Deploying a modern Data Warehouse with Amazon Redshift

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Amazon Development Center India Pvt Ltd.

Agenda

- Evolving Nature of Data & Analytics
- Amazon Redshift Architecture & Key Concepts
- Why is Amazon Redshift your modern Data Warehouse?
    - Performance at scale
    - Auto-everything
    - Advanced Analytics capabilities
    - Integration with Analytics Services
    - Variety of personas and use cases
- Customer case studies
- Migration to Amazon Redshift

Evolving Nature of Data & Analytics

Agility is more important than ever

vyaire MEDICAL

moderna

Customers want more value from their data

Growing Exponentially

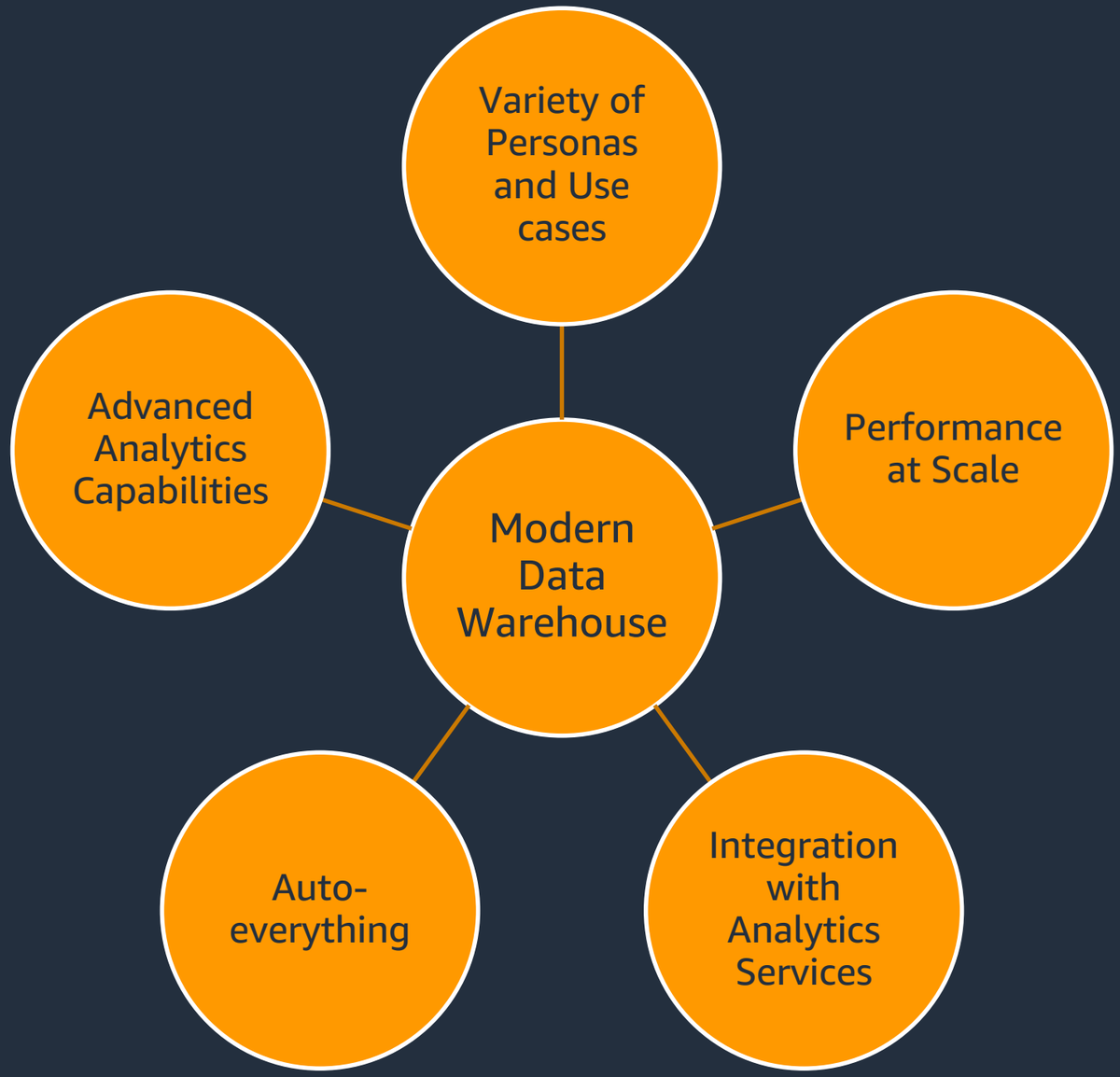
From new sources

Increasingly diverse

Used by many people

Analyzed by many applications

Asks from a Modern Data Warehouse today



Lake House architecture on AWS

Scalable data lakes

Purpose-built data services

Seamless data movement

Unified governance

Performant and cost-effective

Amazon Redshift

Analyze all your data with the fastest and most widely used cloud data warehouse

Analyze all your data

Deepest integration with your data lake

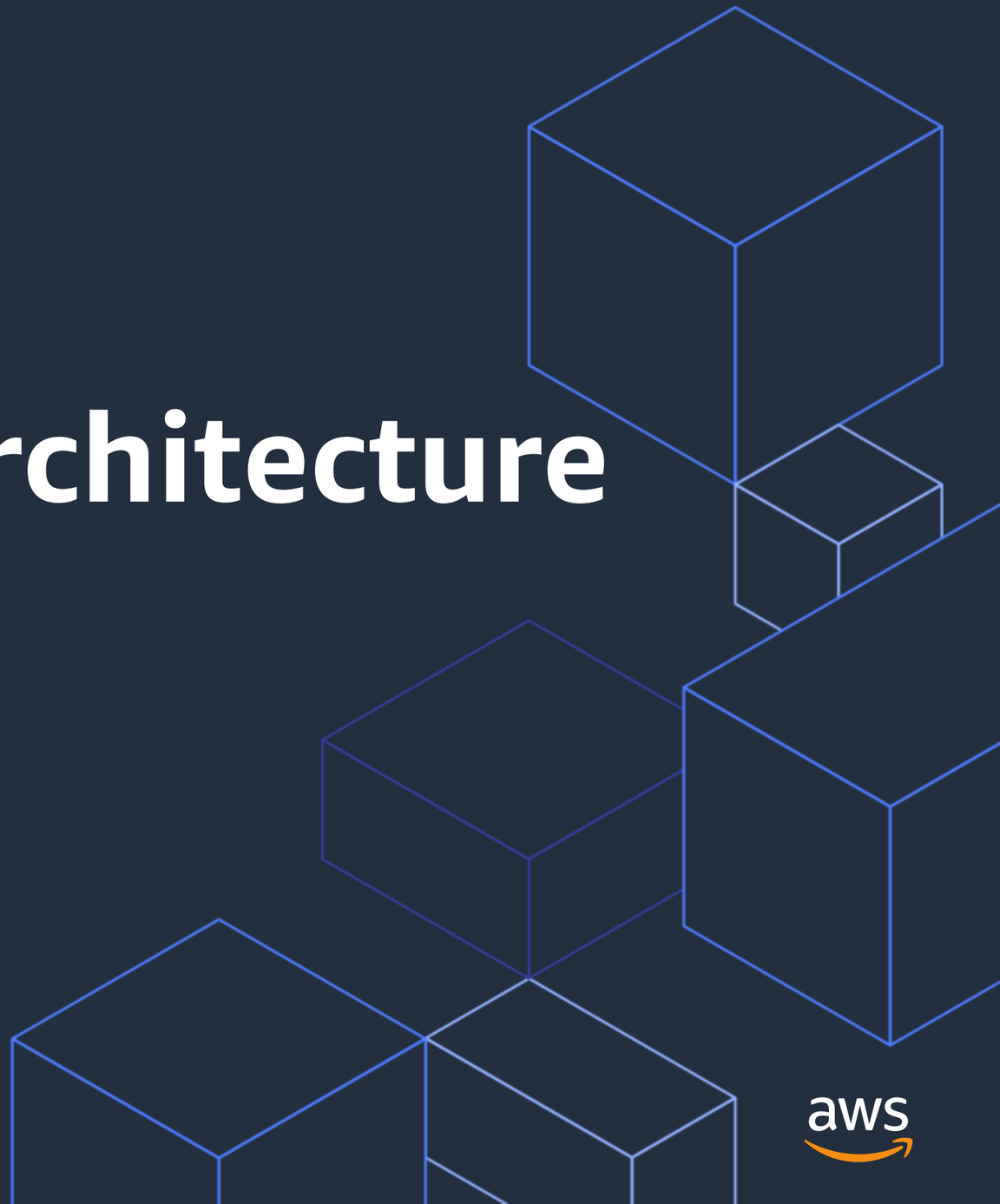
Performance at any scale

Up to 3x better price performance than other cloud DW

Lower your costs

At least 50% less expensive than other cloud DW

Amazon Redshift Architecture & Key concepts



Amazon Redshift Architecture

Massively parallel, shared nothing columnar architecture

Leader node

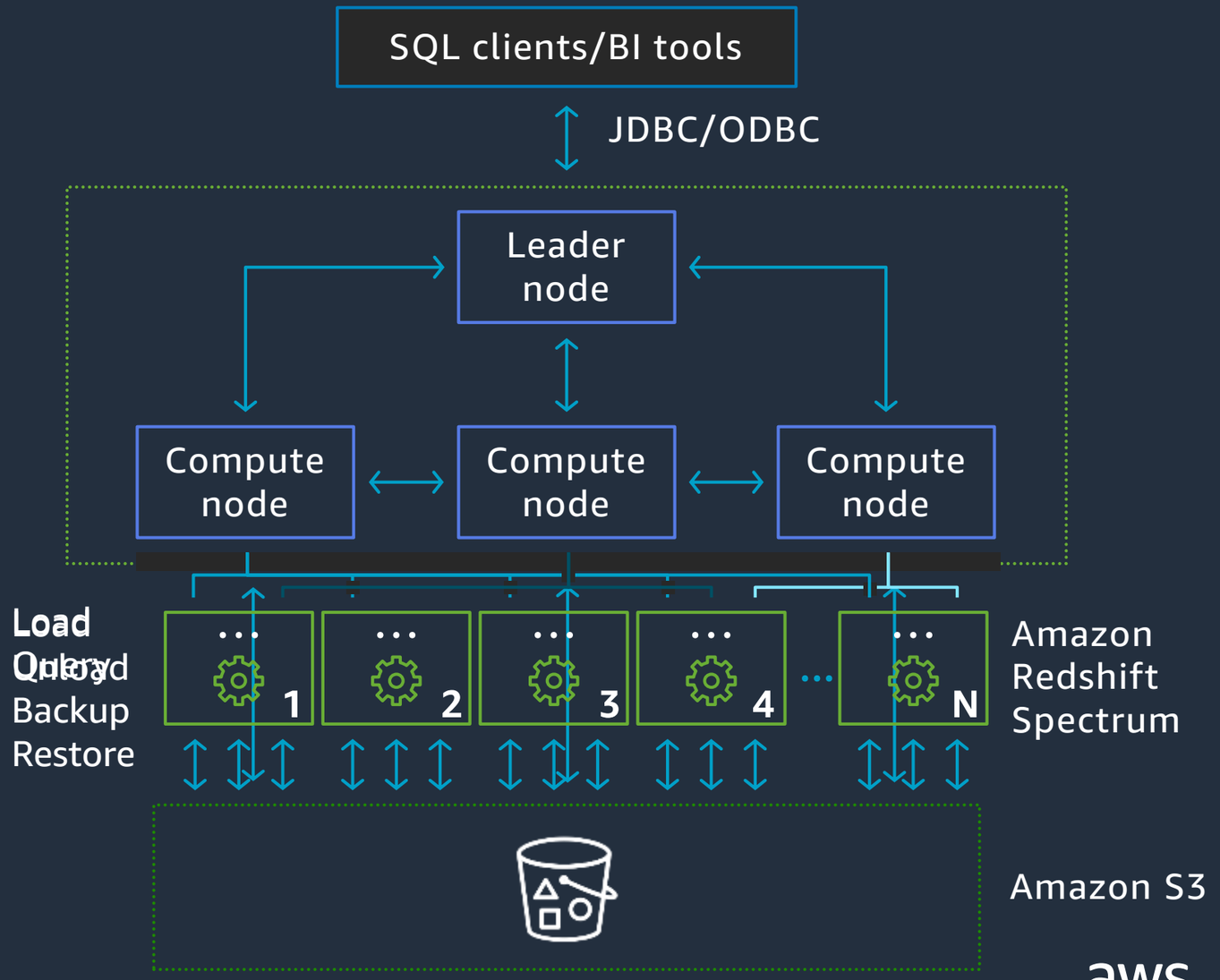
- SQL endpoint
- Stores metadata
- Coordinates parallel SQL processing

Compute nodes

- Local, columnar storage
- Executes queries in parallel
- Load, unload, backup, restore

Amazon Redshift Spectrum nodes

- Execute queries directly against Amazon Simple Storage Service (Amazon S3)



Redshift Node types(2nd Generation)

Dense compute—DC2

- Solid-state disks

Dense storage—DS2

- Magnetic disks

Instance type	Disk type	Size	Memory(GiB)	vCPUs	Slices
DC2 large	SSD	160 GB	15	2	2
DC2 8xlarge	SSD	2.56 TB	244	32	16
DS2 xlarge	Magnetic	2 TB	31	4	2
DS2 8xlarge	Magnetic	16 TB	244	36	16

Columnar Architecture

Amazon Redshift uses a columnar architecture for storing data on disk

