

# AWS Summits 2014

## Uses & Best Practices for Amazon Redshift

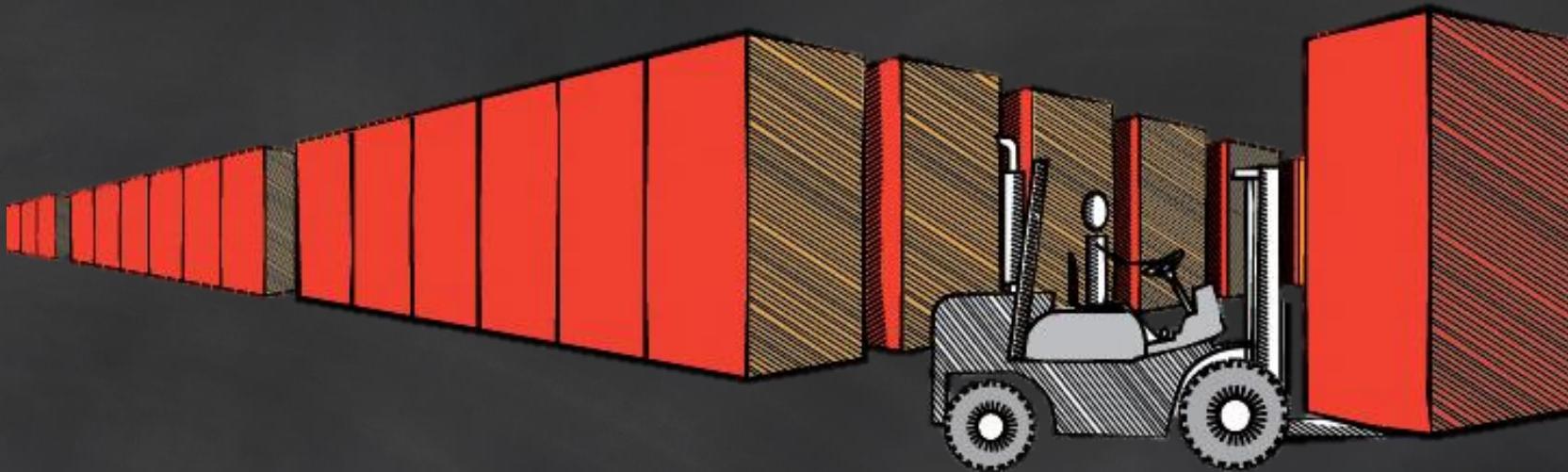
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Jie Li, Pinterest ([jay23jack@](mailto:jay23jack@))

March 26, 2014



# Amazon Redshift



Fast, simple, petabyte-scale data warehousing for less than \$1,000/TB/Year



## Collect



Direct Connect



DynamoDB



Kinesis

## Store



S3



Glacier

## Analyze



EMR



Redshift



EC2

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2014





Amazon  
Redshift

Petabyte scale

Massively parallel

Relational data warehouse

Fully managed; zero admin



*a lot faster  
a lot cheaper  
a whole lot simpler*

# Common Customer Use Cases



## Traditional Enterprise DW

- Reduce costs by extending DW rather than adding HW
- Migrate completely from existing DW systems
- Respond faster to business



## Companies with Big Data

- Improve performance by an order of magnitude
- Make more data available for analysis
- Access business data via standard reporting tools



## SaaS Companies

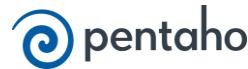
- Add analytic functionality to applications
- Scale DW capacity as demand grows
- Reduce HW & SW costs by an order of magnitude



# Amazon Redshift Customers



# Growing Ecosystem



# AWS Marketplace

- Find software to use with Amazon Redshift
- One-click deployments
- Flexible pricing options

The screenshot shows the AWS Marketplace homepage with a search bar at the top. The search term "Amazon Redshift" has been entered. On the left, there's a sidebar with categories like All Categories, Business Software, Business Intelligence, and Amazon Redshift. Below that are filters for Operating System (Windows releases: All, Linux/UNIX distributions: All), and a "Featured Products" section with logos for JasperSoft, MicroStrategy, ATTUNITY CloudBeam, and birst.

