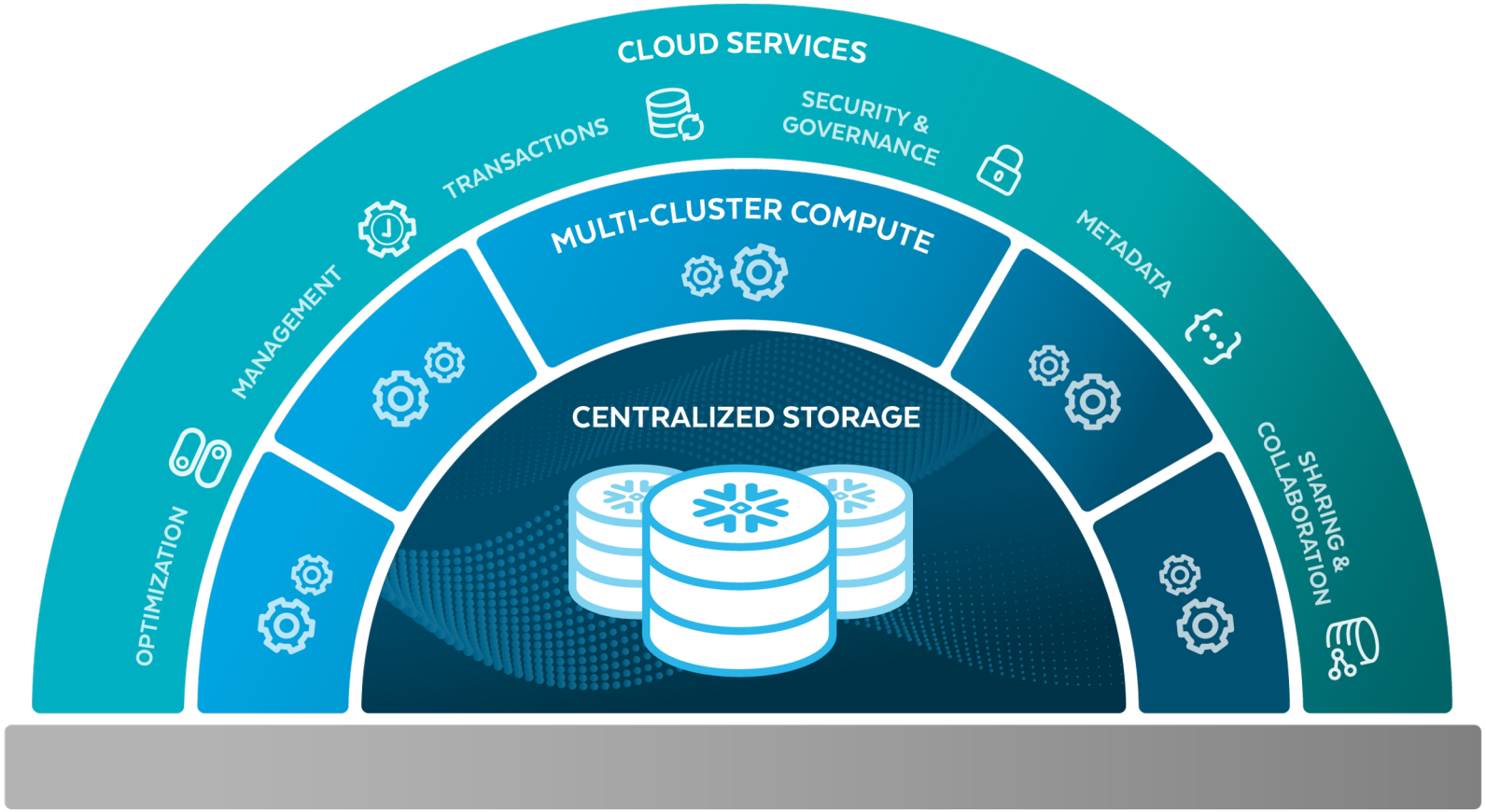
"Multi-cluster, shared data"

Centralized, elastic storage

Multiple MPP, independent compute clusters

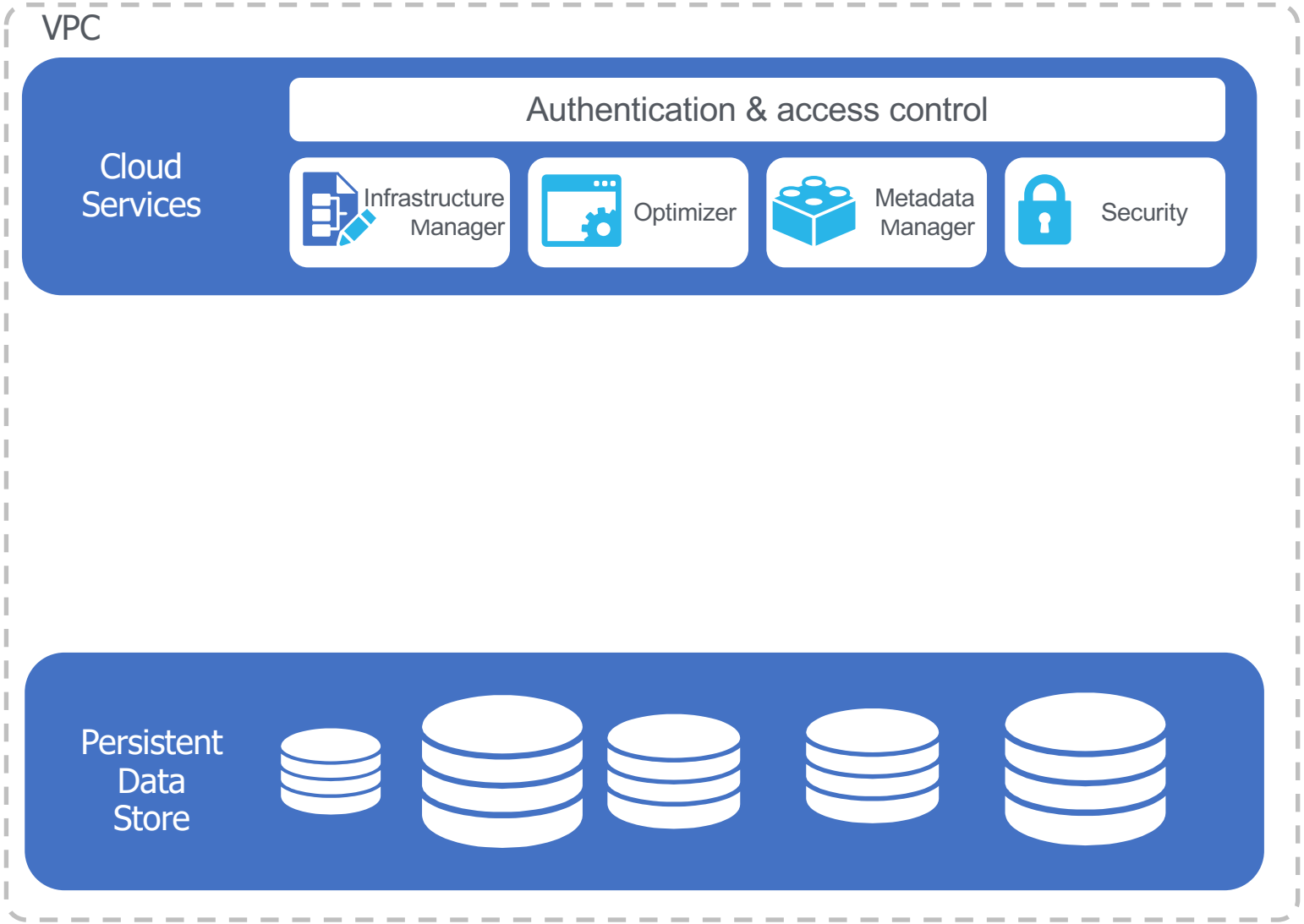
UNLIMITED Storage and Compute

# SNOWFLAKE ARCHITECTURE




Google Cloud aws Azure

# SNOWFLAKE ARCHITECTURE




## Cloud Services + Serverless

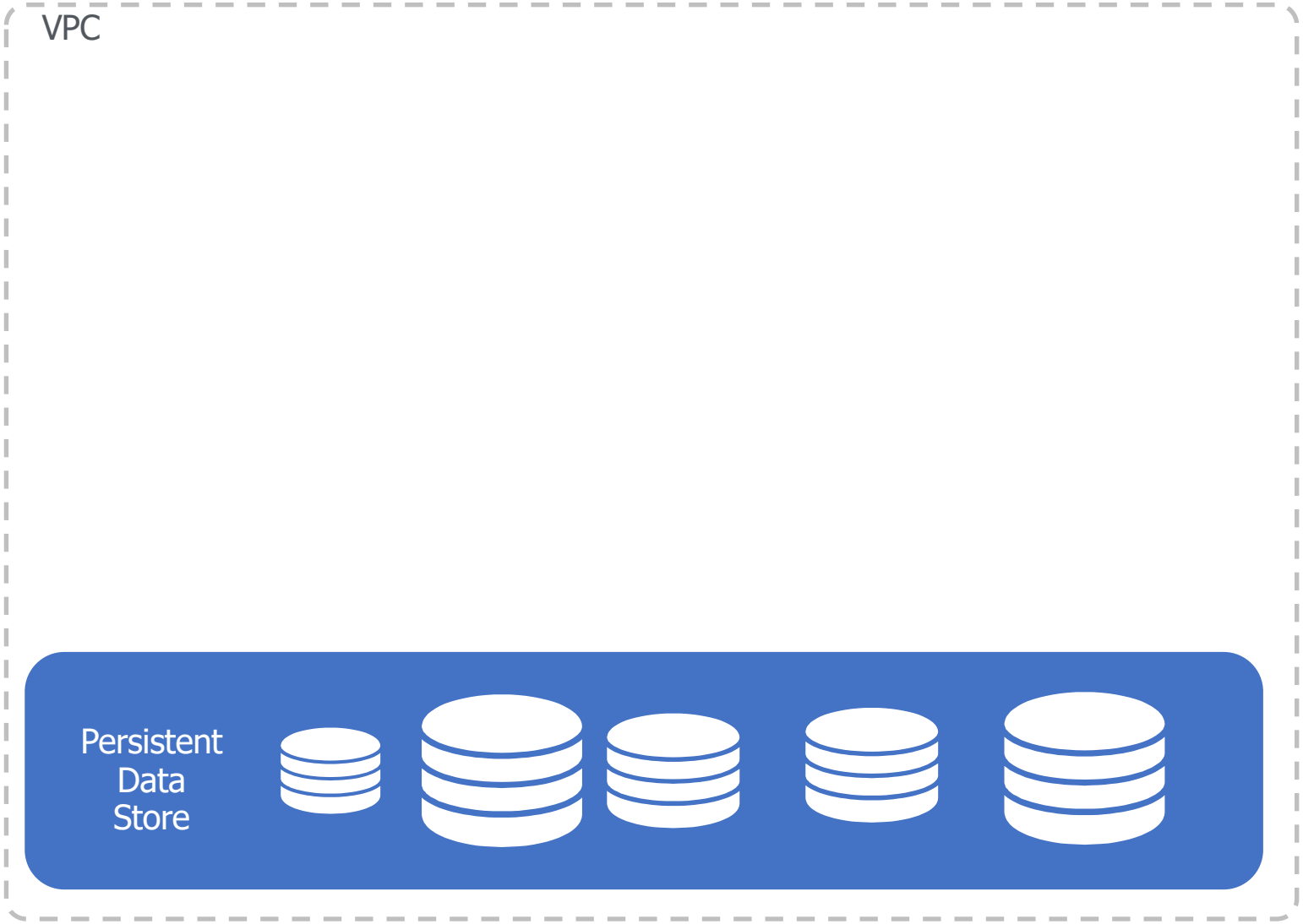
**Compute not running on a Virtual Warehouse**

- SHOW commands
- Query result cache

**Serverless**

- Search optimization service
- Snowpipe
- Auto-clustering
- Materialized view maintenance
- Cross-cloud replication

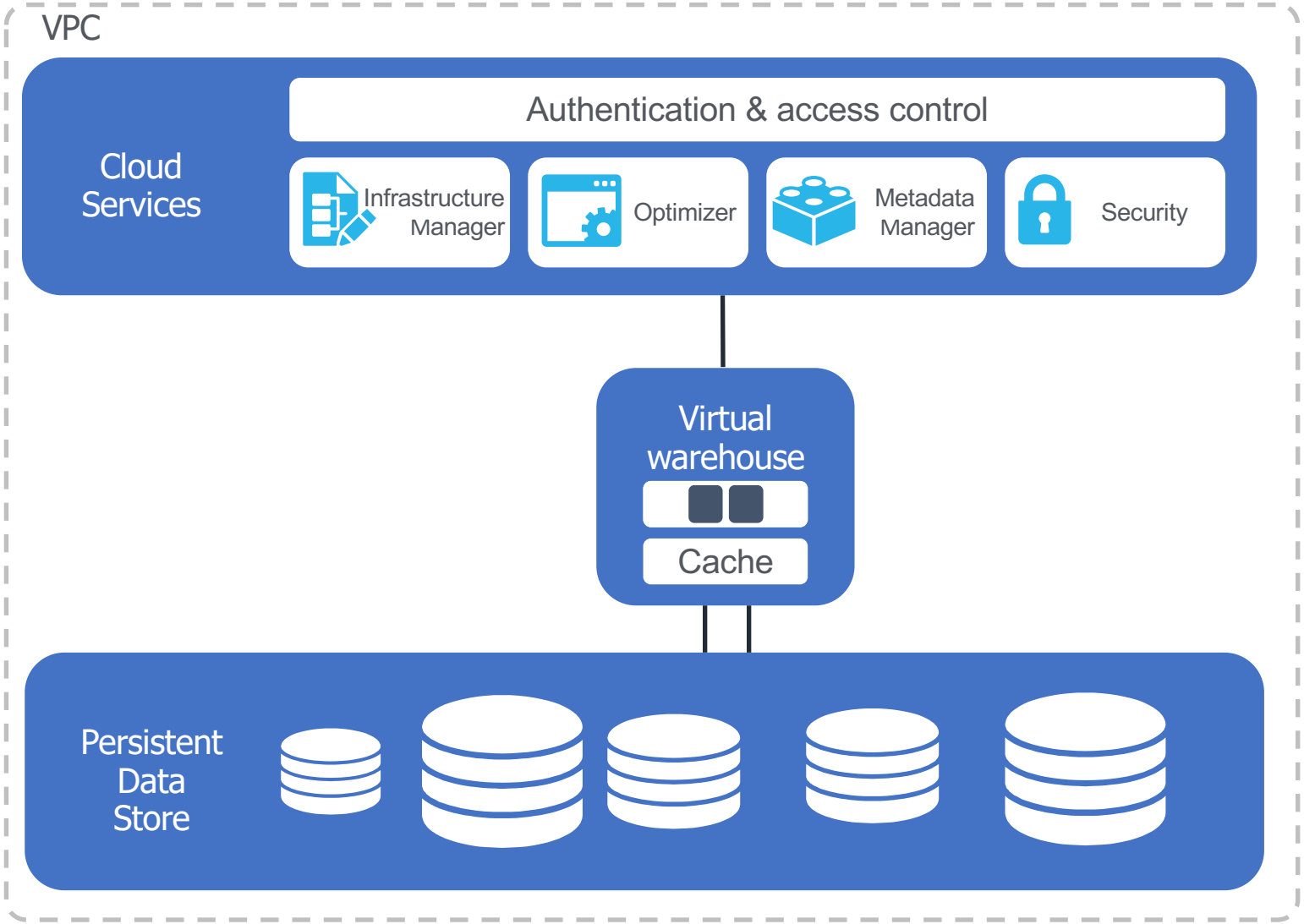
# SNOWFLAKE ARCHITECTURE




## Centralized Storage

- Pass through pricing
- Up to 5x compression
- Native support or semi-structured data
- Zero-copy cloning
- Time Travel