Physically store data on disk by column rather than row

Only read the column data that is required

Goal: Reduce I/O for analytics queries

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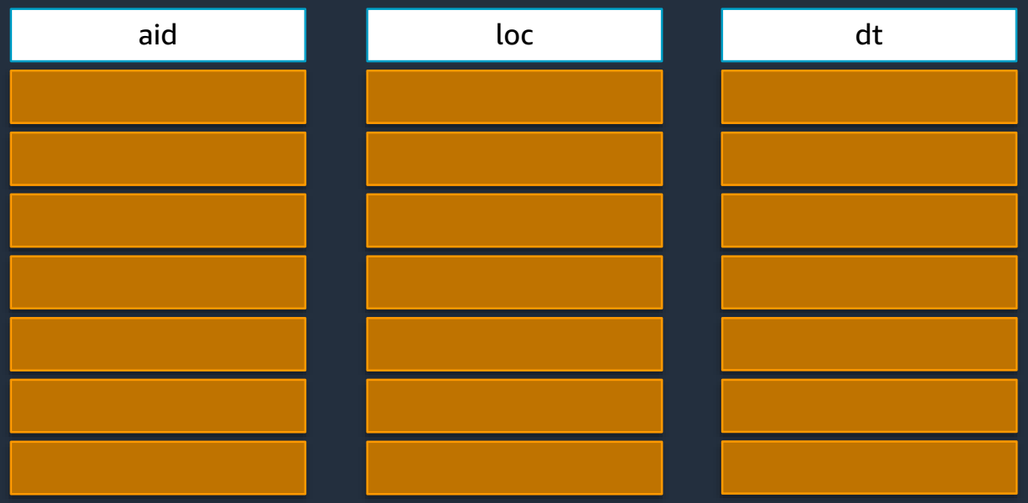
Columnar Architecture: Example

```
CREATE TABLE deep_dive (
     aid   INT        --audience_id
    ,loc   CHAR(3)    --location
    ,dt    DATE       --date
);
```

aid	loc	dt
1	SFO	2017-10-20
2	JFK	2017-10-20
3	SFO	2017-04-01
4	JFK	2017-05-14




```
SELECT min(dt) FROM deep_dive;
```

Row-based storage

- Need to read everything
- Unnecessary I/O

Columnar Architecture: Example

```
CREATE TABLE deep_dive (
     aid   INT        --audience_id
    ,loc   CHAR(3)    --location
    ,dt    DATE       --date
);
```

aid	loc	dt
1	SFO	2017-10-20
2	JFK	2017-10-20
3	SFO	2017-04-01
4	JFK	2017-05-14


```
SELECT min(dt) FROM deep_dive;
```

Column-based storage

- Only scans blocks for relevant column

Compression

Goals

Allow more data to be stored within an Amazon Redshift cluster

Improve query performance by decreasing I/O

Impact

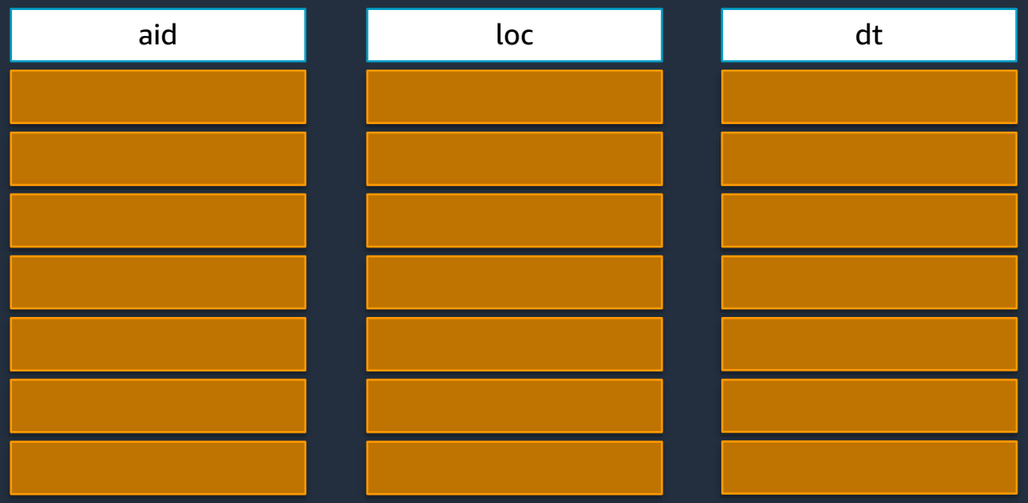
Allows two to four times more data to be stored within the cluster

ANALYZE COMPRESSION is a built-in command that will find the optimal compression for each column on an existing table

Compression: Example

```
CREATE TABLE deep_dive (
     aid   INT        --audience_id
    ,loc   CHAR(3)    --location
    ,dt    DATE       --date
);
```

aid	loc	dt
1	SFO	2017-10-20
2	JFK	2017-10-20
3	SFO	2017-04-01
4	JFK	2017-05-14

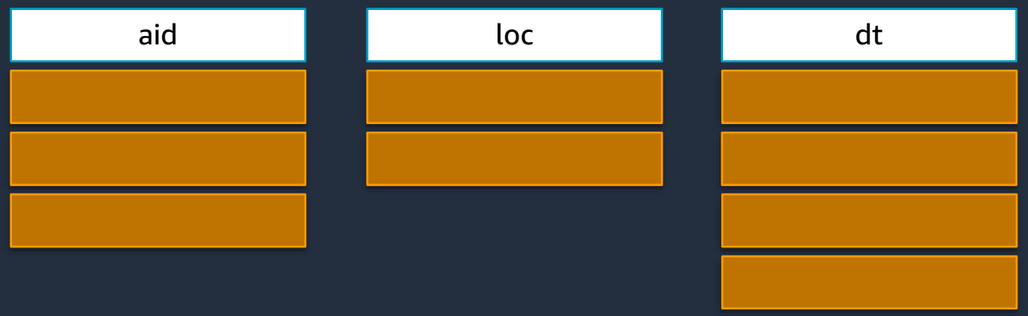


Add 1 of 13 different encodings to each column

Compression: Example

```
CREATE TABLE deep_dive (
     aid   INT         ENCODE AZ64
    ,loc   CHAR(3)     ENCODE BYTEDICT
    ,dt    DATE        ENCODE RUNLENGTH
);
```

aid	loc	dt
1	SFO	2017-10-20
2	JFK	2017-10-20
3	SFO	2017-04-01
4	JFK	2017-05-14



More efficient compression is due to storing the same data type in the columnar architecture

Columns grow and shrink independently

Reduces storage requirements

Reduces I/O

Data distribution

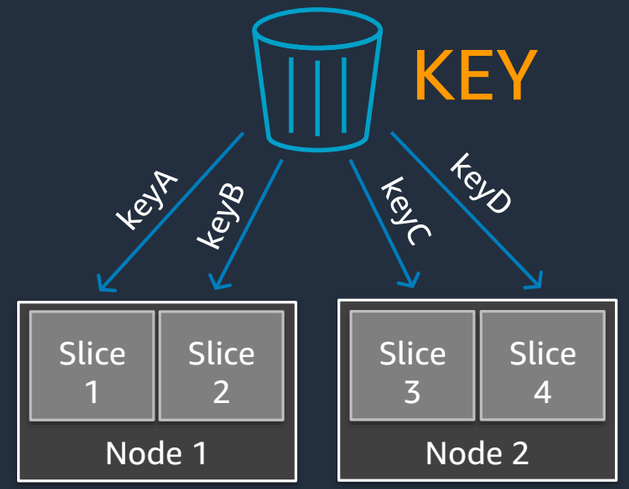
Distribution style is a table property which dictates how that table's data is distributed throughout the cluster