**Amazon Redshift**

Amazon Redshift is a fast and powerful, fully managed, petabyte-scale data warehouse service in the cloud. Amazon Redshift offers you fast query performance when analyzing virtually any size data set using the same SQL-based tools and business intelligence applications you use today. With a few clicks in the AWS Management Console, you can launch an Amazon Redshift cluster, starting with a few hundred gigabytes of data and scaling to a petabyte or more. [Read more](#)

**Resources**

**Amazon Redshift**  
Fast and Powerful, Petabyte-Scale Data Warehouse Service

**AWS Partners**  
AWS Partners can help you with data warehousing, BI and more

**Featured Products**

**Jaspersoft Reporting and Analytics for AWS (Hourly)**  
Jaspersoft Reporting and Analytics fo...  
Jaspersoft \$0.40 to \$5.54/hr for software

**Free MicroStrategy Suite**  
MicroStrategy \$0.00/hr for software

**ATTUNITY CloudBeam**  
Attunity From \$49.95 per month

**birst**  
Birst Birst From \$995 per month

**Amazon Redshift (9 results)**

**Jaspersoft Reporting and Analytics for AWS (Hourly)**  
★★★★★ (11) Version 5.5.0 | Sold by Jaspersoft  
\$0.40 to \$5.54/hr for software + AWS usage fees  
Jaspersoft for AWS is a commercial open source reporting and analytics server built for AWS that can run standalone or be embedded in your application. It is priced very ...  
Linux/Unix, Amazon Linux 2013.03 | 64-bit Amazon Machine Image (AMI)

**MicroStrategy Free MicroStrategy Suite**  
★★★★★ (3) Version 9.3.1 | Sold by MicroStrategy  
\$0.00/hr for software + AWS usage fees  
MicroStrategy Suite is a powerful free Mobile and Business Intelligence solution that gives

<http://aws.amazon.com/marketplace/redshift>



# Data Loading Options

- Parallel upload to Amazon S3
- AWS Direct Connect
- AWS Import/Export
- Amazon Kinesis
- Systems integrators

## Data Integration



## Systems Integrators

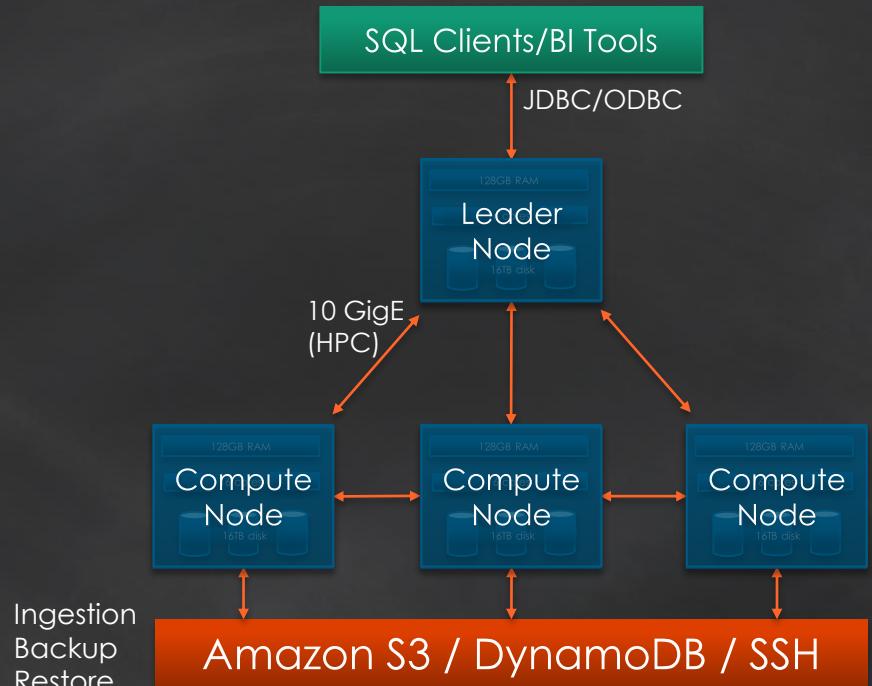


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# Amazon Redshift Architecture