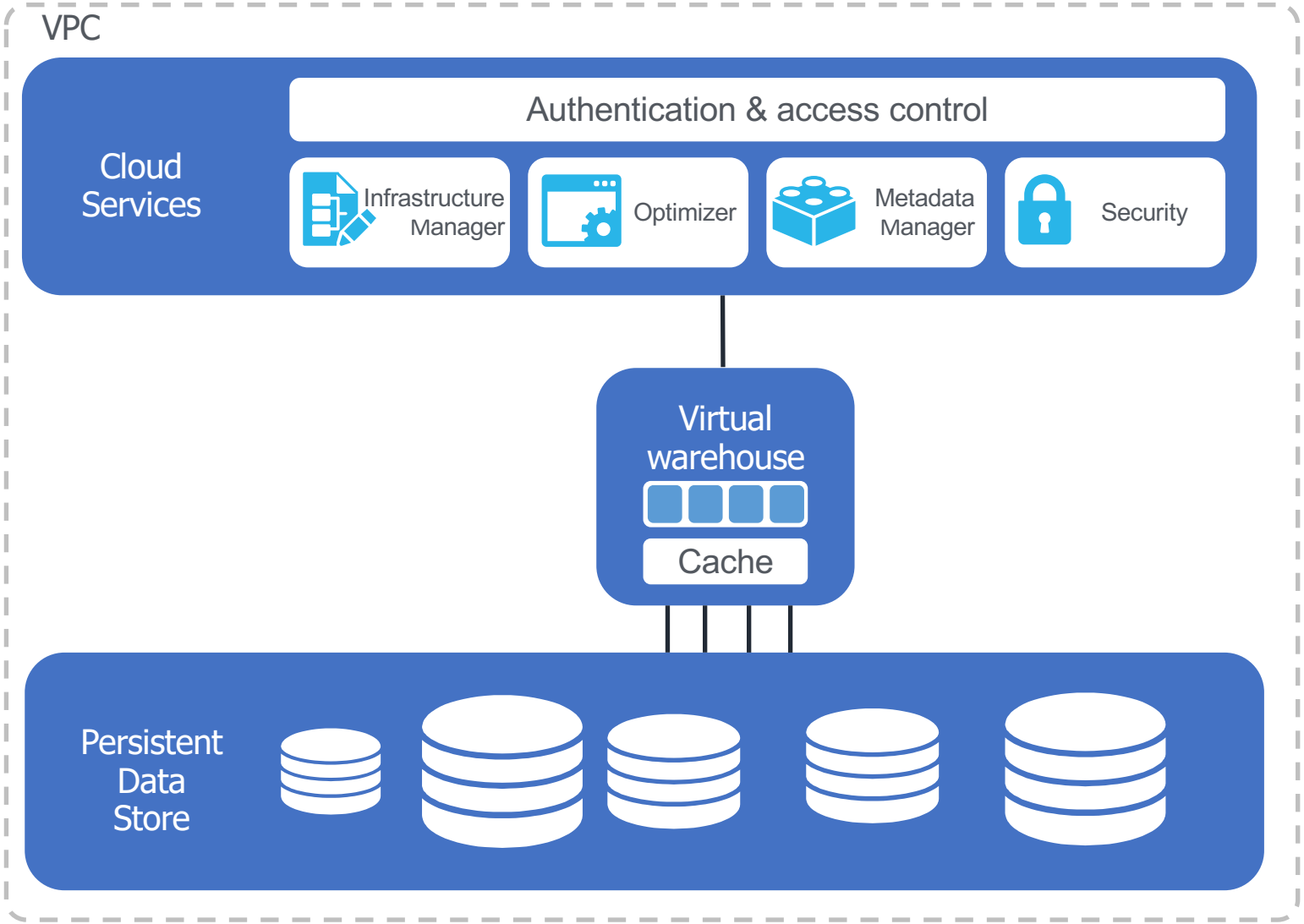
# SNOWFLAKE ARCHITECTURE




## Independently Scalable Compute

- Elastic (turn on instantly)

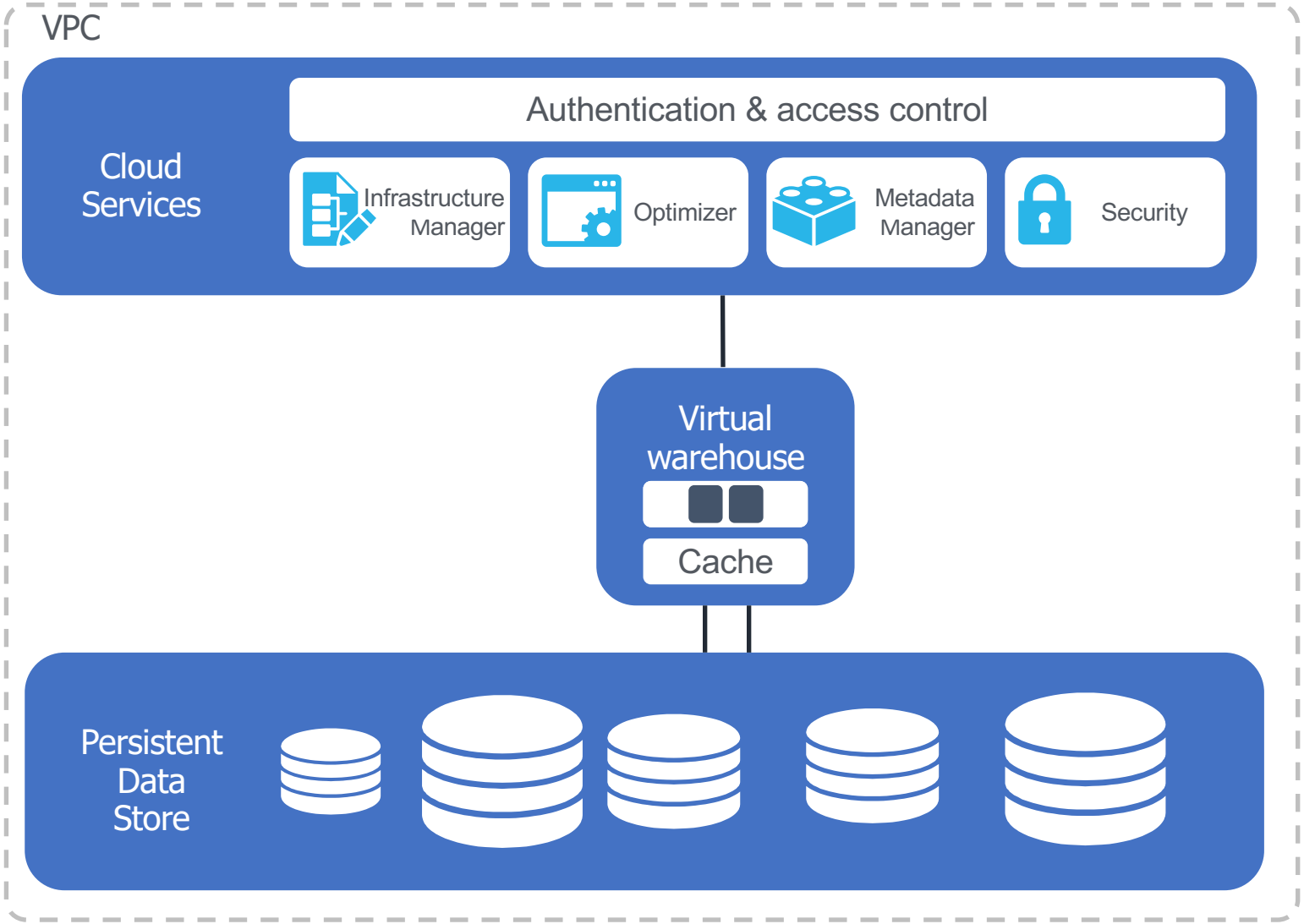
# SNOWFLAKE ARCHITECTURE




## Independently Scalable Compute

- Elastic (turn on instantly)
- Scale up (complex queries)

# SNOWFLAKE ARCHITECTURE

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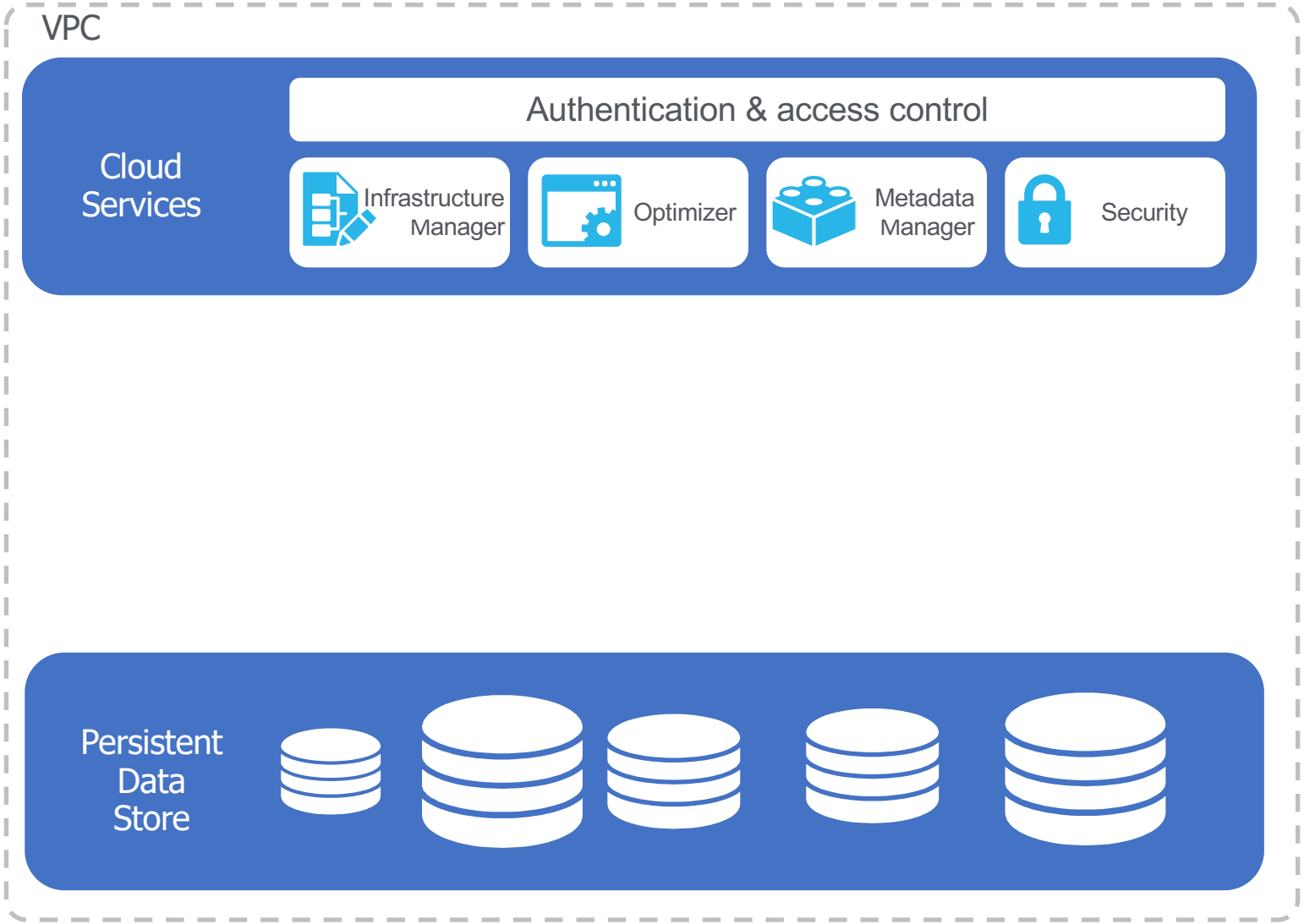
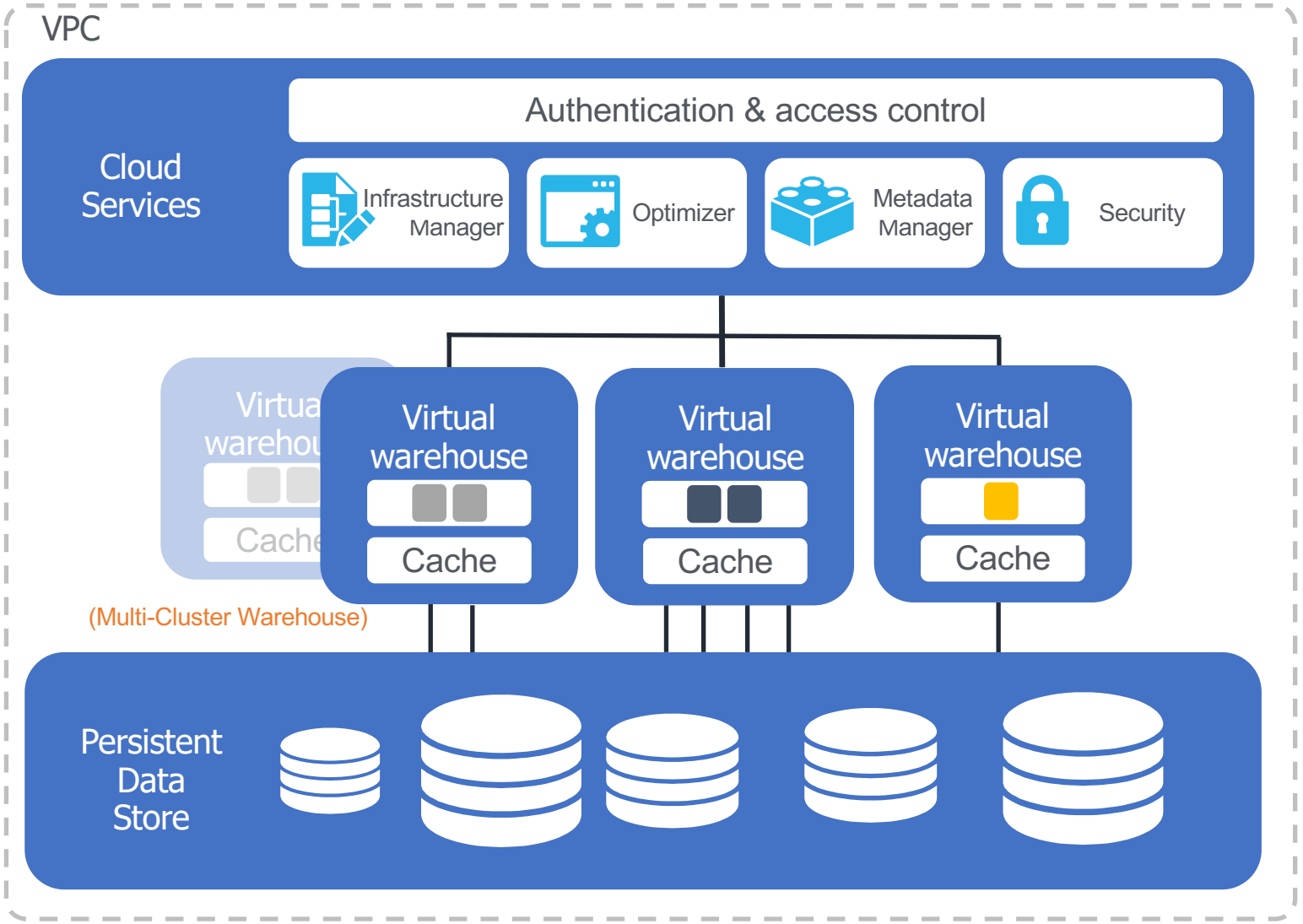