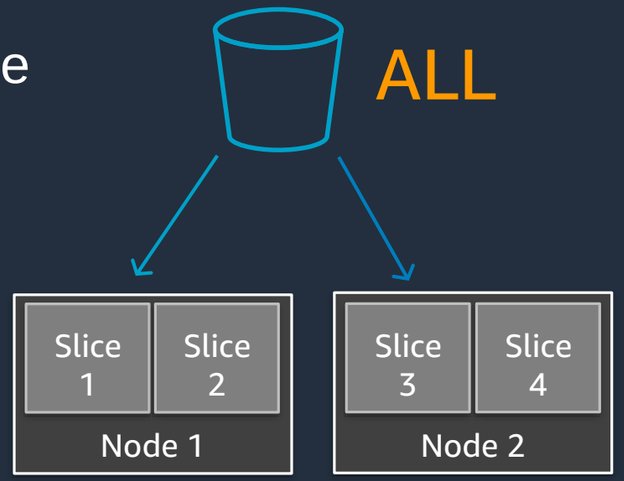
KEY: Value is hashed, same value goes to same location (slice)

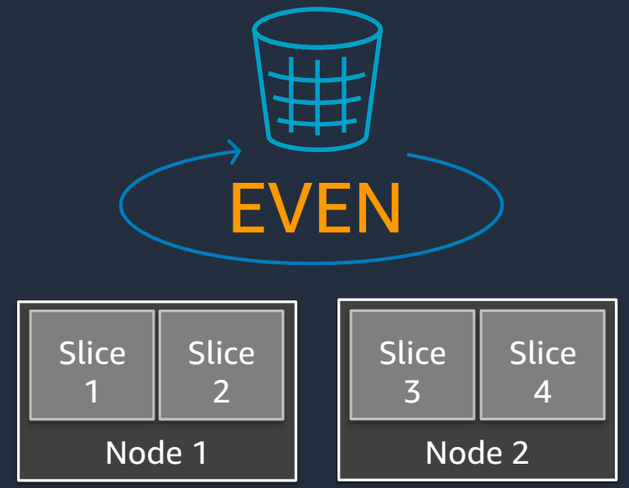
ALL: Full table data goes to the first slice of every node

EVEN: Round robin

AUTO: Redshift chooses the distribution style







Goals

Distribute data evenly for parallel processing

Minimize data movement during query processing

Sort Keys

Goal

Make queries run faster by increasing the effectiveness of zone maps and reducing I/O

Impact

Enables range-restricted scans to prune blocks by leveraging zone maps

---

Achieved with the table property SORTKEY defined on one or more columns

Optimal sort key is dependent on:

- Query patterns
- Business requirements
- Data profile

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(AUTO) VACUUM

The VACUUM process runs either manually or automatically in the background

Goals

VACUUM will remove rows that are marked as deleted

VACUUM will globally sort tables

- For tables with a sort key, ingestion operations will locally sort new data and write it into the unsorted region

(AUTO) ANALYZE

- The ANALYZE process collects table statistics for optimal query planning
- In the vast majority of cases AUTO ANALYZE automatically handles statistics gathering

Workload Management (WLM) modes

Manual WLM

- Define different queues based on user groups or query groups
- Define how many concurrent queries can run within each queue
- Allocate a certain percentage of the cluster memory to each queue

Auto WLM

- Define different queues based on user groups or query groups
- Redshift will determine the number of concurrent queries to run at any given point in time
- Redshift will also decide how much memory to allocate for each query based on the need.

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Why is Redshift your modern Data warehouse?

Performance at Scale

RA3 nodes with managed storage

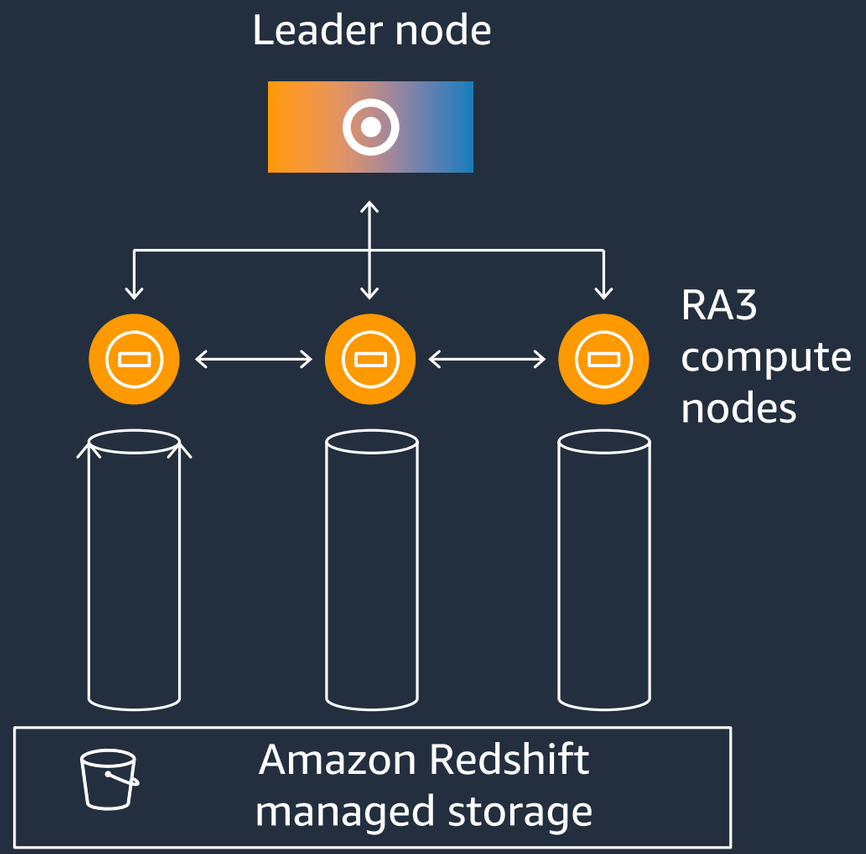
SCALE COMPUTE AND STORAGE INDEPENDENTLY

Managed storage

Large high-speed cache

High-bandwidth networking

- Size of data warehouse only based on steady state compute needs
- Scale and pay independently for compute and storage
- Automatic, no changes to any workflows, no need to manage storage



Redshift Node types

Amazon Redshift analytics—RA3

- Amazon Redshift Managed Storage (RMS)—Solid-state disks + Amazon S3

Dense compute—DC2

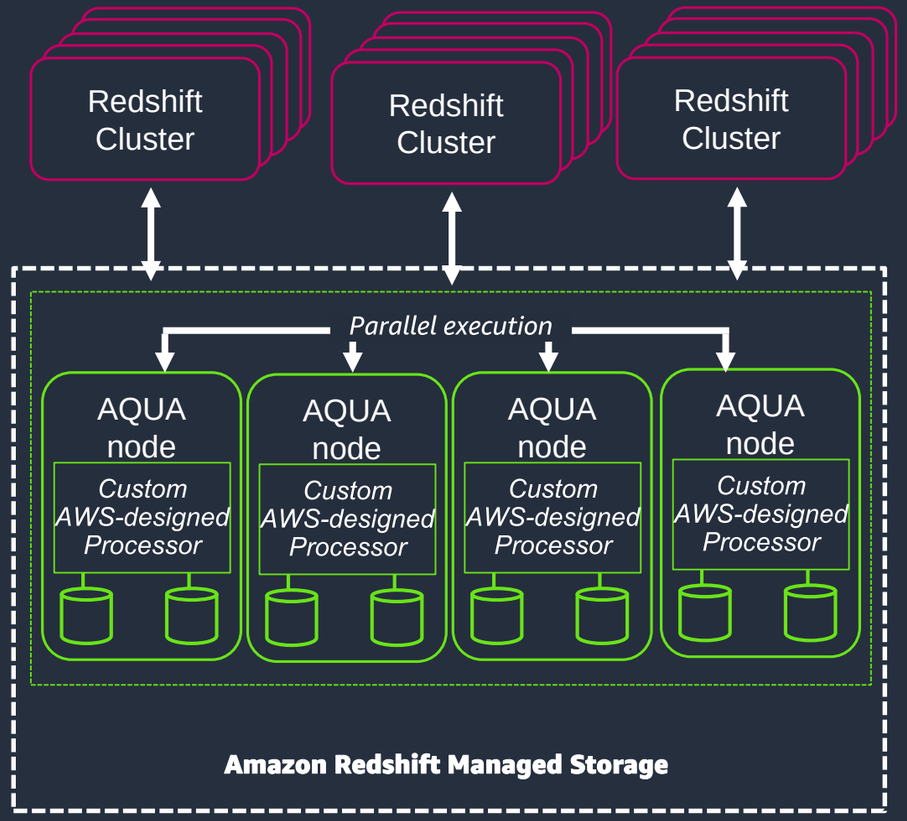
- Solid-state disks

Dense storage—DS2

- Magnetic disks

Instance type	Disk type	Size	Memory(GiB)	vCPUs	Slices
RA3.xlplus	RMS	Upto 32 TB RMS	32	4	2
RA3 4xlarge	RMS	Upto 128 TB RMS	96	12	4
RA3 16xlarge	RMS	Upto 128 TB RMS	384	48	16
DC2 large	SSD	160 GB	15	2	2
DC2 8xlarge	SSD	2.56 TB	244	32	16
DS2 xlarge	Magnetic	2 TB	31	4	2
DS2 8xlarge	Magnetic	16 TB	244	36	16

AQUA (Advanced Query Accelerator)



New distributed & hardware-accelerated processing layer

With AQUA, Amazon Redshift is multiple times **faster** than any other cloud data warehouse, no extra cost

AQUA Nodes with custom AWS-designed analytics processors to make operations (compression, encryption, filtering, and aggregations) faster than traditional CPUs

Available with RA3 and no code changes required

Data sharing builds on Redshift managed storage

HIGH PERFORMANCE DATA ACCESS WHILE PRESERVING WORKLOAD ISOLATION

Producer pays for Amazon Redshift managed storage and consumers pay for consumer cluster