- Leader Node
  - SQL endpoint
  - Stores metadata
  - Coordinates query execution
- Compute Nodes
  - Local, columnar storage
  - Execute queries in parallel
  - Load, backup, restore via Amazon S3; load from Amazon DynamoDB or SSH
- Two hardware platforms
  - Optimized for data processing
  - DW1: HDD; scale from 2TB to 1.6PB
  - DW2: SSD; scale from 160GB to 256TB



# Amazon Redshift Node Types

**DW1.XL:** 16 GB RAM, 2 Cores

3 Spindles, 2 TB compressed storage

**DW1.8XL:** 128 GB RAM, 16 Cores, 24

Spindles 16 TB compressed, 2 GB/sec scan  
rate

- Optimized for I/O intensive workloads
  - High disk density
  - On demand at \$0.85/hour
  - As low as \$1,000/TB/Year
  - Scale from 2TB to 1.6PB
- 

**DW2.L \*New\*:** 16 GB RAM, 2 Cores,

160 GB compressed SSD storage

- High performance at smaller storage size
- High compute and memory density
- On demand at \$0.25/hour
- As low as \$5,500/TB/Year
- Scale from 160GB to 256TB

**DW2.8XL \*New\*:** 256 GB RAM, 32 Cores,

2.56 TB of compressed SSD storage



# Amazon Redshift dramatically reduces I/O

- Column storage
- Data compression
- Zone maps
- Direct-attached storage

ID	Age	State	Amount
123	20	CA	500
345	25	WA	250
678	40	FL	125
957	37	WA	375

- With row storage you do unnecessary I/O
- To get total amount, you have to read everything



# Amazon Redshift dramatically reduces I/O

- Column storage
- Data compression
- Zone maps
- Direct-attached storage



- With column storage, you only read the data you need



# Amazon Redshift dramatically reduces I/O

- Column storage
- **Data compression**
- Zone maps
- Direct-attached storage

```
analyze compression listing;

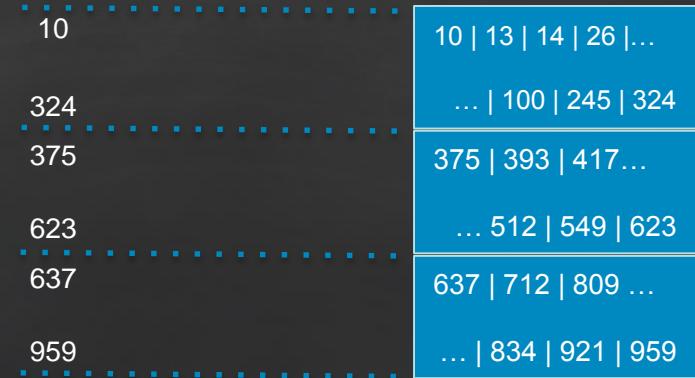
Table | Column      | Encoding
-----+-----+-----+
listing | listid      | delta
listing | sellerid    | delta32k
listing | eventid     | delta32k
listing | dateid      | bytedict
listing | numtickets   | bytedict
listing | priceperticket | delta32k
listing | totalprice   | mostly32
listing | listtime     | raw
```

- COPY compresses automatically
- You can analyze and override
- More performance, less cost



# Amazon Redshift dramatically reduces I/O

- Column storage
- Data compression
- **Zone maps**
- Direct-attached storage



- Track the minimum and maximum value for each block
- Skip over blocks that don't contain relevant data