## Independently Scalable Compute

- Elastic (turn on instantly)
- Scale up (complex queries)
- Suspend

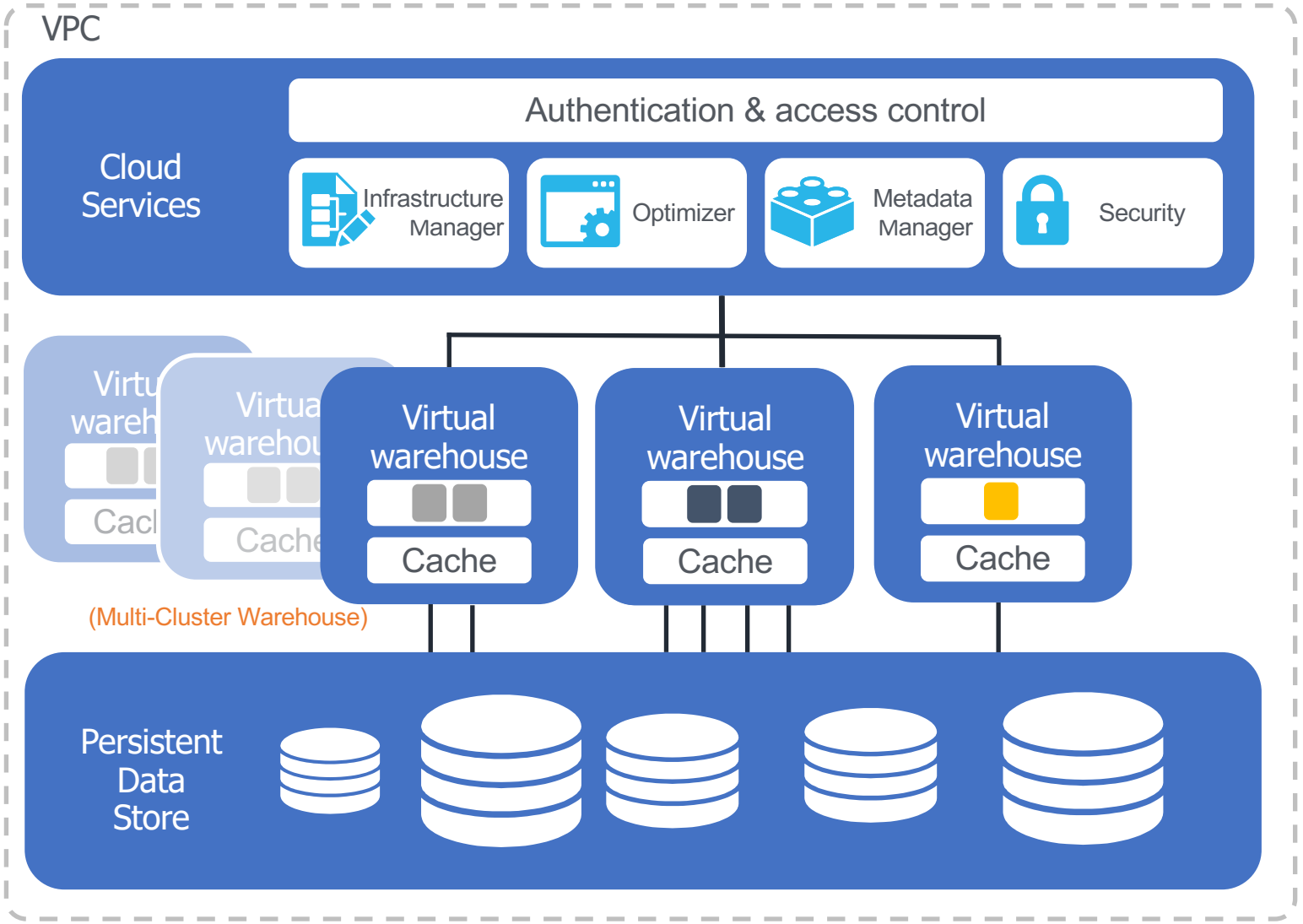
# SNOWFLAKE ARCHITECTURE




## Independently Scalable Compute

- Elastic (turn on instantly)
- Scale up (complex queries)
- Suspend
- Scale out (concurrency)

# SNOWFLAKE ARCHITECTURE




## Independently Scalable Compute

- Elastic (turn on instantly)
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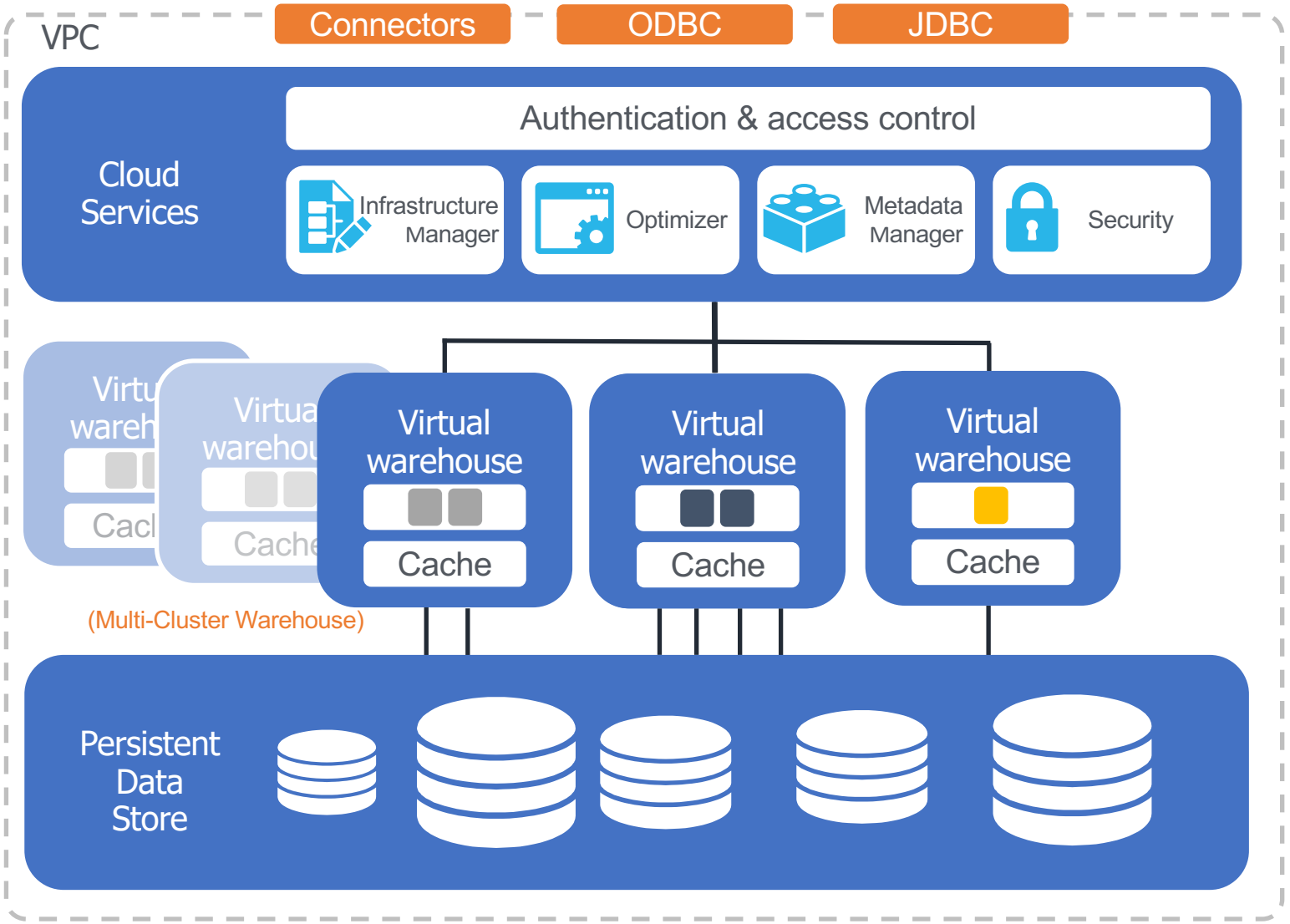


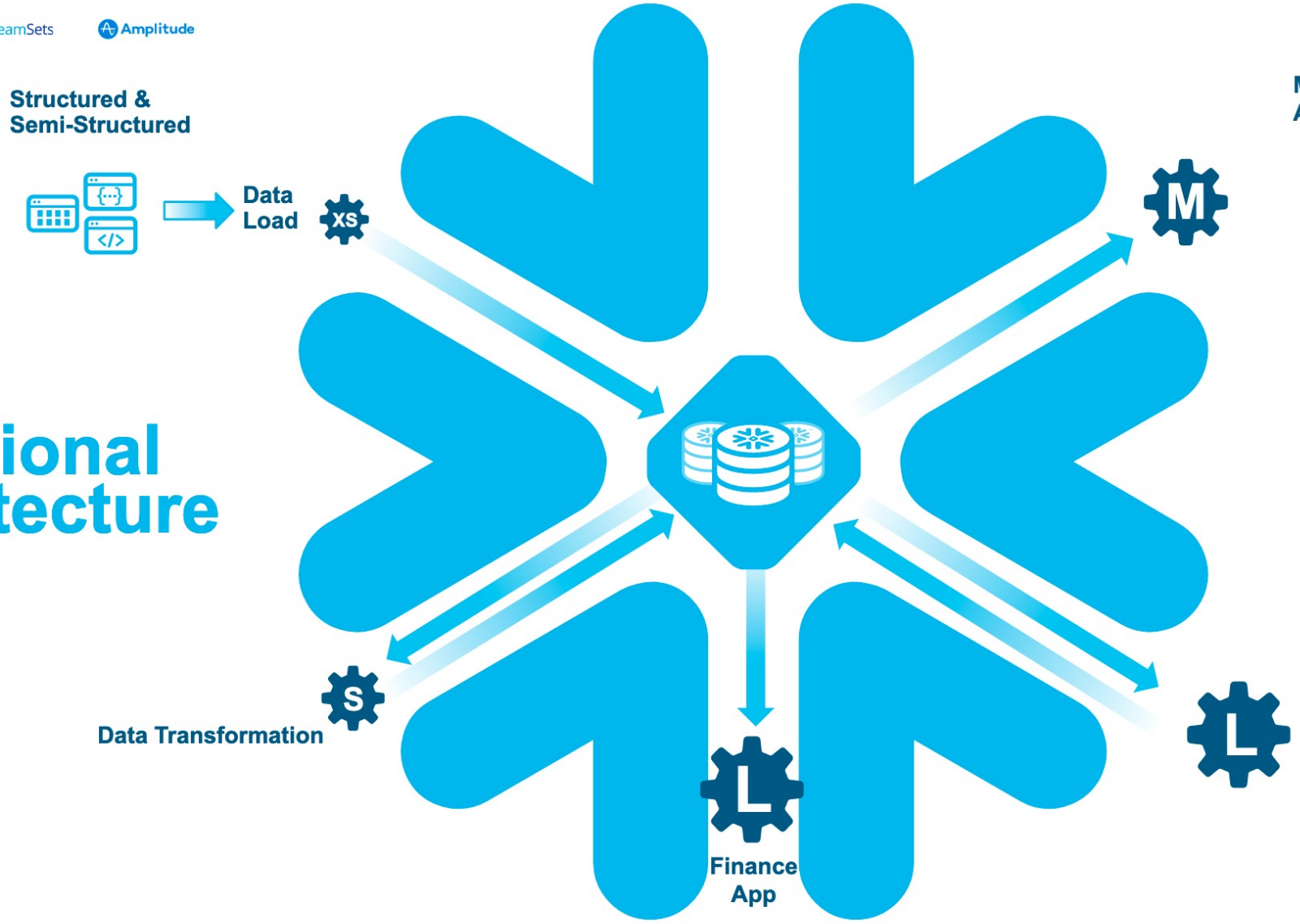

## Independently Scalable Compute

- Elastic (turn on instantly)
- Scale up (complex queries)
- Suspend
- Scale out (concurrency)
- Per second billing

# PAY FOR WHAT YOU ACTUALLY USE… DOWN TO THE SECOND

Informatica · talend · Stitch · Fivetran · MATILLION · ATTUNITY · striim · Segment · StreamSets · Amplitude

## Functional Architecture



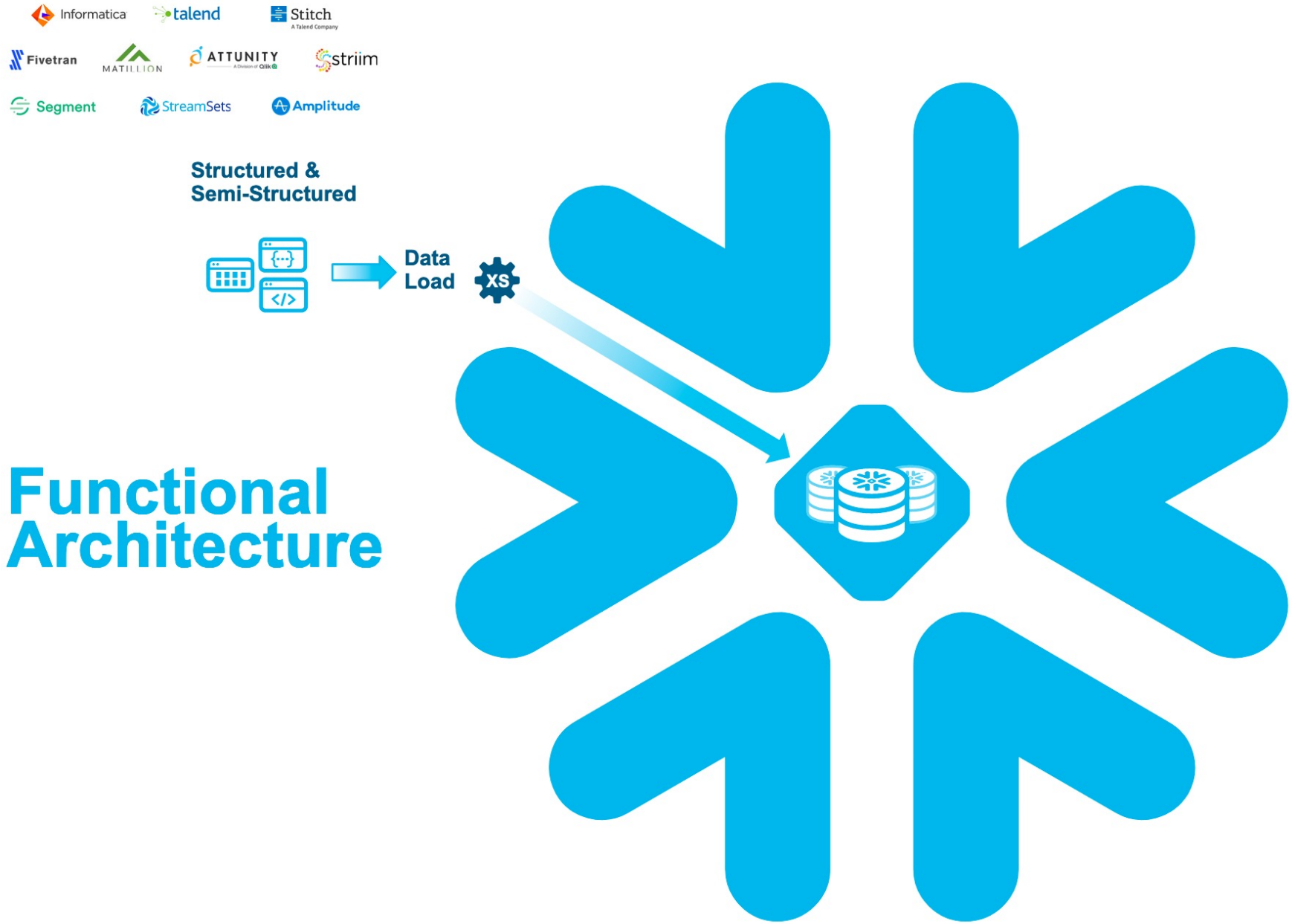

Marketing
Analytics / Reporting / BI

SIGMA · ThoughtSpot · SISENSE · MODE · Power BI · Periscope Data by Sisense · Qlik · looker · tableau