Workloads accessing shared data are isolated from each other and the producer

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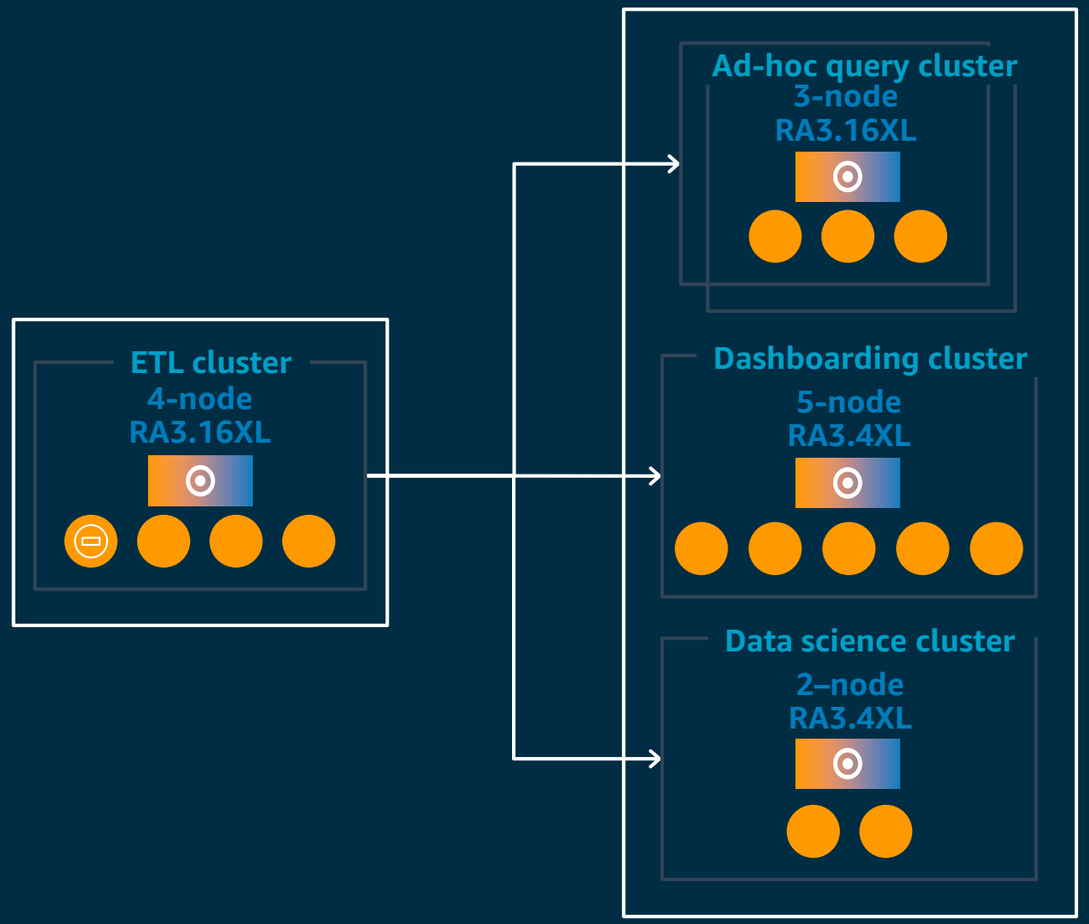
Data sharing use cases (1)

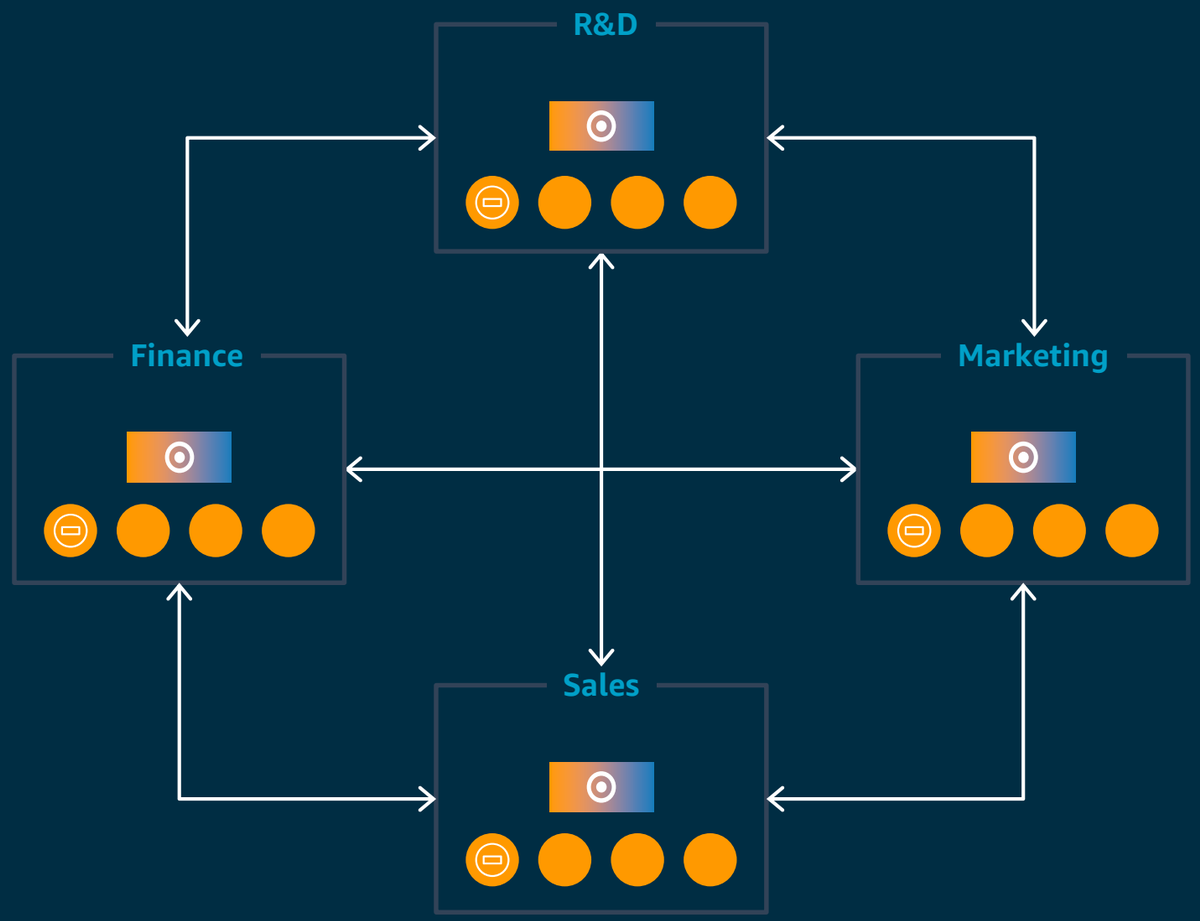
SEPARATE ETL VS BI WORKLOADS



- Rapidly onboard new analytics workloads
- Size and scale individual workloads according to their performance requirements
- Provide workload isolation while sharing common datasets
- Offer chargeback for individual workloads
- Pause / resume consumer clusters as necessary

Data sharing use cases (2)

CROSS-GROUP COLLABORATION



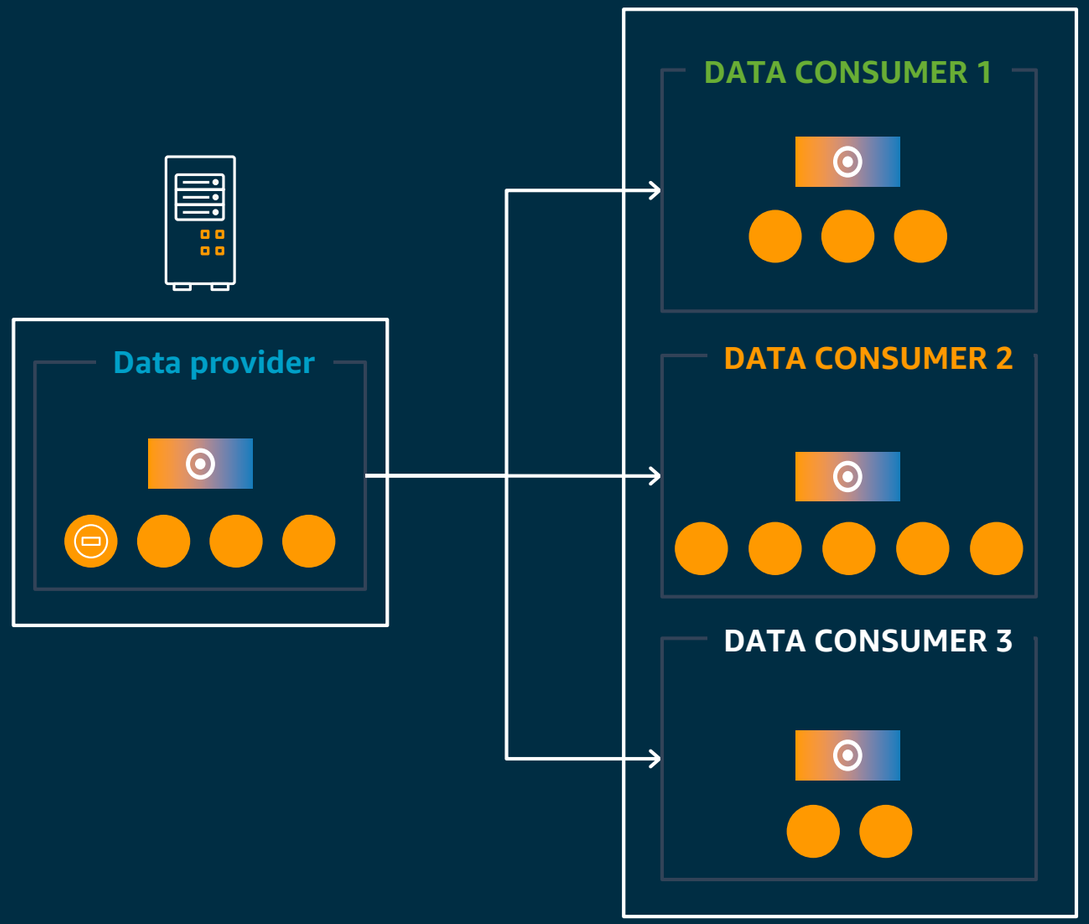
Seamlessly collaborate across business groups for broader analytics and data science and analyze cross-product impact

Eliminate compliance concerns with moving data

Each Amazon Redshift cluster can be producer and consumer of the data

Data sharing use cases (3)

DELIVER DATA AS A SERVICE



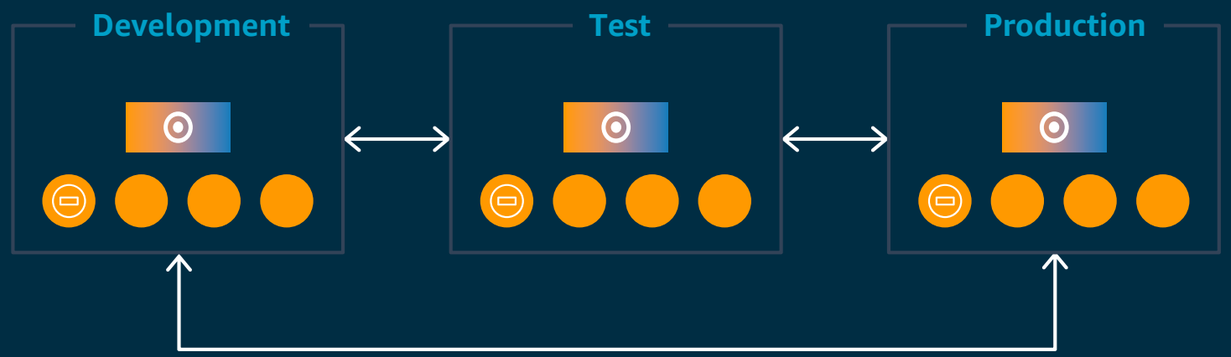
Offer data and analytics as a service within and across organizations and with external parties

Securely share live data with Amazon Redshift clusters in same or different AWS accounts