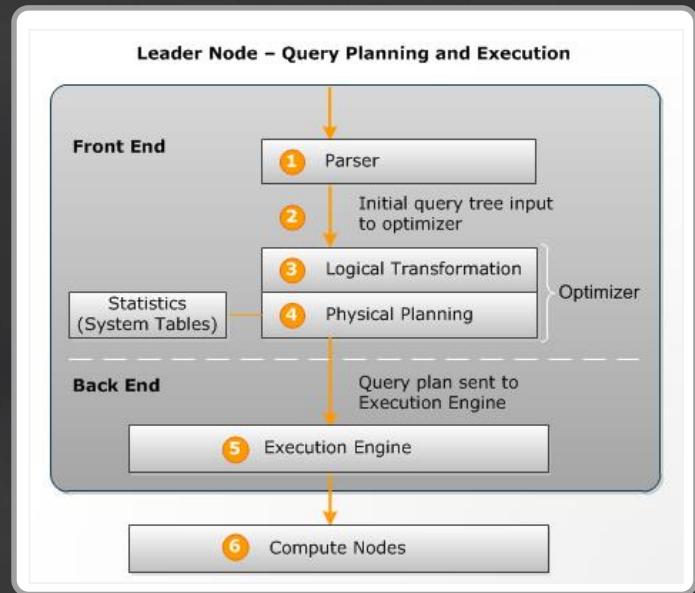
# Amazon Redshift dramatically reduces I/O

- Column storage
- Data compression
- Zone maps
- **Direct-attached storage**
- Use local storage for performance
- Maximize scan rates
- Automatic replication and continuous backup
- HDD & SSD platforms



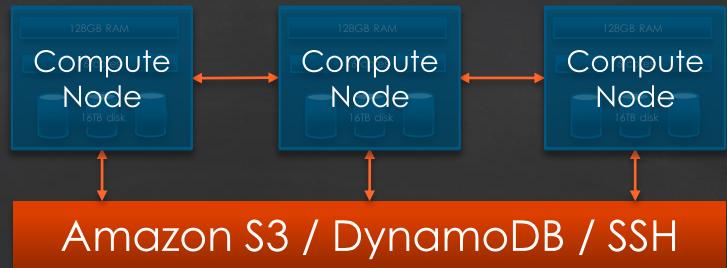
# Amazon Redshift parallelizes and distributes everything

- Query
- Load
- Backup/Restore
- Resize



# Amazon Redshift parallelizes and distributes everything

- Query
- Load
- Backup/Restore
- Resize



- Load in parallel from Amazon S3 or Amazon DynamoDB or any SSH connection
- Data automatically distributed and sorted according to DDL
- Scales linearly with number of nodes



# Amazon Redshift parallelizes and distributes everything

- Query
- Load
- **Backup/Restore**
- Resize



- Backups to Amazon S3 are automatic, continuous and incremental
- Configurable system snapshot retention period. Take user snapshots on-demand
- Cross region backups for disaster recovery
- Streaming restores enable you to resume querying faster



# Amazon Redshift parallelizes and distributes everything

- Query
- Load
- Backup/Restore
- **Resize**

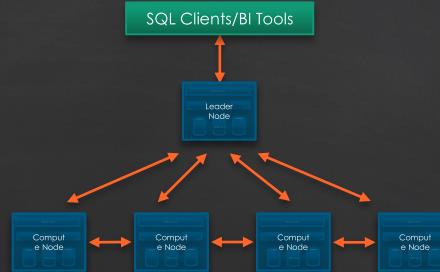


- Resize while remaining online
- Provision a new cluster in the background
- Copy data in parallel from node to node
- Only charged for source cluster



# Amazon Redshift parallelizes and distributes everything

- Query
- Load
- Backup/Restore
- **Resize**



- Automatic SQL endpoint switchover via DNS
- Decommission the source cluster
- Simple operation via Console or API



# Amazon Redshift is priced to let you analyze all your data

DW1 (HDD)	Price Per Hour for DW1.XL Single Node	Effective Annual Price per TB
On-Demand	\$ 0.850	\$ 3,723
1 Year Reservation	\$ 0.500	\$ 2,190
3 Year Reservation	\$ 0.228	\$ 999