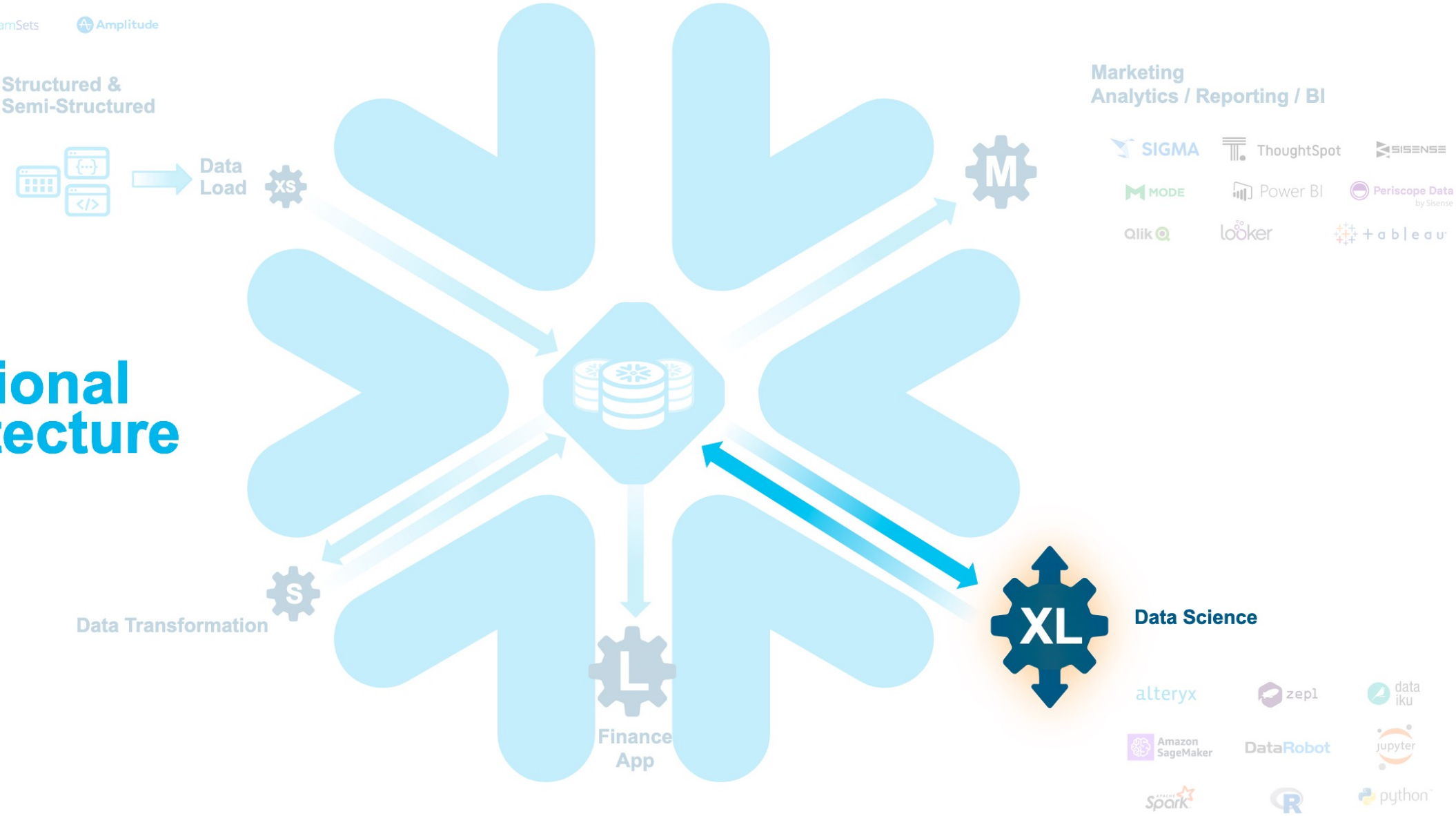
Data Science

alteryx · zepl · data iku · Amazon SageMaker · DataRobot · jupyter · Spark · R · python