Monitor / track usage of the data and retain control of the data sets

Data sharing use cases (4)

SHARE DATA BETWEEN ENVIRONMENTS



Improve agility of teams by sharing data between development, test, and production environments at any granularity

Data Sharing in Action - Demo

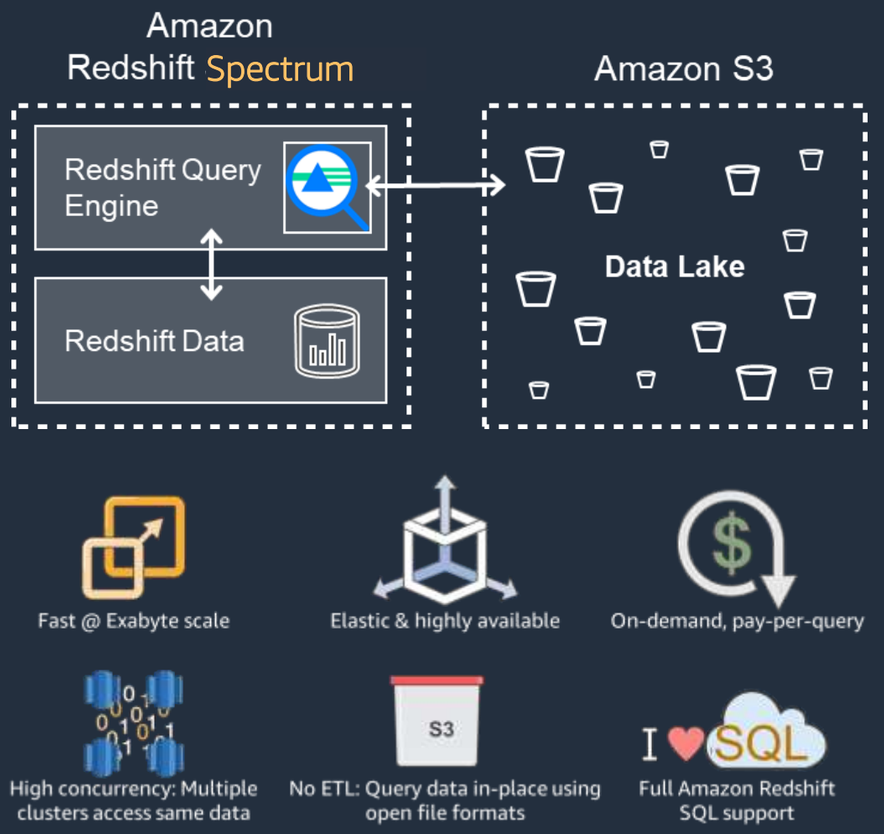
Redshift Spectrum

Redshift Spectrum is a feature of Redshift that allows Redshift SQL queries to reference external data on Amazon S3 as they would any other table in Amazon Redshift

Benefits

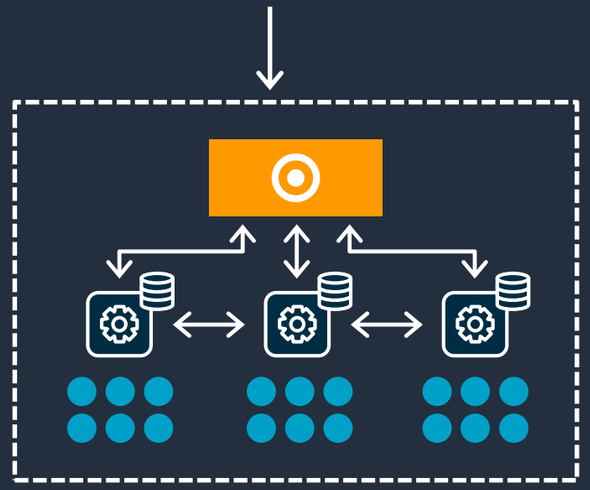
- Enables the Lake House pattern out-of-the-box
- Allows for querying of potentially exabytes of data in an S3 data lake from within Amazon Redshift
- Data is queried in-place, so no loading of data into your Redshift cluster is required
- Keeps your data warehouse lean by ingesting warm data locally while keeping other data in the data lake within reach
- Powered by a separate fleet of powerful Amazon Redshift Spectrum nodes

Run SQL queries directly against data in S3 using thousands of nodes



Concurrency scaling

Amazon Redshift automatically adds transient clusters, in seconds, to serve sudden spike in concurrent requests with consistently fast performance



For every 24 hours that your main cluster is in use, you accrue a one-hour credit for Concurrency Scaling. This means that Concurrency Scaling is free for > 97% of customers.

How it works:

1. All queries go to the leader node, user only sees less wait for queries
2. When queries in designated WLM queue begin queuing, Amazon Redshift automatically routes them to the new clusters, enabling Concurrency Scaling automatically
3. Amazon Redshift automatically spins up a new cluster, processes waiting queries and automatically shuts down the Concurrency Scaling cluster

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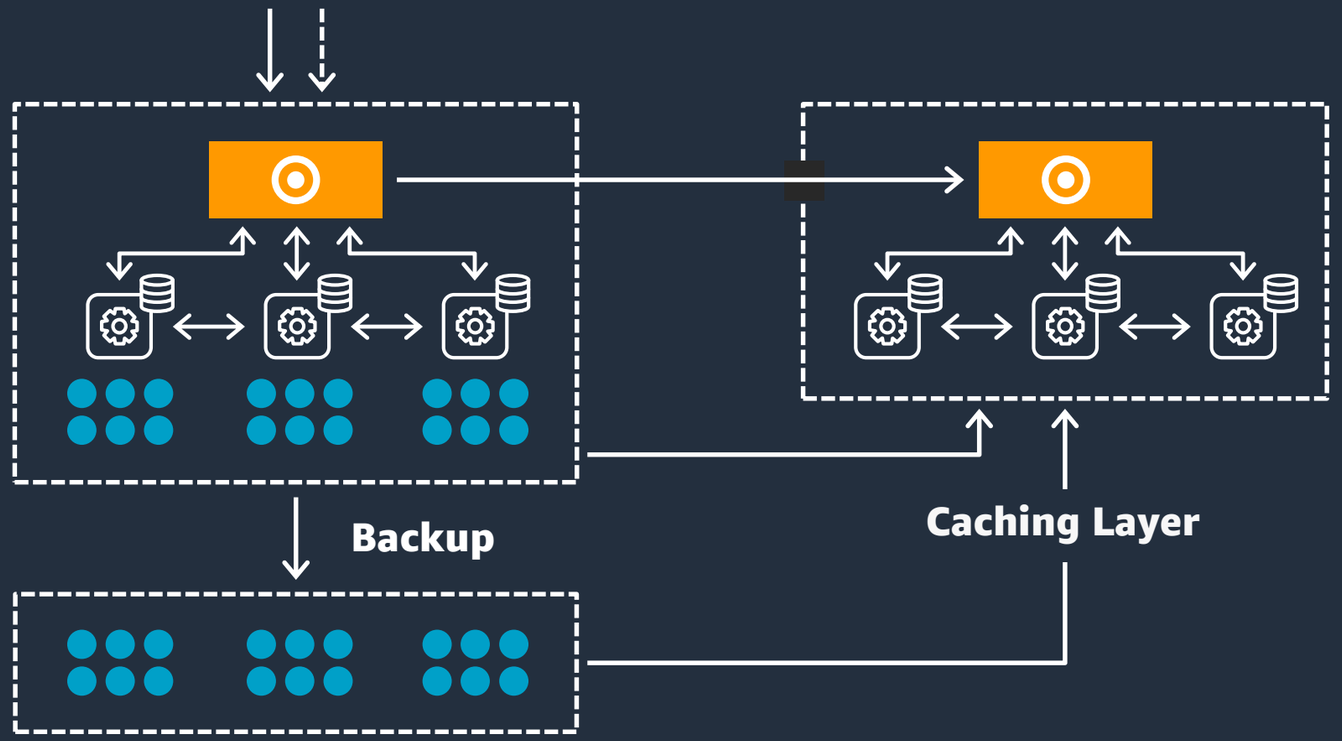

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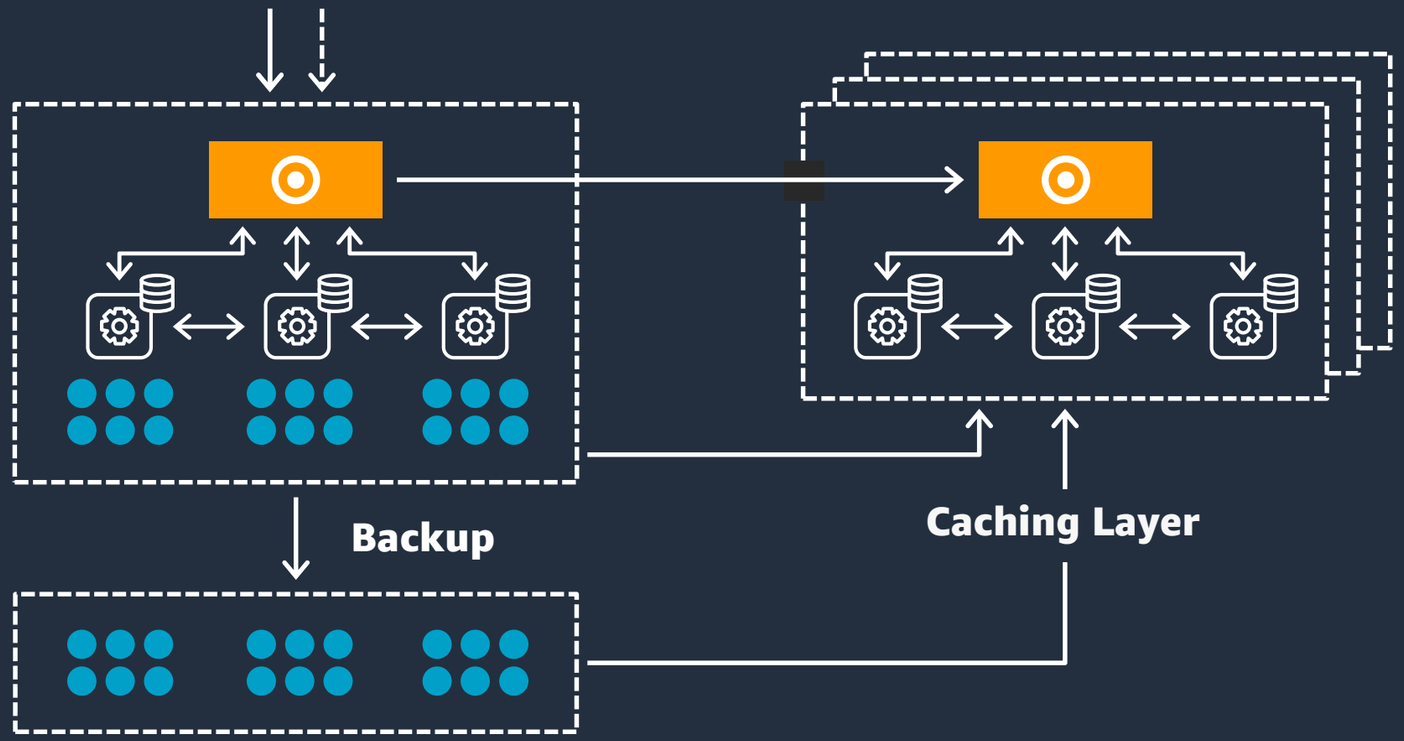

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Resizing Amazon Redshift

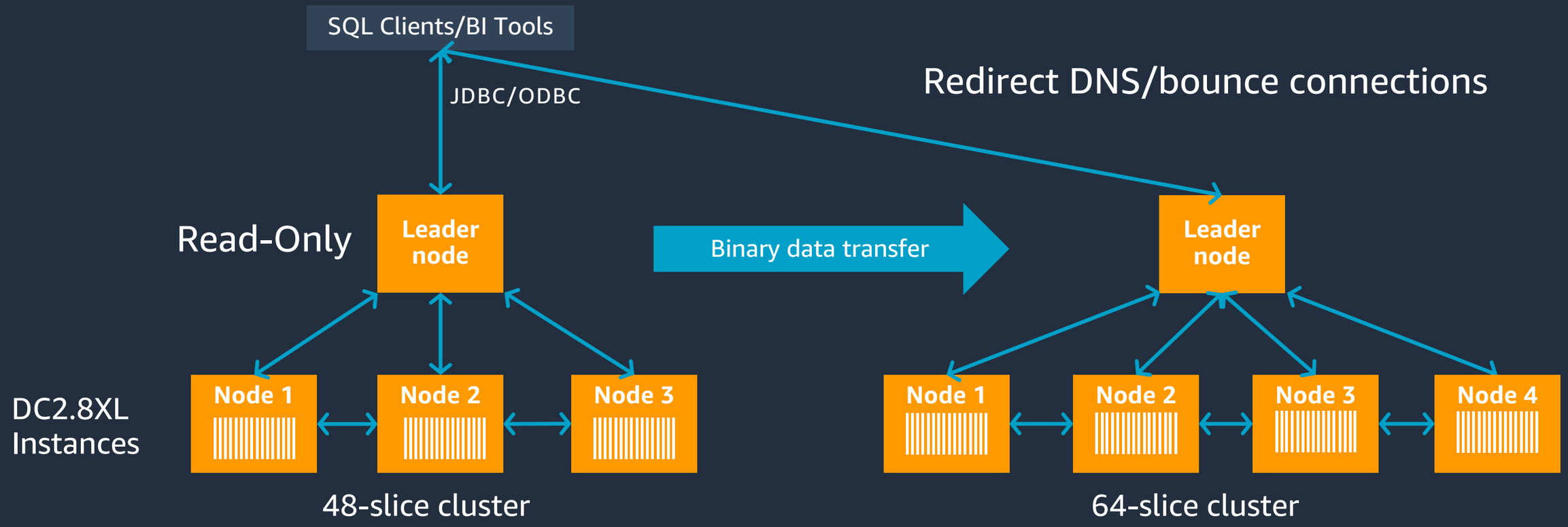
Classic resize

- Data is transferred from old cluster to new cluster (within hours)

Elastic resize

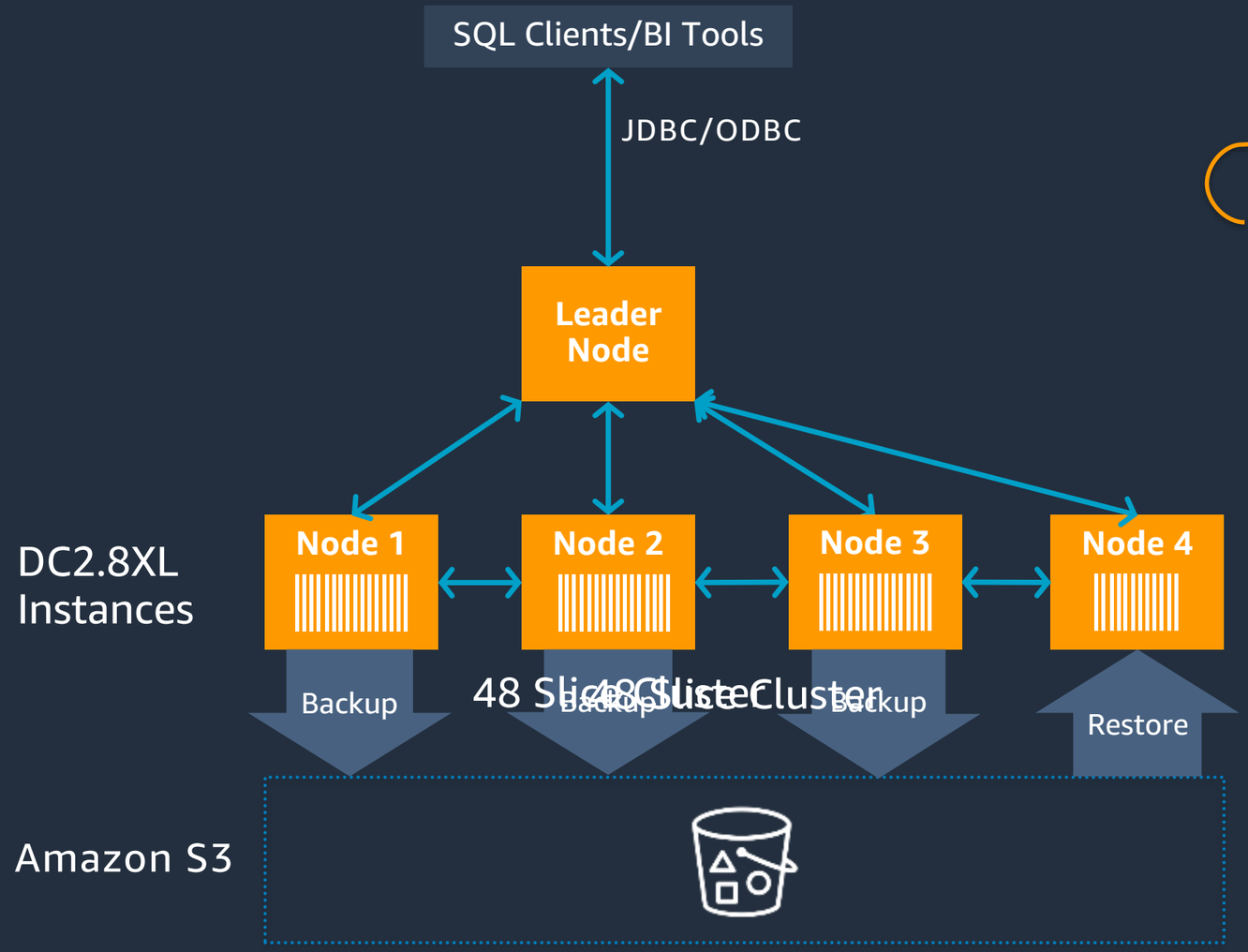
- Nodes are added/removed to/from existing cluster (within minutes)

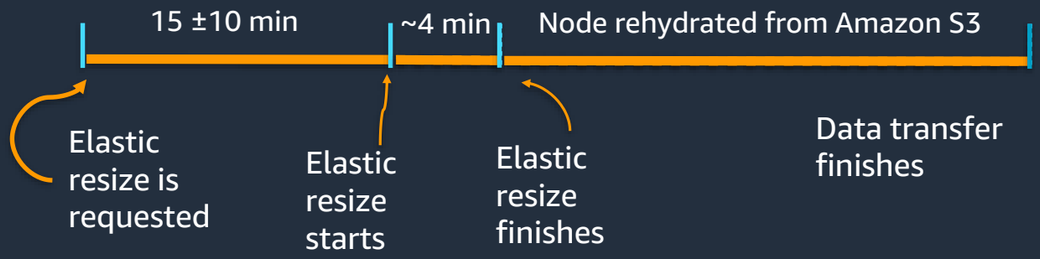
Classic resize



- Source cluster is placed into read-only mode during resize
- All data is copied and redistributed on the target cluster
- Allows for changing node types

Elastic resize



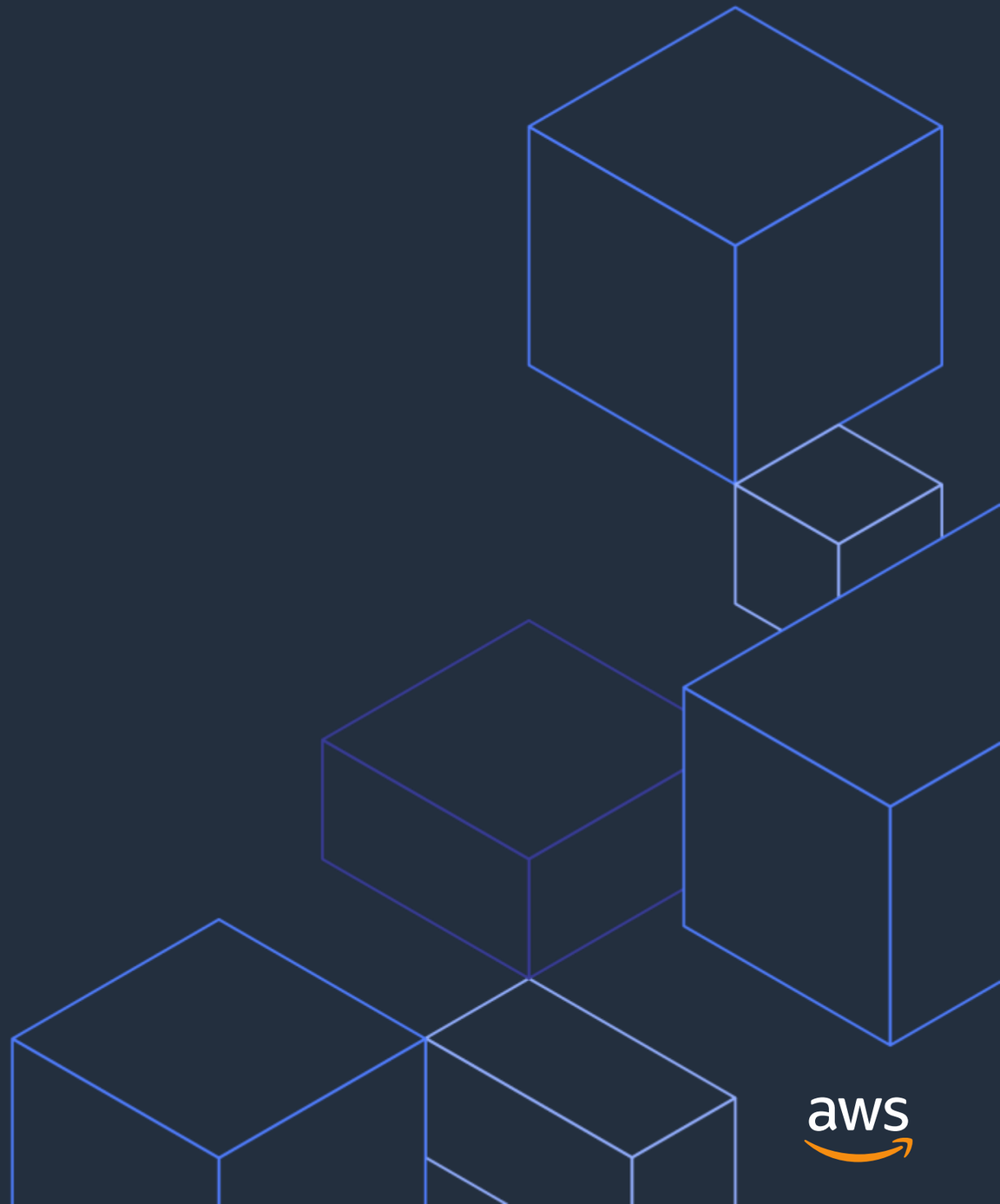


- Cluster is unavailable for ~4 minutes
- Incoming queries/connections are put on hold
- Some queries within transactions maybe rolled back

When to use what kind of scaling?