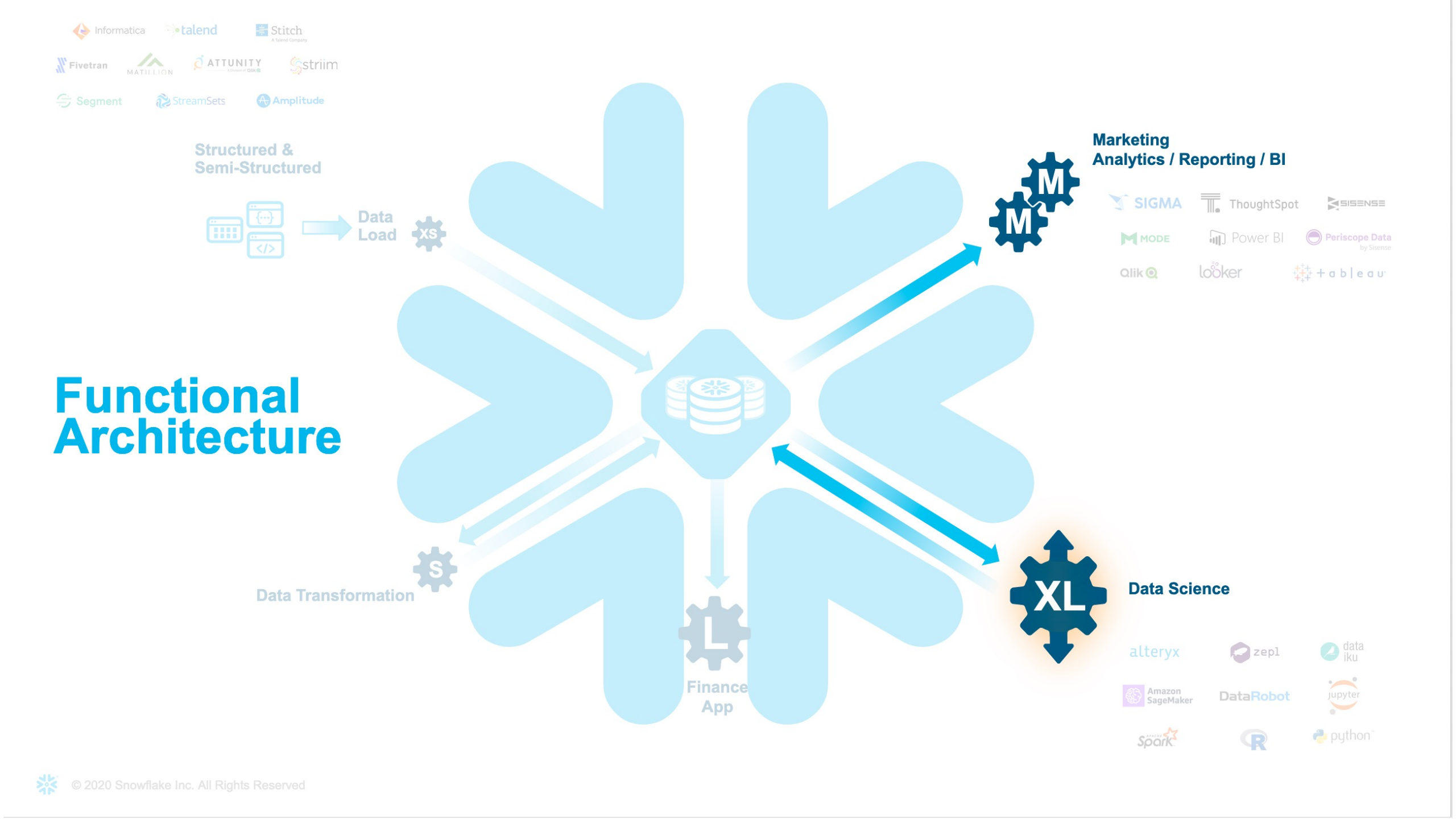
# Functional Architecture



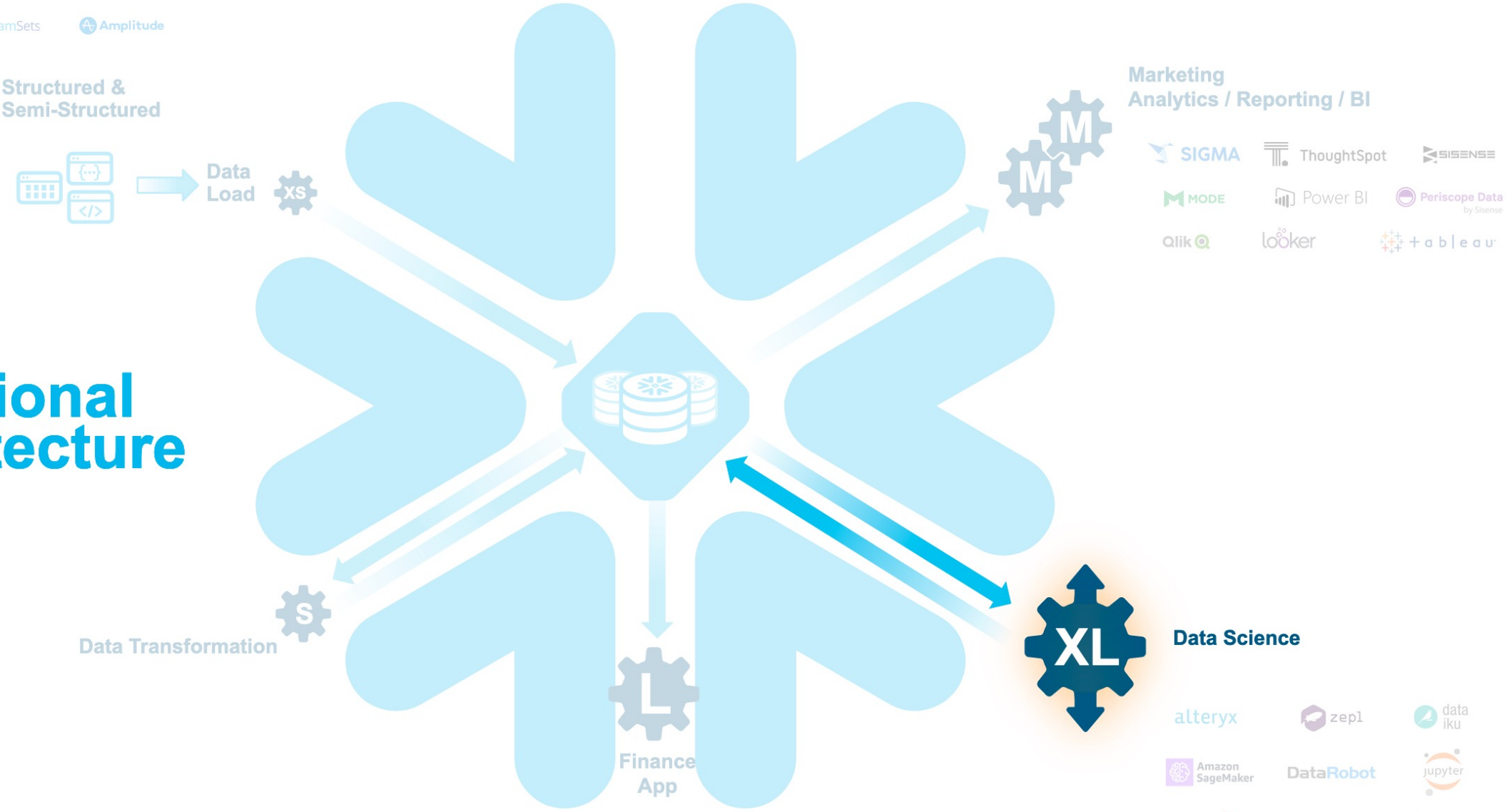
# Functional Architecture



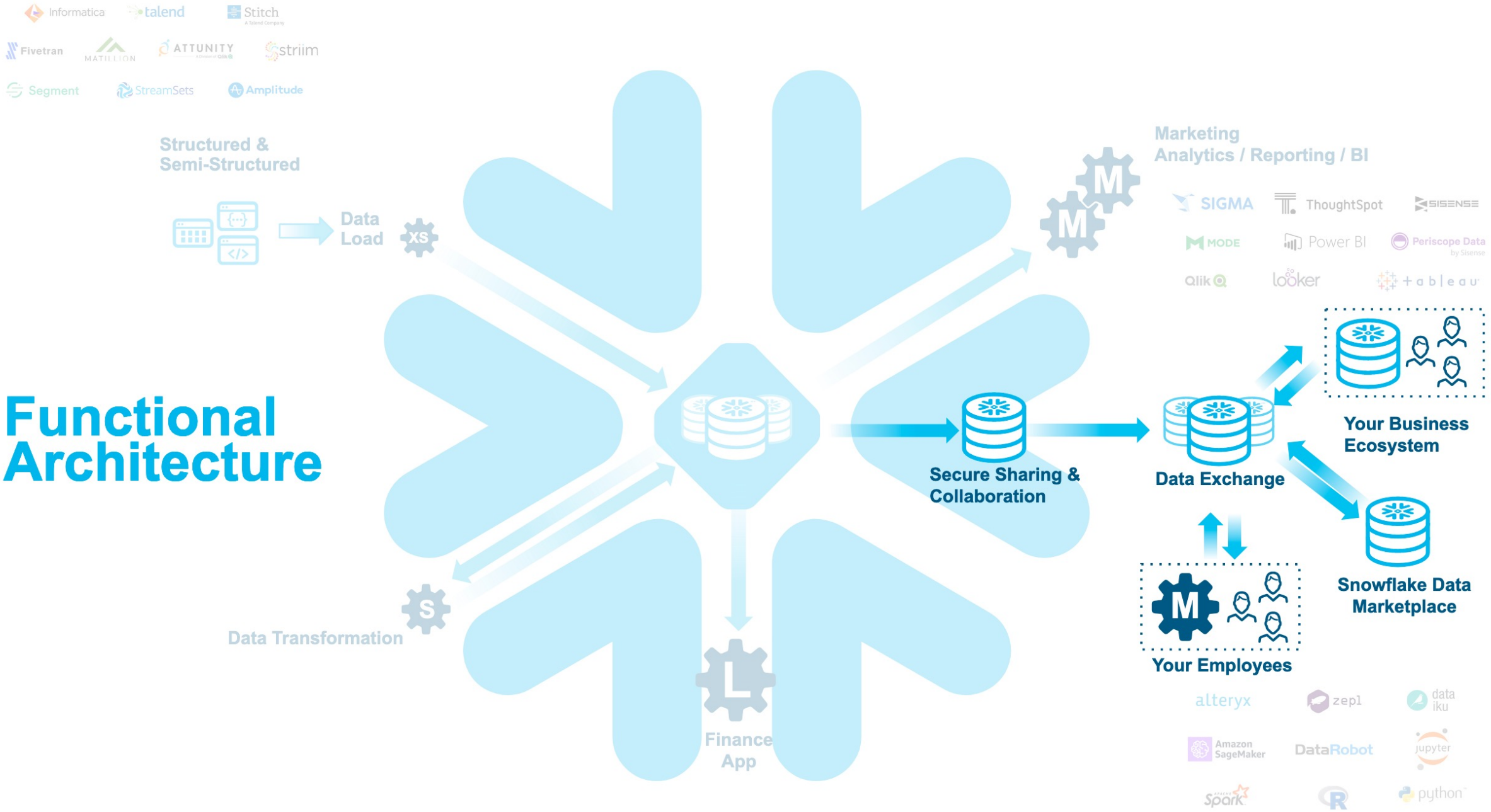
# Functional Architecture



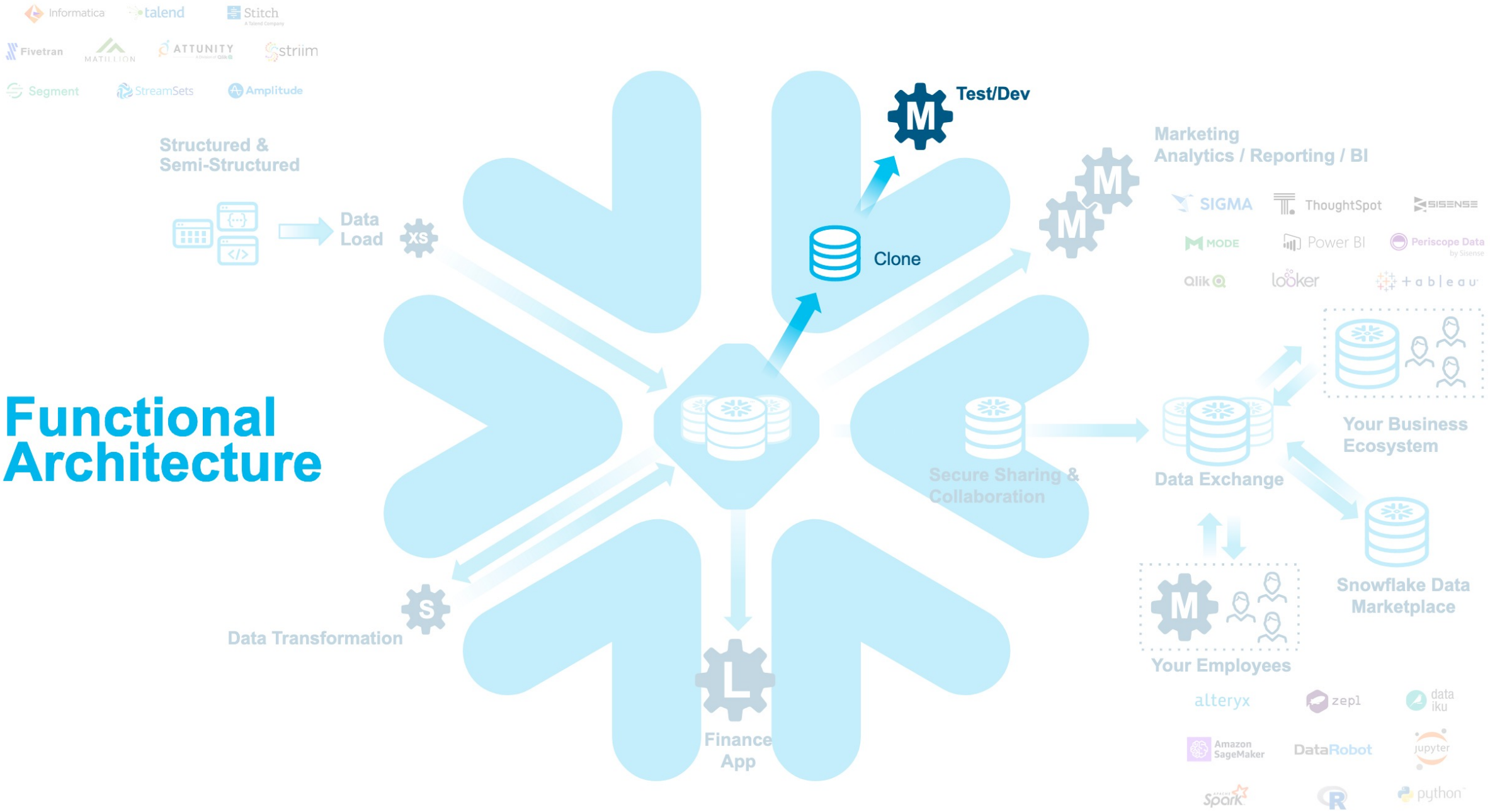
# Functional Architecture



# Functional Architecture



# Functional Architecture

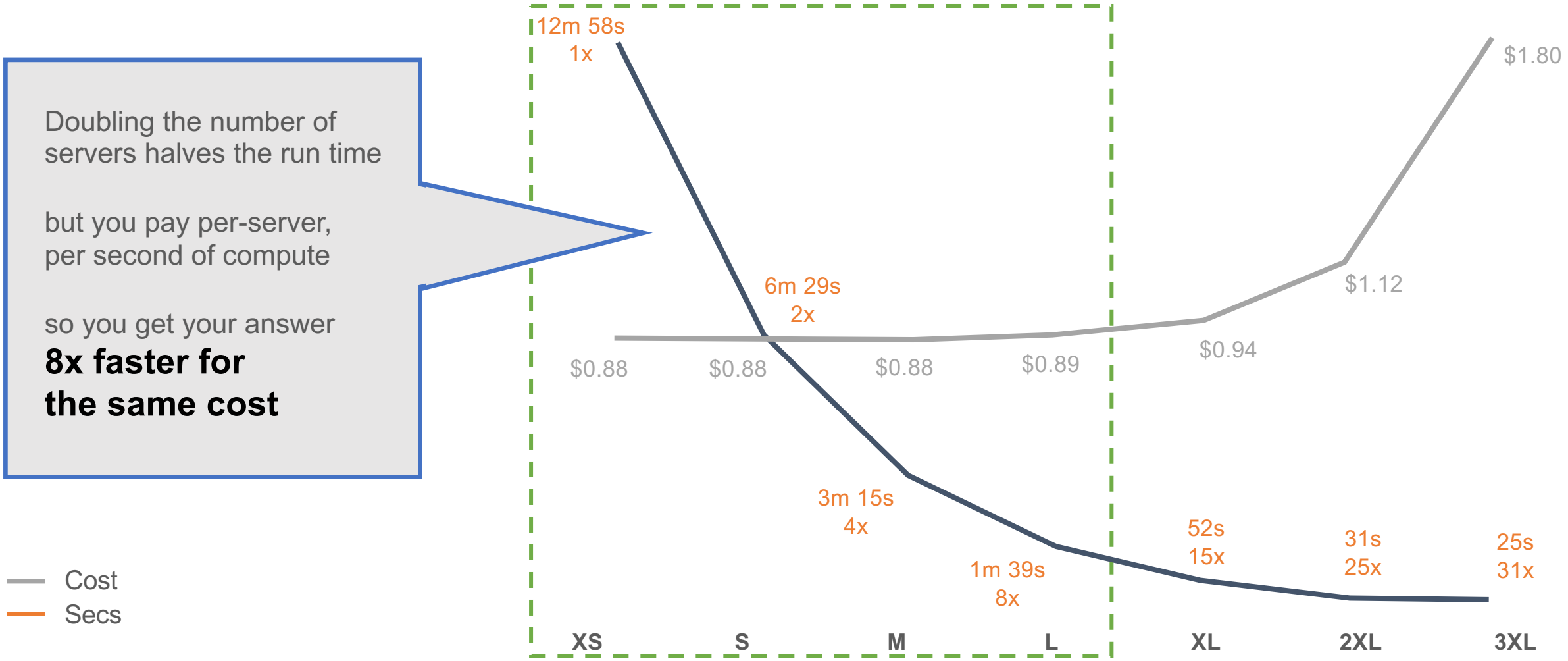


# SCALE UP - LOADING 1BN RECORDS

Doubling the number of servers halves the run time

but you pay per-server, per second of compute

so you get your answer
**8x faster for the same cost**



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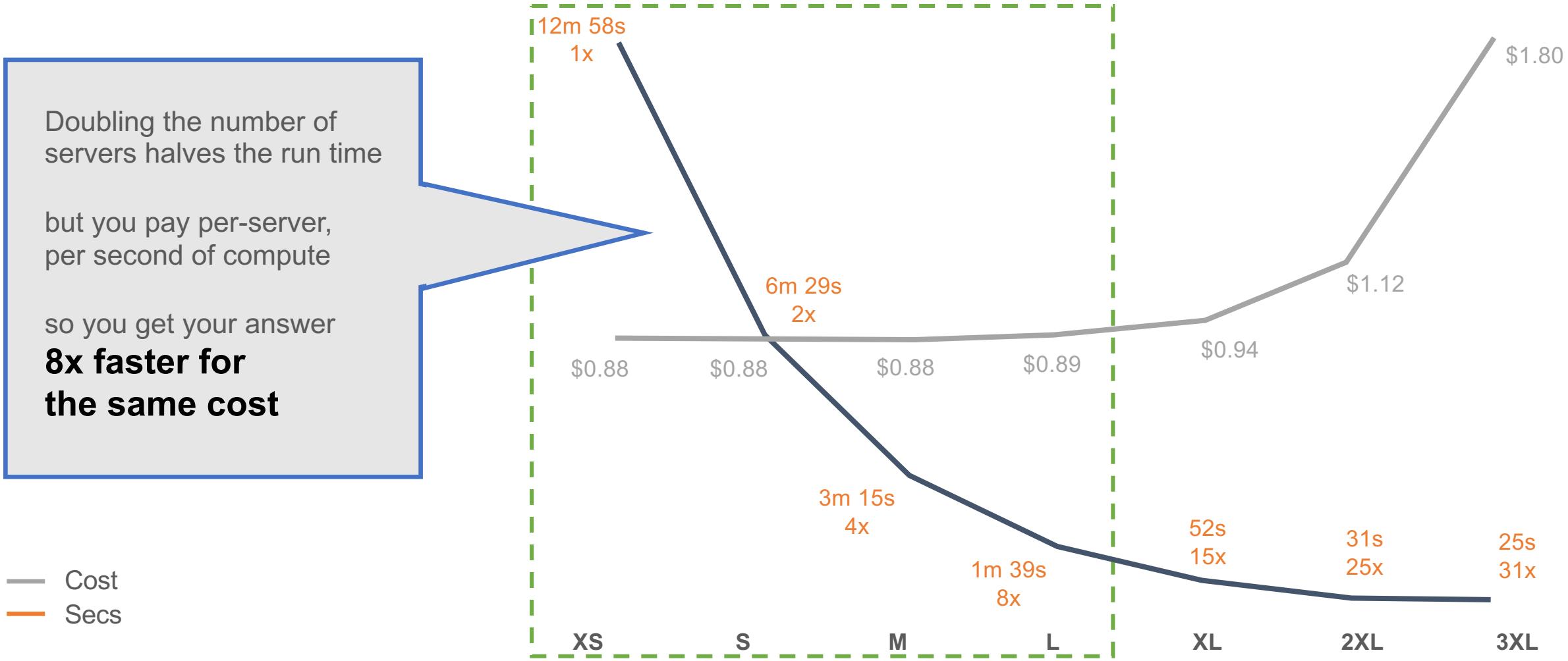


# COMPUTE LAYER

- Known internally as "Execution Platform" ("XP")
- A "compute cluster" is logical collection of 1+ VMs grouped together in a cluster—all VMs that are interconnected in a "mesh" network
- Size of compute cluster (number of nodes) is determined by the configured size of Virtual Warehouse that it exists within

| Warehouse Size | Servers / Cluster | Credits / Hour | Credits / Second |
|---|---|---|---|
| X-Small | 1 | 1 | 0.0003 |
| Small | 2 | 2 | 0.0006 |
| Medium | 4 | 4 | 0.0012 |
| Large | 8 | 8 | 0.0024 |
| X-Large | 16 | 16 | 0.0048 |
| 2X-Large | 32 | 32 | 0.0096 |
| 3X-Large | 64 | 64 | 0.0192 |
| 4X-Large | 128 | 128 | 0.0384 |

# VIRTUAL WAREHOUSE SIZING

These figures indicate the number of credits consumed for an hour's worth of compute

Scale each Warehouse independently for each workload type to provide additional compute power

Automatically scale concurrent homogenized workloads with multi-cluster warehouses

While both an XL with 1 cluster and a Medium with 4 clusters both will utilize 16 credits in 1 hour, they will behave differently and are equipped for different types of workloads.

SCALE FOR CONCURRENCY

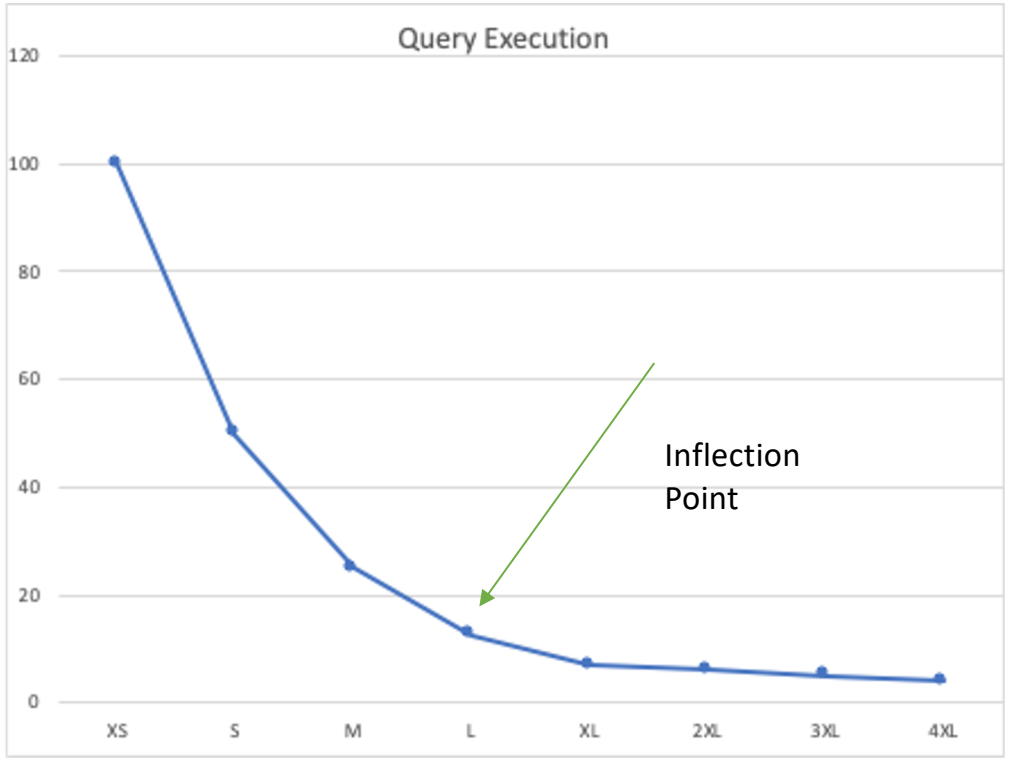
SCALE FOR PERFORMANCE

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4XL | 128 | 256 | 384 | 512 | 640 | 768 | 896 | 1024 | 1152 | 1280 |
| 3XL | 64 | 128 | 192 | 256 | 320 | 384 | 448 | 512 | 576 | 640 |
| 2XL | 32 | 64 | 96 | 128 | 160 | 192 | 224 | 256 | 288 | 320 |
| XL | 16 | 32 | 48 | 64 | 80 | 96 | 112 | 128 | 144 | 160 |
| L | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 80 |
| M | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 |
| S | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
| XS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