Scenario	Concurrency Scaling	Elastic Resize	Classic Resize
Unpredictable spiky Workload	✓		
Scale Up and down for known spikes		✓	
Permanently scaling out or scaling in			✓

Auto-Everything



Automated Performance Tuning

ML-BASED OPTIMIZATIONS TO GET STARTED EASILY AND GET THE FASTEST PERFORMANCE QUICKLY

Automates physical data design and optimization

Optimizes for peak performance as data and workloads scale

Leverages machine learning to adapt to shifting workloads

Automated performance tuning

Automatic vacuum delete

Automatic distribution keys

Automatic sort keys

Auto workload manager

Automatic table sort

MV auto-refresh and rewrite

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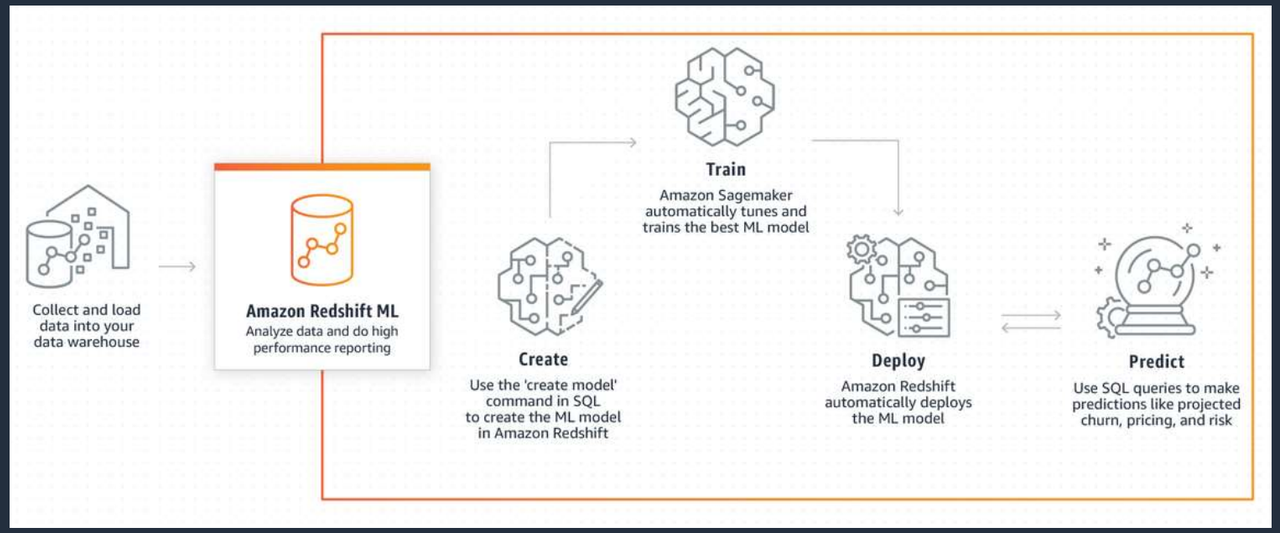
Advanced Analytics Capabilities

Amazon Redshift ML

EASILY CREATE AND TRAIN ML MODELS USING SQL QUERIES WITH AMAZON SAGEMAKER

- Use case: Product recommendations, fraud prevention, reduce customer churn
- Train and apply ML models using SQL
- From fully automated training to partially or fully guided training
- Automatic pre-processing, creation, training, deployment of your model
- Deploy inference models locally in Amazon Redshift
- Run an inference as invoking a user-defined function as part of SQL statements




```
CREATE MODEL customer_churn
FROM (SELECT c.age, c.zip, c.monthly_spend, c.monthly_cases,
c.active FROM customer_info_table c)
TARGET c.active
FUNCTION predict_customer_churn
...;
```

```
SELECT n.id, n.firstName, n.lastName,
predict_customer_churn(n.age,c.zip,..)
AS activity_prediction
FROM new_customers n
WHERE n.marital_status = 'single'
...;
```

Redshift ML in Action - Demo

Native Semi Structured Data Support

New data type: **SUPER**

Easy, efficient, and powerful JSON processing

Fast row-oriented data ingestion

Fast column-oriented analytics with materialized views over SUPER/JSON

Access to schema-less nested data with easy-to-use SQL extensions powered by the PartiQL query language

id INTEGER	**name** **SUPER**	phones SUPER
1	{"given":"Jane", "family":"Doe"}	[{"type":"work", "num":"9255550100"}, {"type":"cell", "num": 6505550101}]
2	{"given":„Richard", "family":„Roe"},	[{"type":"work", "num": 5105550102}]

```
SELECT name.given AS firstname, ph.num
FROM customers c, c.phones ph
WHERE ph.type = 'cell';

firstname | num
----------+--------------
"Jane"    | 6505550101
```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Super Data type in Action - Demo

Materialized Views

SPEED UP QUERY PERFORMANCE BY ORDERS OF MAGNITUDE WITH PRECOMPUTED RESULTS

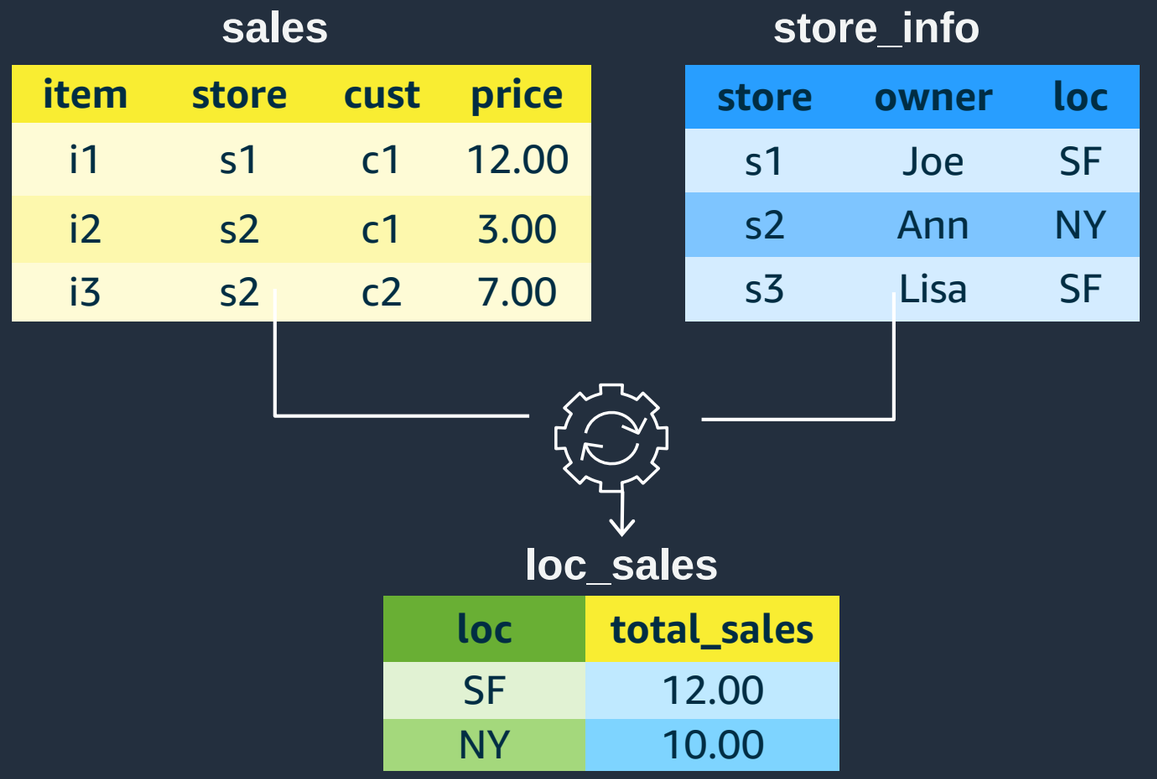
Simplify and accelerate iterative and predictable workloads, such as ETL, BI/dashboarding queries

MVs can be based on one or more Amazon Redshift tables or external tables (Spectrum, Federated)

Efficient incremental maintenance

Scheduled, automatic, or manually timed refresh

Amazon Redshift auto query rewrite optimizes queries by replacing native tables with materialized views