# VIRTUAL WAREHOUSE MANAGEMENT

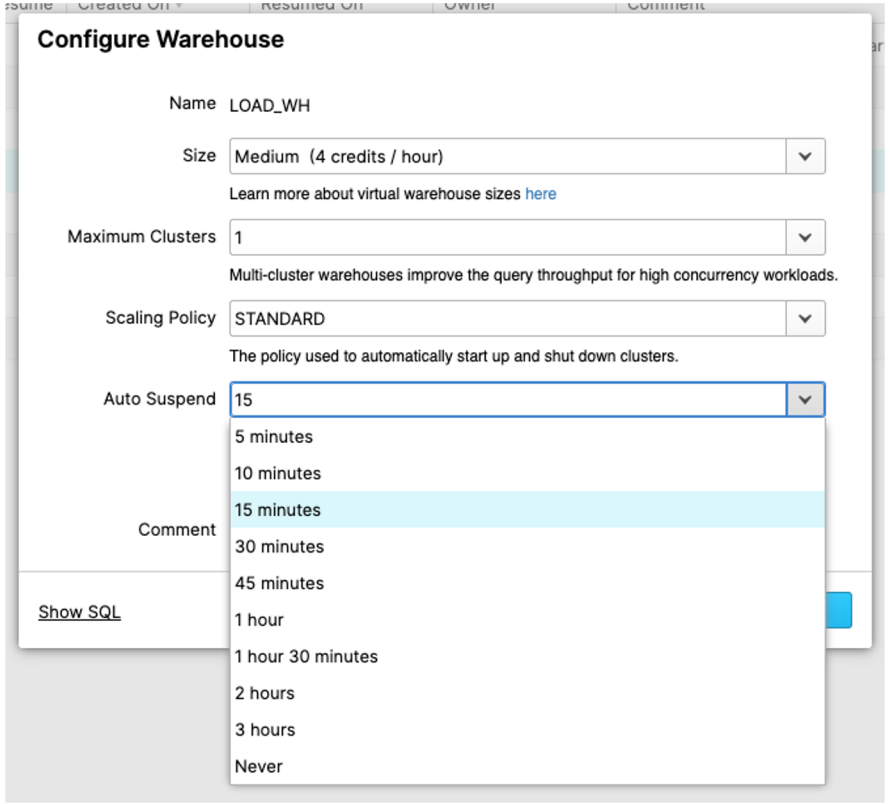
**Assign unique warehouses to unique workloads**

**Start testing query workload with an X-SMALL, and test scaling-up.**




**Auto-suspend should be set for all warehouse. Time setting should be dependent on caching requirement.**

**Leverage MCW when it makes sense.**



# Warehouse Design Consideration

## How are Credits Charged for Warehouses?

Credit charges are calculated based on:

- ✓ The number of servers per cluster (determined by warehouse size).
- ✓ The number of clusters (if using multi-cluster warehouses).
- ✓ The length of time each server in each cluster runs.

## How Does Query Composition Impact Warehouse Processing?

The number of servers required to process a query depends on the size and complexity of the query.

- ✓ The overall size of the tables being queried has more impact than the number of rows.
- ✓ Query filtering using predicates has an impact on processing, as does the number of joins/tables in the query.

## How Does Warehouse Caching Impact Queries?

Each warehouse, when running, maintains a cache of table data accessed as queries are processed by the warehouse. This enables improved performance for subsequent queries if they are able to read from the cache instead of from the table(s) in the query. The size of the cache is determined by the number of servers in the warehouse

- ✓ This cache is dropped when the warehouse is suspended
- ✓ Consider the trade-off between saving credits by suspending a warehouse versus maintaining the cache of data from previous queries to help with performance.

## Scaling Up vs Scaling Out

Snowflake supports two ways to scale warehouses:

- ✓ Scale up by resizing a warehouse.
- ✓ Scale out by adding clusters to a warehouse (requires Snowflake Enterprise Edition or higher).

## Warehouse Resizing Improves Performance

Resizing a warehouse generally improves query performance, particularly for larger, more complex queries.

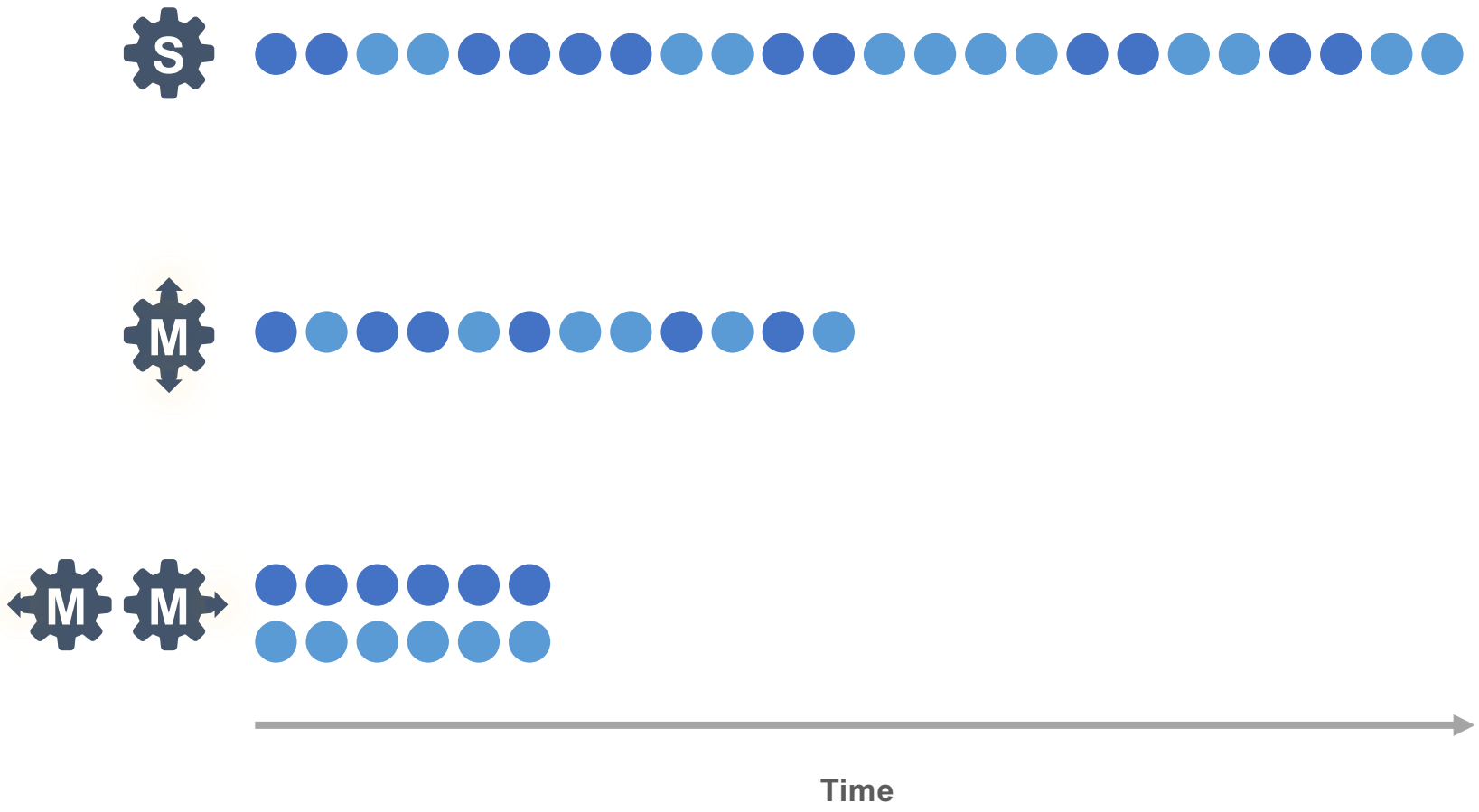
- ✓ Larger is not necessarily faster; for smaller, basic queries that are already executing quickly,
- ✓ There is a trade-off with regards to saving credits versus maintaining the server cache.

## Multi-cluster Warehouses Improve Concurrency

Multi-cluster warehouses are designed specifically for handling queuing and performance issues related to large numbers of concurrent users and/or queries.

- ✓ Multi-cluster warehouses should be configured to run in Auto-scale mode, which enables Snowflake to automatically start and stop clusters as needed.
- ✓ When choosing the minimum and maximum number of clusters for a multi-cluster warehouse

# ALL TOGETHER - SCALE, ELASTICITY, COST




All three examples contain the **Same amount of work.**

Using scale up and scale out, total **run-time is significantly reduced.**

You pay per server, per second so they **all cost the same.**

# ADAPTIVE CACHING

## Metadata

Metadata cached for fast access during query planning

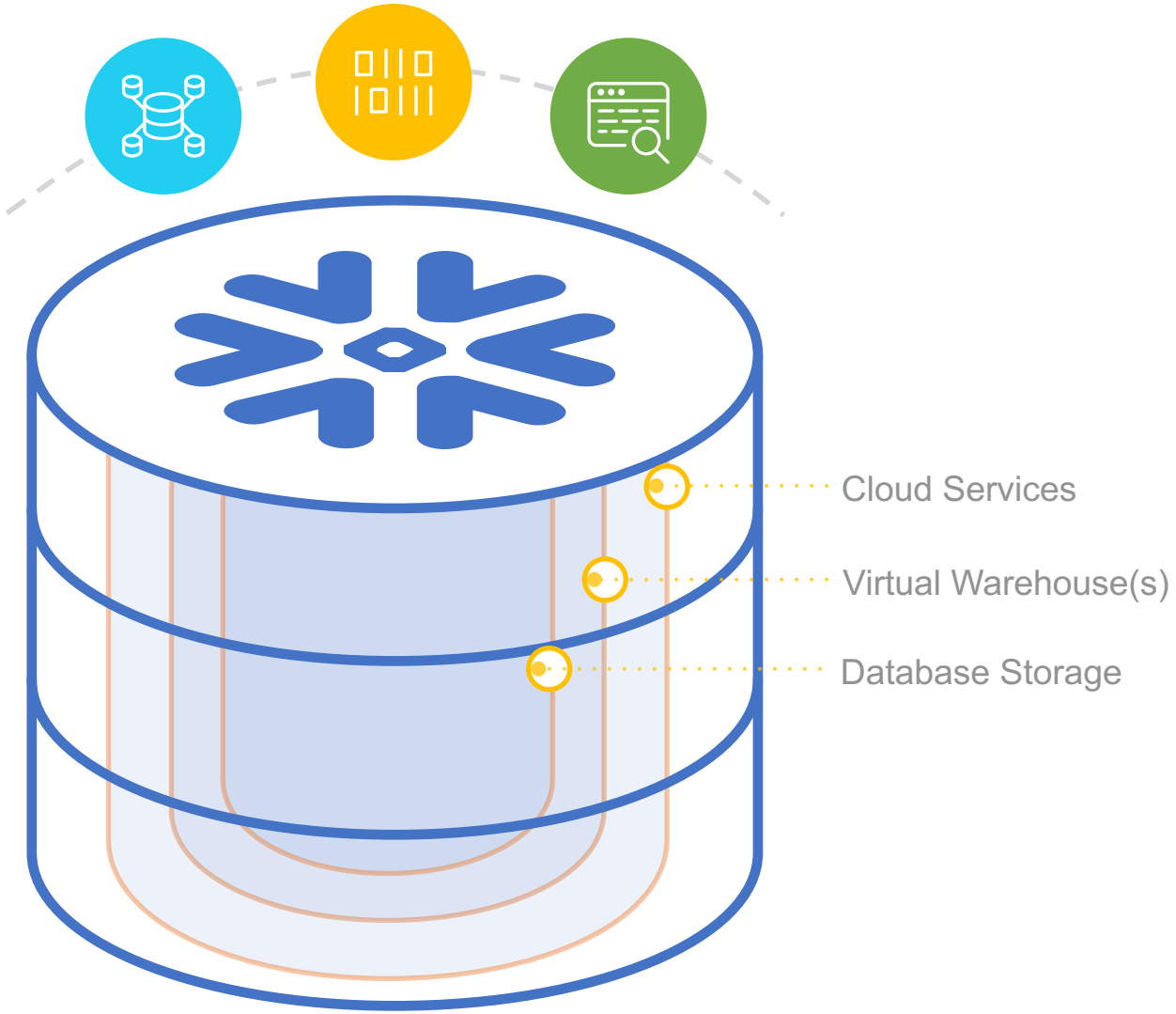
## Data

Active working set transparently cached on virtual warehouse SSD

## Query results

Results sets cached for reuse without requiring compute

(e.g., static dashboard queries)



# STORAGE

# ISSUES WITH TRADITIONAL PARTITIONING

- Static partitioning needs to be defined upfront
- Only improves queries on partitioning columns
- Size: can be too big or too small
  - Data has to be uniformly distributed over the partitions
- Skew: the wrong number of partitions, or an unbalanced distribution of data, can have a huge impact on performance
  - e.g., some dates may have many more observations / much more data than others

# SNOWFLAKE'S AUTOMATIC MICRO-PARTITIONING

## Tables divided horizontally in smaller units

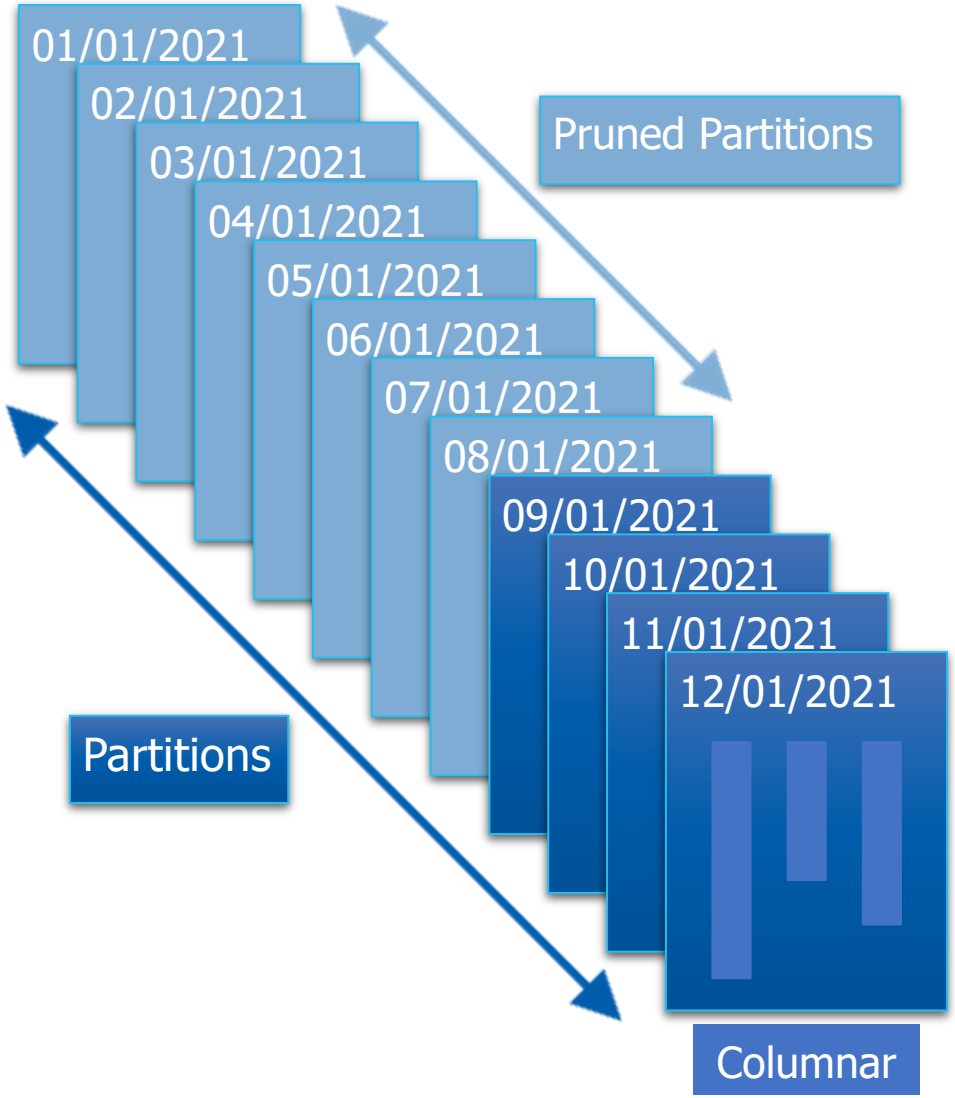
- Natural ingestion order maintains correlations between columns
- Few MBs per partition

## Statistics per column stored in meta-data

- Range of values
- Number of distinct values
- Number of NULLs

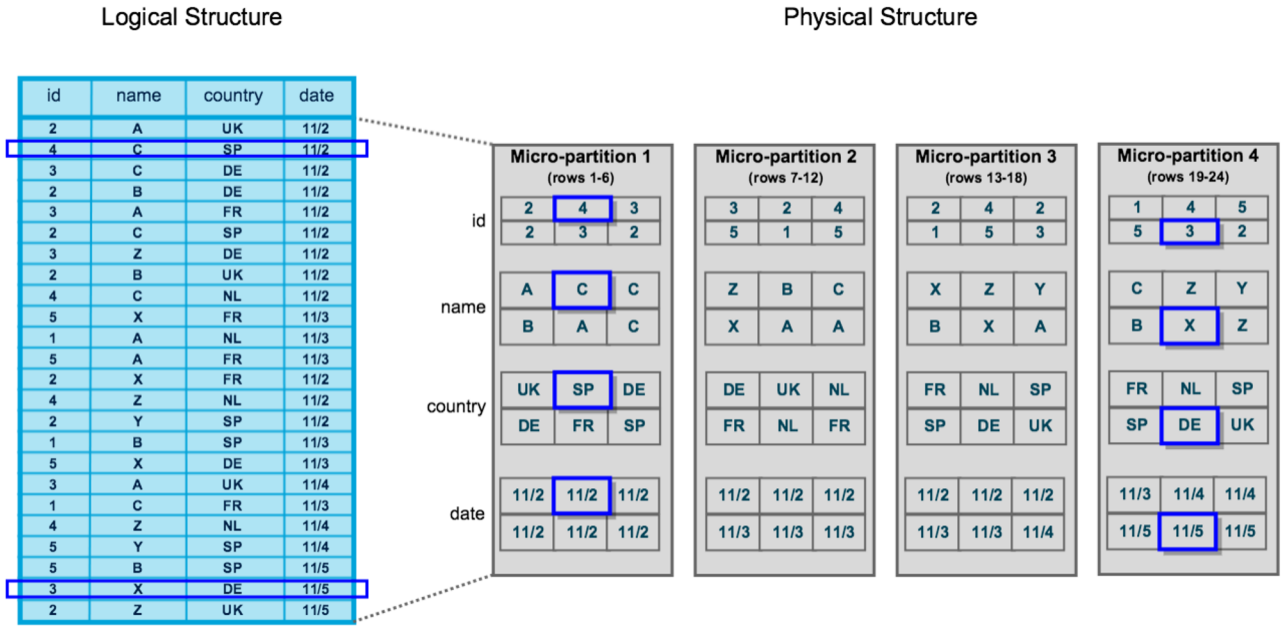
## Advantages

- Optimizer uses metadata for fine-grained pruning
- Helps limiting memory footprint
- Help data shuffling



# MICRO-PARTITIONING FORMAT: FDN

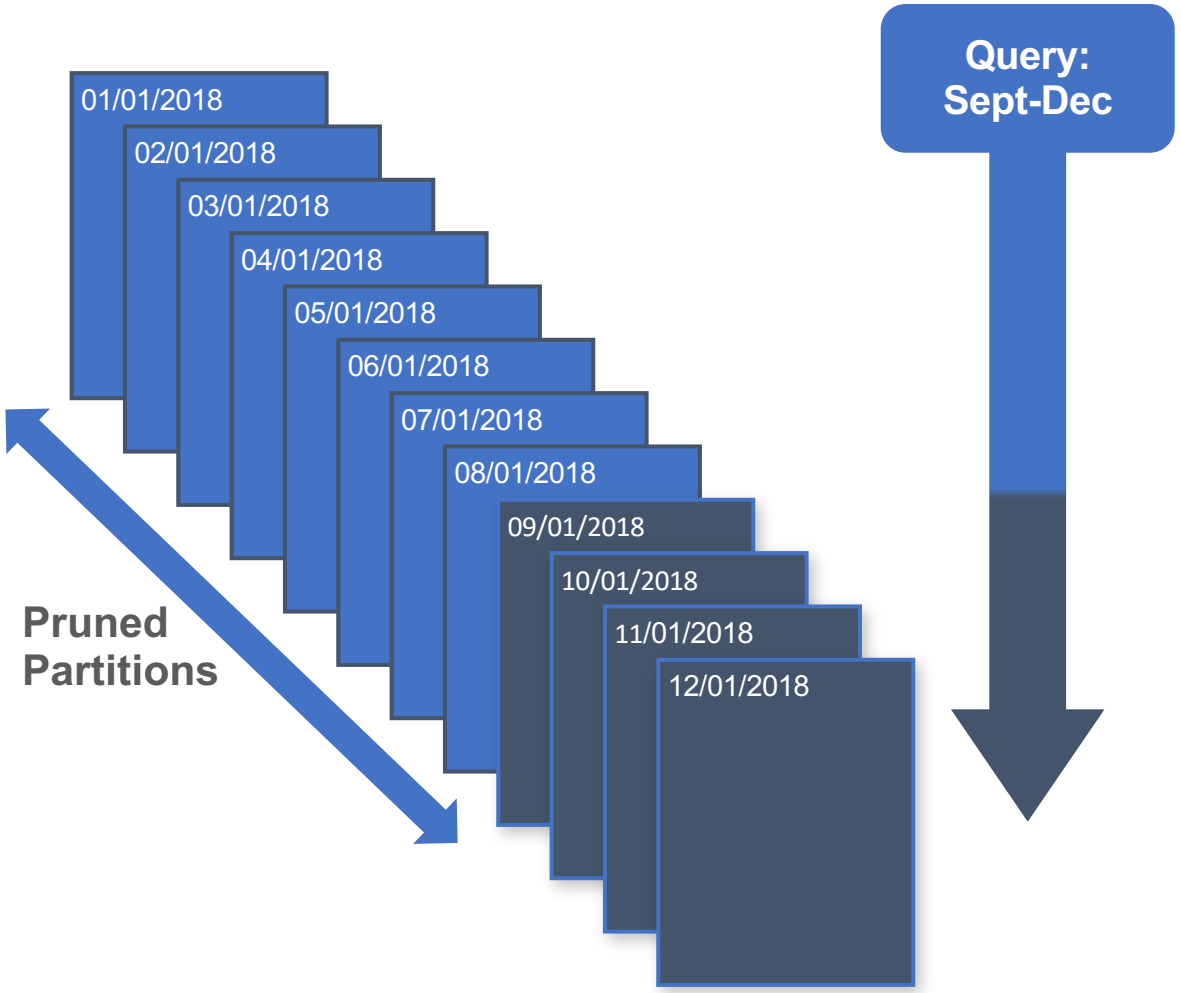
- Micro-partition files are in a **Snowflake proprietary format**: FDN
- Both structured and semi-structured data share the same proprietary FDN format
- **Since FDNs are completely immutable**
  - New FDNs are created to reflect the new final state of the data when it changed by inserts/updates/deletes (DML)
  - Old FDNs are retained and versioned in metadata (basis for Time Travel capability)



# QUERY PRUNING WITH DEFAULT CLUSTERING

Select … from orders where date between ’09-01-2018’ and ’12-01-2018’

Select … from orders where product = ‘IPhone’

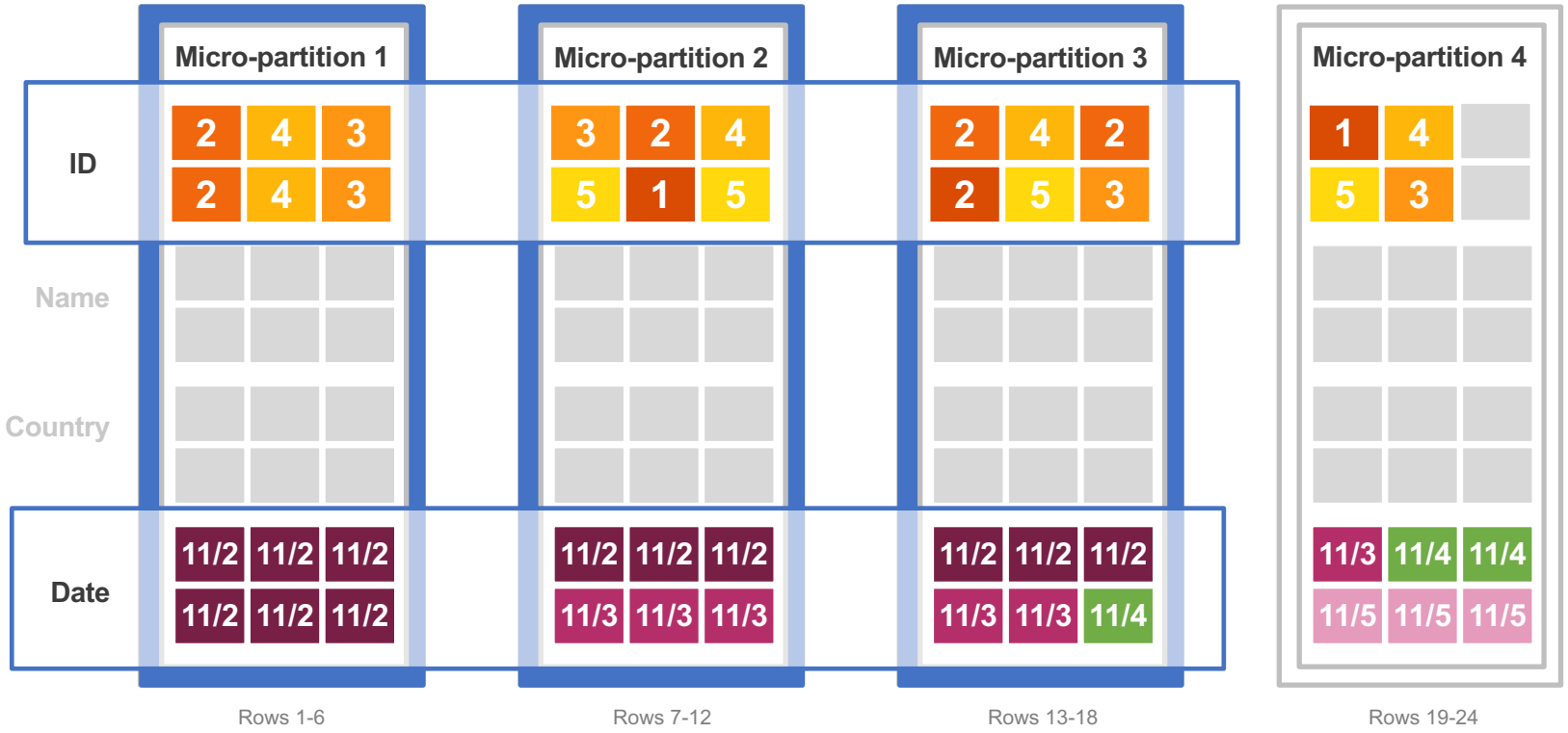


# DEFAULT CLUSTERED TABLE

| ID | Name | Country | Date |
|---|---|---|---|
| 2 | A | UK | 11/2 |
| 4 | C | SP | 11/2 |
| 3 | C | DE | 11/2 |
| 2 | B | DE | 11/2 |
| 3 | A | FR | 11/2 |
| 2 | C | SP | 11/2 |
| 3 | Z | DE | 11/2 |
| 2 | B | UK | 11/2 |
| 4 | C | NL | 11/2 |
| 5 | X | FR | 11/3 |
| 1 | A | NL | 11/3 |
| 5 | A | FR | 11/3 |
| 2 | X | FR | 11/2 |
| 4 | Z | NL | 11/2 |
| 2 | Y | SP | 11/2 |
| 2 | B | SP | 11/3 |
| 5 | X | DE | 11/3 |
| 3 | A | UK | 11/4 |
| 1 | C | FR | 11/3 |
| 4 | Z | NL | 11/4 |
| 5 | Y | SP | 11/4 |
| 5 | B | SP | 11/5 |
| 3 | X | DE | 11/5 |
| 2 | Z | UK | 11/5 |

Query

```
Select count(*) from T where id = 2 and date = '11/2';
```



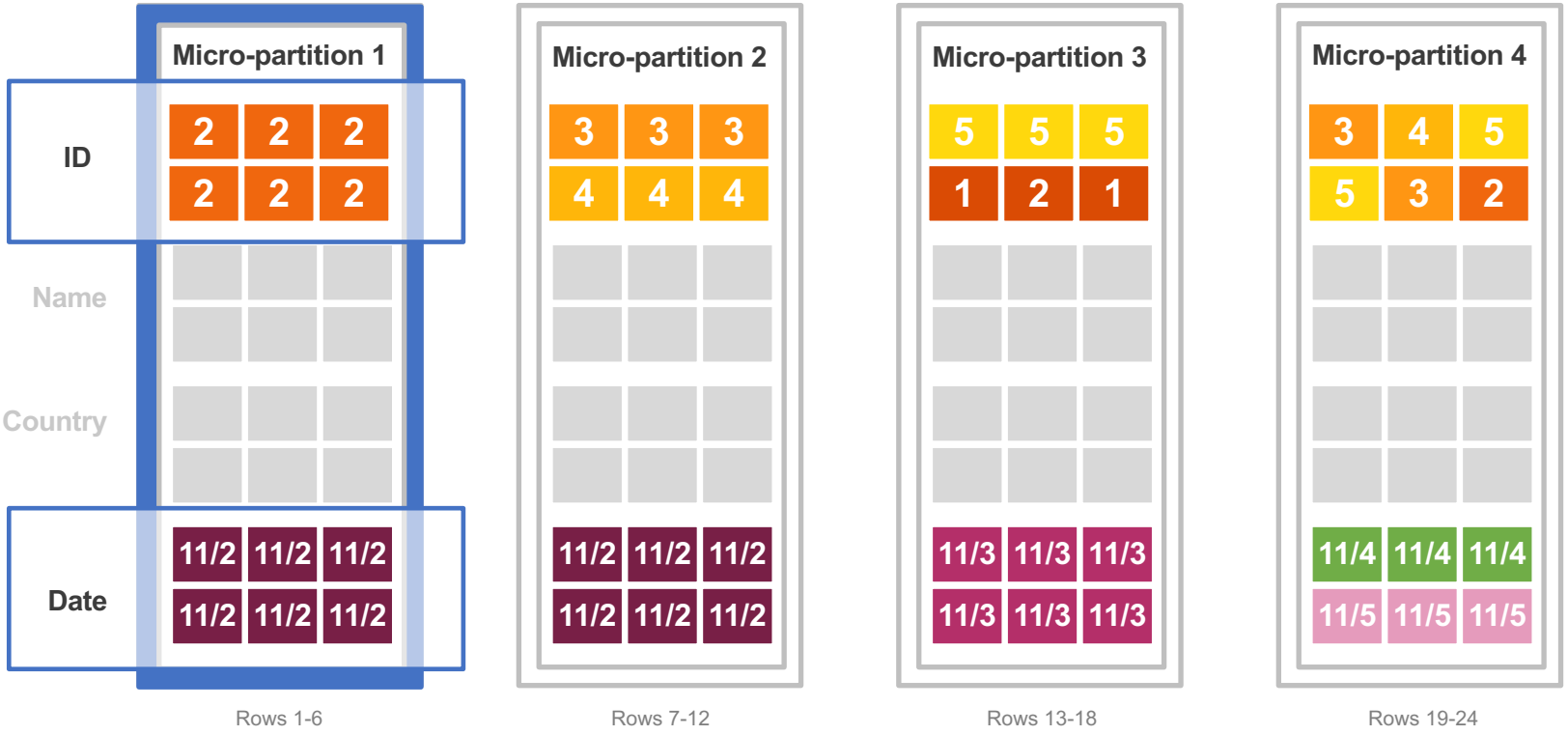

- Natural ordering by date
- **Scans 3 partitions**

# EXPLICITLY CLUSTERED TABLE

| ID | Name | Country | Date |
|---|---|---|---|
| 2 | A | UK | 11/2 |
| 4 | C | SP | 11/2 |
| 3 | C | DE | 11/2 |
| 2 | B | DE | 11/2 |
| 3 | A | FR | 11/2 |
| 2 | C | SP | 11/2 |
| 3 | Z | DE | 11/2 |
| 2 | B | UK | 11/2 |
| 4 | C | NL | 11/2 |
| 5 | X | FR | 11/3 |
| 1 | A | NL | 11/3 |
| 5 | A | FR | 11/3 |
| 2 | X | FR | 11/2 |
| 4 | Z | NL | 11/2 |
| 2 | Y | SP | 11/2 |
| 2 | B | SP | 11/3 |
| 5 | X | DE | 11/3 |
| 3 | A | UK | 11/4 |
| 1 | C | FR | 11/3 |
| 4 | Z | NL | 11/4 |
| 5 | Y | SP | 11/4 |
| 5 | B | SP | 11/5 |
| 3 | X | DE | 11/5 |
| 2 | Z | UK | 11/5 |