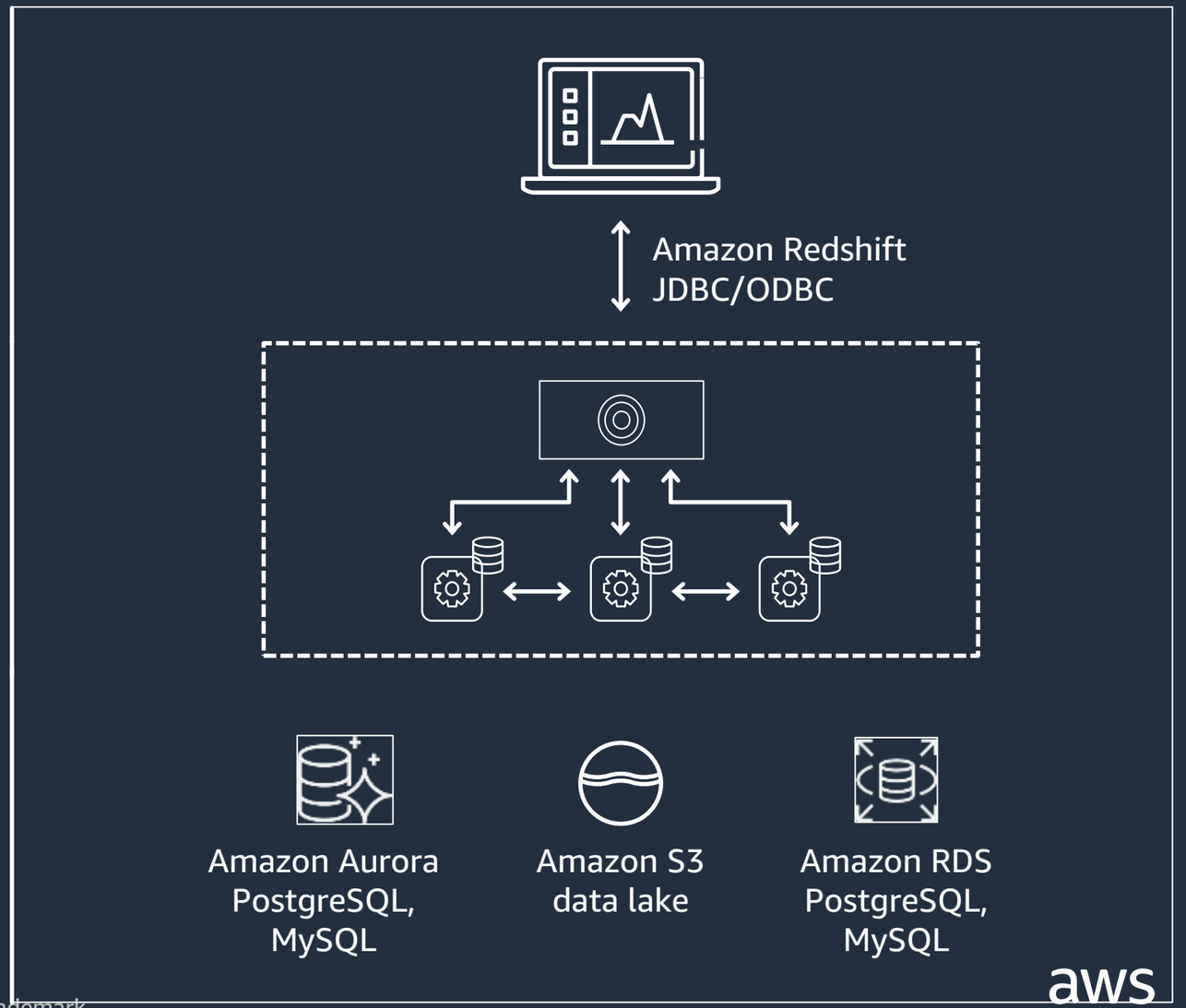
"The Amazon Redshift materialized view auto query rewrite feature reduced dashboard load times from 8 minutes to just 500 ms. The best part is that this is completely transparent for Tableau and the business user."

Arman Nasrollahi, Home24

Amazon Redshift Federated Query

UNIFIED ANALYTICS ACROSS DATABASES, DATA WAREHOUSE, AND DATA LAKE

- Use case: Integrate operational data with DW and data lake for real-time analytics
- Analytics on operational data without data movement and ETL delays
- Query and join data from one or more Amazon RDS and Aurora PostgreSQL databases
- Flexible and easy way to ingest data avoiding complex ETL pipelines
- Intelligent distribution of computation to remote sources to optimize performance
- Preview — Amazon RDS and Aurora MySQL support



Integration with Analytics Services

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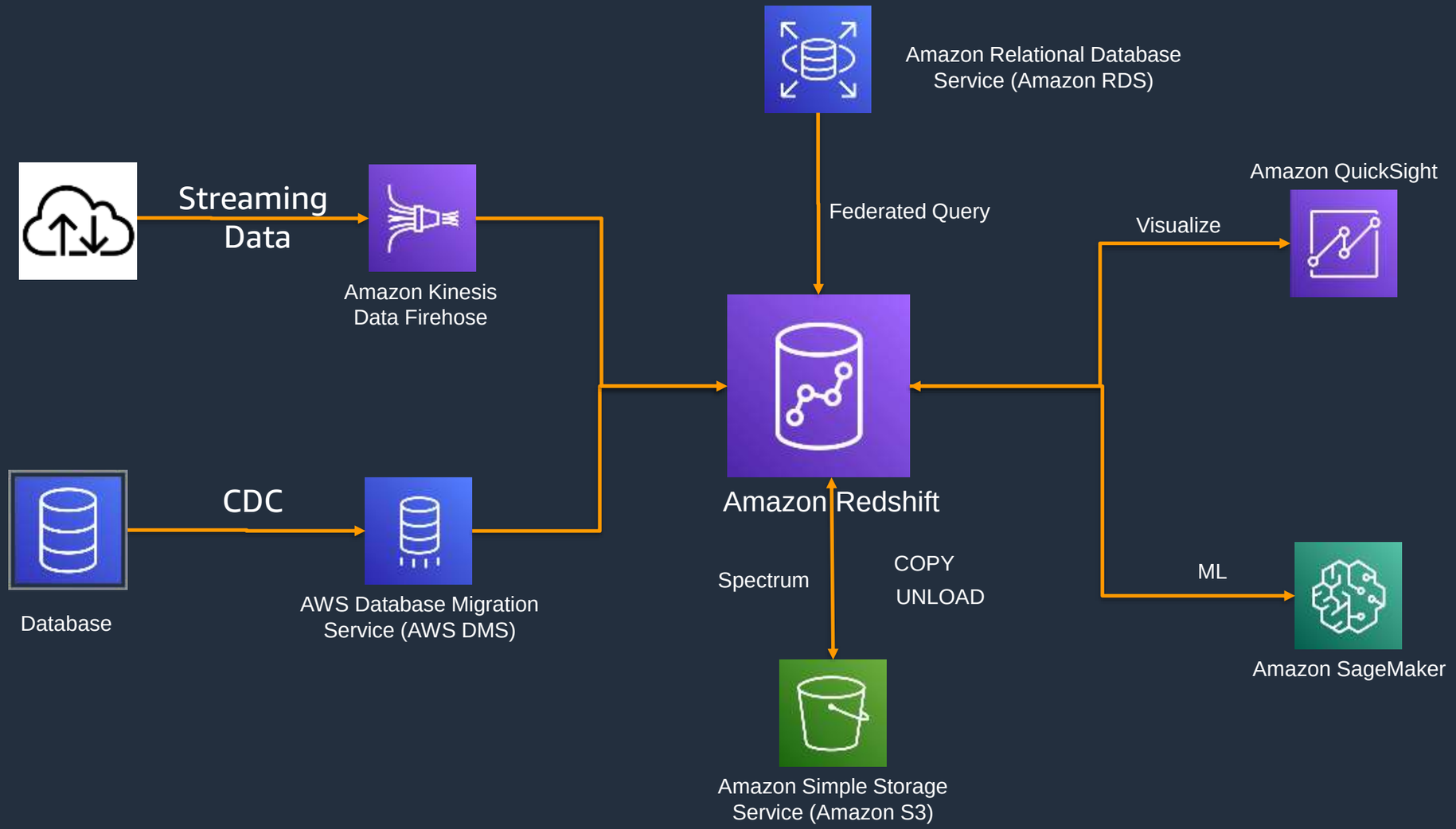
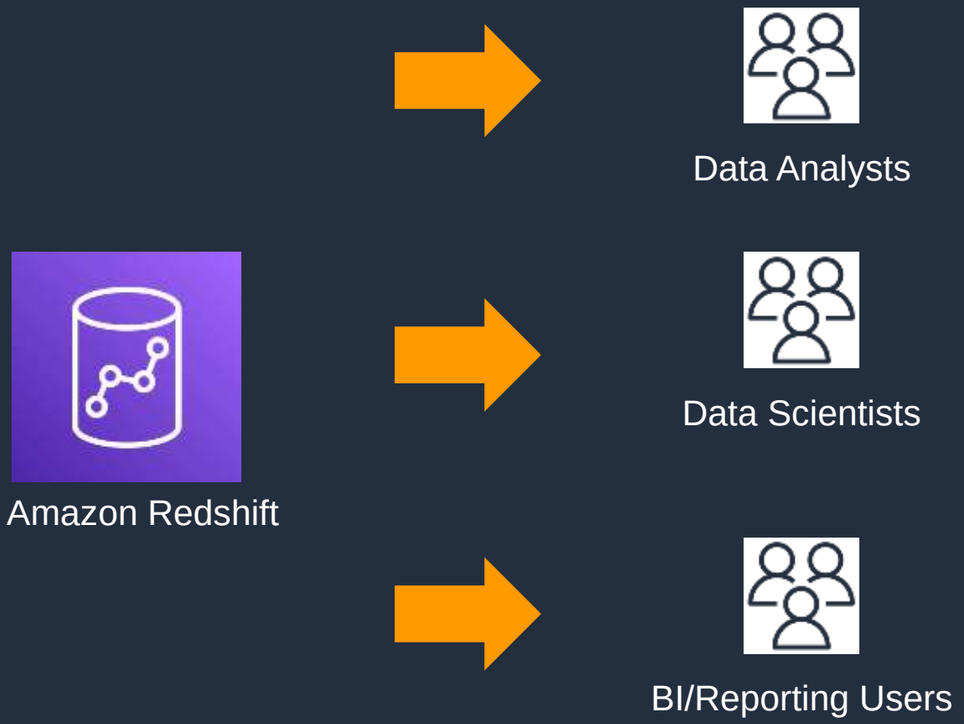


Variety of Personas and Use cases

Variety of Personas and Use Cases



Customer Case studies

Tens of thousands of customers process exabytes of data with Amazon Redshift daily

NTT DOCOMO

Moved >10 PB of data from on-premises to cloud

FOX Corp.

Taking a lake house approach with RA3 nodes and Amazon S3

Dream11

Reporting for Finance and Product Teams for better decision making

DSP Mutual Fund

Building a data platform using Amazon Redshift to democratize access to data

Warner Bros. Games

Performance, scale, cost-effective

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Migration to Amazon Redshift

AWS data migrations: broadest toolkit

AWS provides the broadest range of tools for easy, fast, and secure data movement to and from the AWS cloud

AWS Direct Connect

AWS Snowball

Amazon S3 Transfer Acceleration

AWS Storage Gateway

AWS Schema Conversion Tool (SCT)

AWS Database Migration Service (DMS)

Migrate with AWS partners

AWS consulting partners offer a wide range of migration services to help you move your data warehouse to Amazon Redshift. **AWS Data Warehouse Migration Partners** provide support to accelerate moving a data warehouse to the cloud with proven best practices and resources. The **AWS Service Delivery Partners** have deep understanding of specific AWS services, follow best practices and have proven success delivering AWS services to customers.

This is not a complete list; to view all Amazon Redshift partners, visit https://aws.amazon.com/redshift/partners/

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Thank You