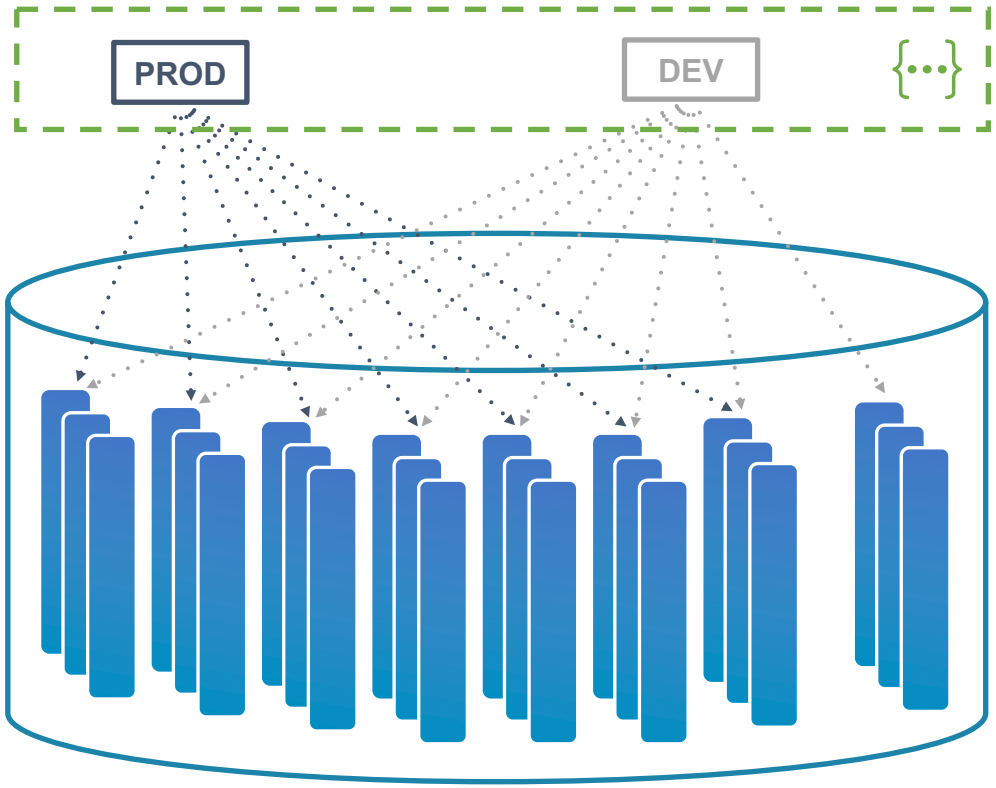
Query

```
Select count(*) from T where id = 2 and date = '11/2';
```




- Clustering keys (date, id)
- **Scans only 1 partition**

# ZERO-COPY CLONING




**The Metadata layer keeps track of every micro-partition file in every customer database.**

**Creating a DEV environment usually means copying the PROD database**

Limited to subset of full Prod

Up to 2x storage requirement

Periodic refreshes

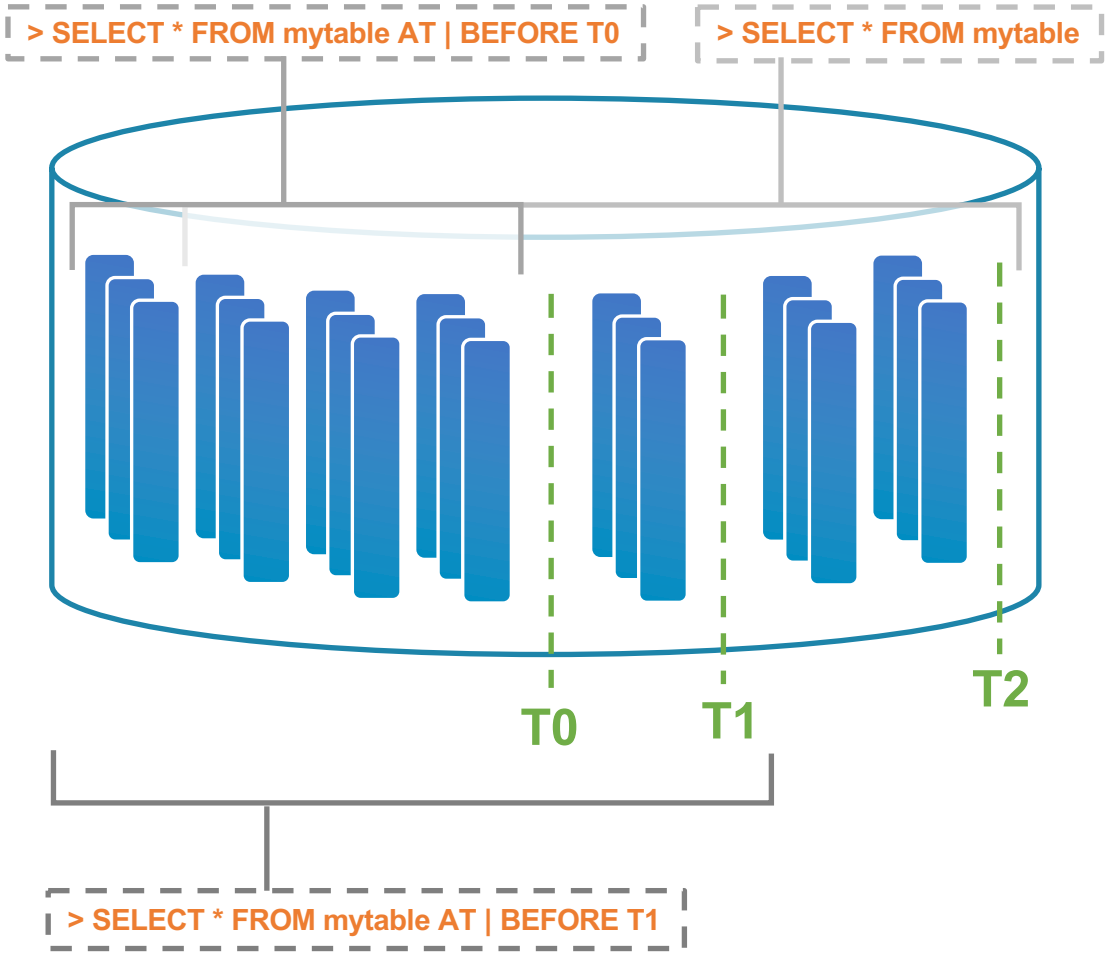
**Snowflake Zero-Copy Clones**

Simply “point” to the same files

Consumes zero additional storage

Changes to either DB are isolated

# TIME TRAVEL




**T0 – Initial state of database**

T1 – `update myTable set colX = Y where…`

**T2 – ELT job loads new data**

**Previous versions of data automatically retained**

AT | BEFORE [ timestamp | statement | offset ]

CLONE AT | BEFORE to recreate a prior version

UNDROP recovers from accidental deletion

**Accessed via SQL extensions**

AT | BEFORE [ timestamp | statement | offset ]

CLONE AT | BEFORE to recreate a prior version

UNDROP recovers from accidental deletion

# PROTECTING YOUR DATA IN SNOWFLAKE

## End-to-End Encryption

Always-encrypted client communications, plus integration with cloud provider private networking

## Fully Encrypted Storage

Data at rest is always encrypted while handled by the Snowflake drivers and systems

## Strong Authentication

Built in multi-factor, integration with your federated SSO, easy user management


## Full Auditing

Track every login, every transaction, every data transfer, and export to your security tools

## Role-Based Access Control

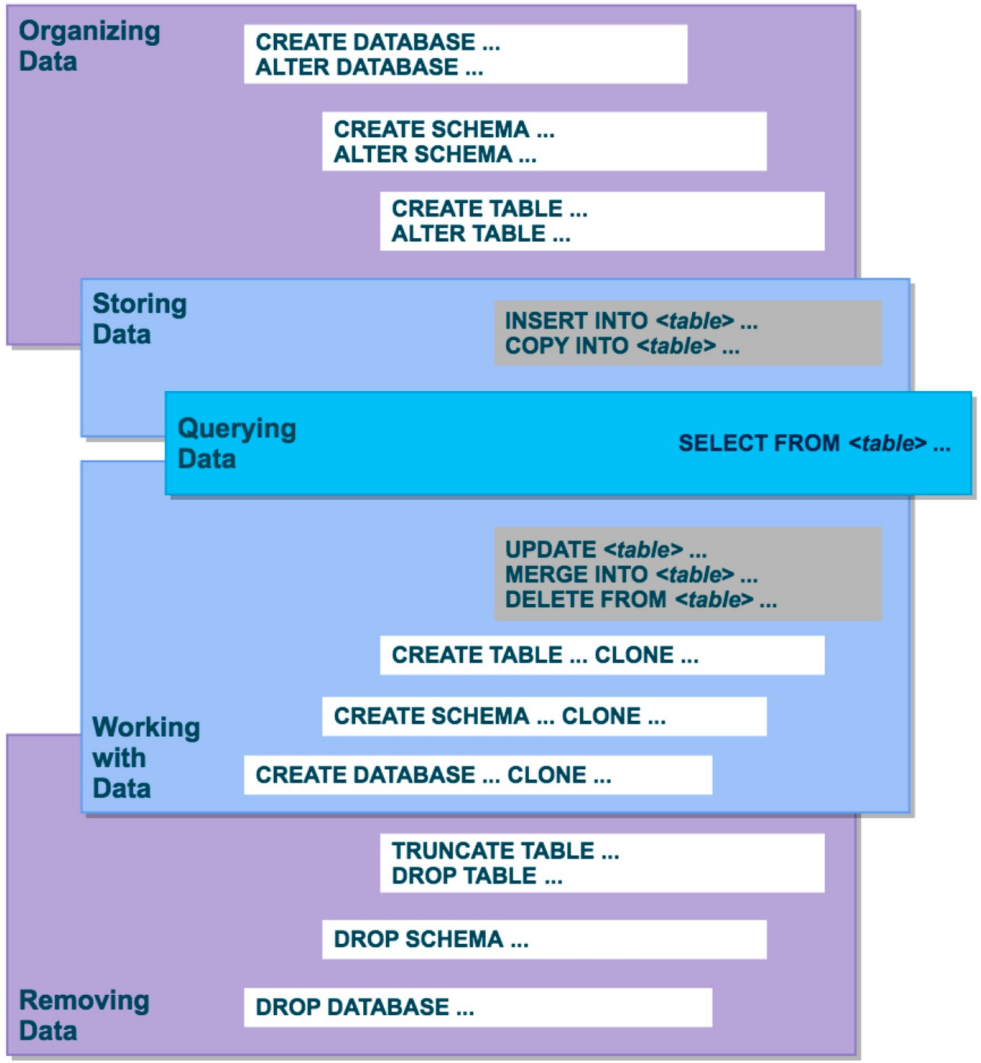
All objects, actions, and even compute usage can be controlled with roles

## Recovery

We give you options to ensure your data can be recovered in case of an accident or worse

[Snowflake Security Product Documentation]

# Snowflake Data Life Cycle



# Sample Questions

**Question 1 of 30** 100 pts

Which of the following is not a layer in Snowflake's Architecture?

**A**

- ○ Storage
- ○ Cloud Services
- ○ Data Catalog
- ○ Virtual Warehouses

**Question 3 of 30** 100 pts

Which of the following are true of Multi-Cluster warehouses? Select all that apply.

**A**

- ☐ Adds clusters automatically based on query activity
- ☐ Sizes each cluster optimally based on the queries
- ☐ Scales down when query activity slows
- ☐ Multi-cluster warehouses will never auto-suspend

**Question 4 of 30** 100 pts

What technique does Snowflake use to limit the number of micro-partitions scanned by each query?

**A**

- ○ Indexing
- ○ Pruning
- ○ Map Reduce
- ○ B-Tree

**Question 6 of 30** 100 pts

True or false: Virtual Warhouses cannot be resized while queries are running.

**A**

- ○ TRUE
- ○ FALSE

# Sample Questions

**Question 9 of 30** 100 pts

True or false: The warehouse cache may be reset if a running warehouse is suspended and then resumed.

**A**

- ○ TRUE
- ○ FALSE

**Question 12 of 30** 100 pts

True or false: Snowflake only works with cloud-based tools.

**A**

- ○ TRUE
- ○ FALSE

**Question 17 of 30** 100 pts

Snowflake supports which of the following file formats for data loading? Select all that apply.

**A**

- ☐ Parquet
- ☐ ORC
- ☐ CSV
- ☐ PDF

**Question 18 of 30** 100 pts

Which of the following are options when creating a Virtual Warehouse?

**A**

- ☐ Auto-suspend
- ☐ Storage size
- ☐ Auto-resume
- ☐ Cache size

# Sample Questions

**Question 21 of 30** 100 pts

True or false: A table in Snowflake can only be queried using the Virtual Warehouse used to load the data.

**A**

- ○ TRUE
- ○ FALSE

**Question 22 of 30** 100 pts

True or false: Snowflake offers tools to extract data from source systems.

**A**

- ○ TRUE
- ○ FALSE

**Question 25 of 30** 100 pts

Which of the following terms best describes Snowflake's database architecture?

**A**

- ○ Columnar shared nothing
- ○ Shared disk
- ○ Multi-cluster shared data
- ○ Cloud-native shared memory

**Question 29 of 30** 100 pts

Which of the following are types of caching use by Snowflake? Select all that apply.

**A**

- ☐ Warehouse caching
- ☐ Index Caching
- ☐ Metadata caching
- ☐ Query result caching


# *Thank You*