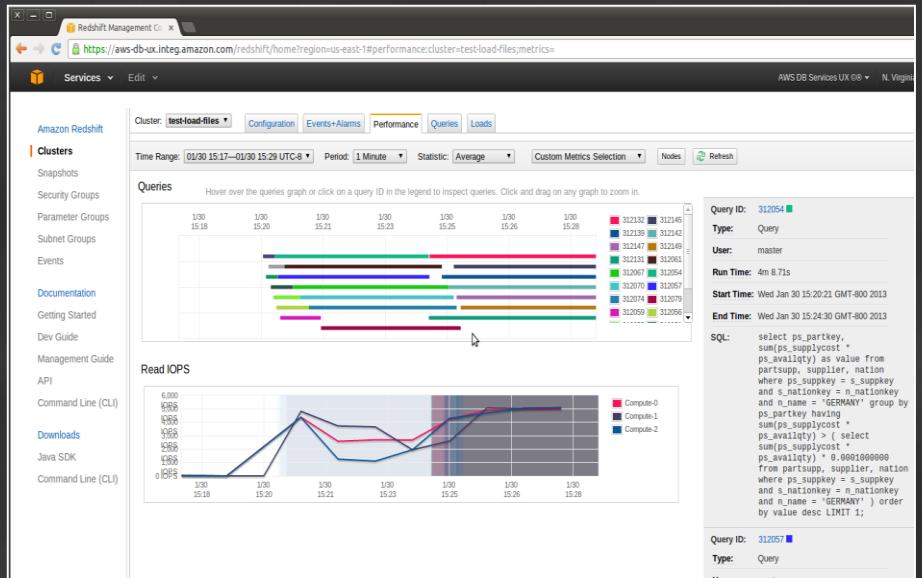
- Number of nodes x cost per hour
- No charge for leader node
- No upfront costs
- Pay as you go

DW2 (SSD)	Price Per Hour for DW2.L Single Node	Effective Annual Price per TB
On-Demand	\$ 0.250	\$ 13,688
1 Year Reservation	\$ 0.161	\$ 8,794
3 Year Reservation	\$ 0.100	\$ 5,498



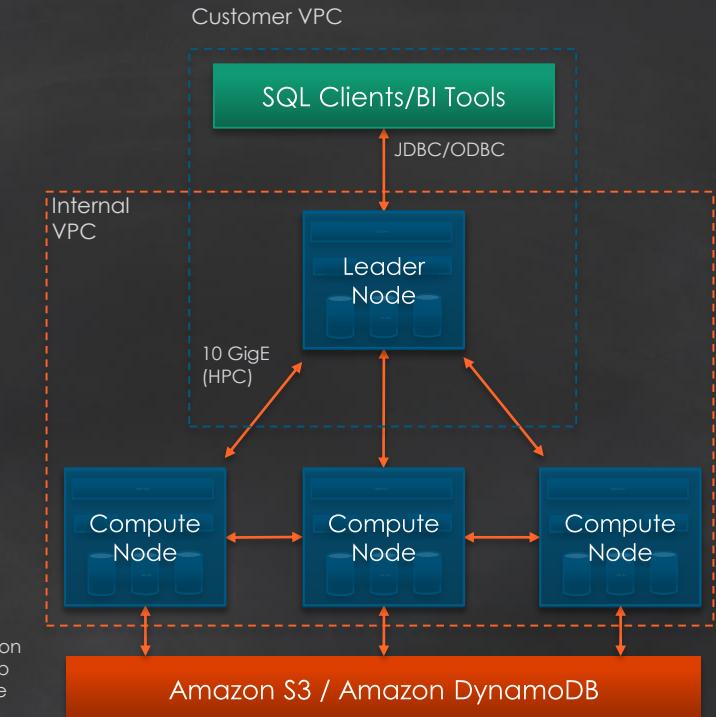
# Amazon Redshift is easy to use

- Provision in minutes
- Monitor query performance
- Point and click resize
- Built in security
- Automatic backups



# Amazon Redshift has security built-in

- SSL to secure data in transit
- Encryption to secure data at rest
  - AES-256; hardware accelerated
  - All blocks on disks and in Amazon S3 encrypted
  - HSM Support
- No direct access to compute nodes
- Audit logging & AWS CloudTrail integration
- Amazon VPC support



# Amazon Redshift continuously backs up your data and recovers from failures

- Replication within the cluster and backup to Amazon S3 to maintain multiple copies of data at all times
- Backups to Amazon S3 are continuous, automatic, and incremental
  - Designed for eleven nines of durability
- Continuous monitoring and automated recovery from failures of drives and nodes
- Able to restore snapshots to any Availability Zone within a region
- Easily enable backups to a second region for disaster recovery

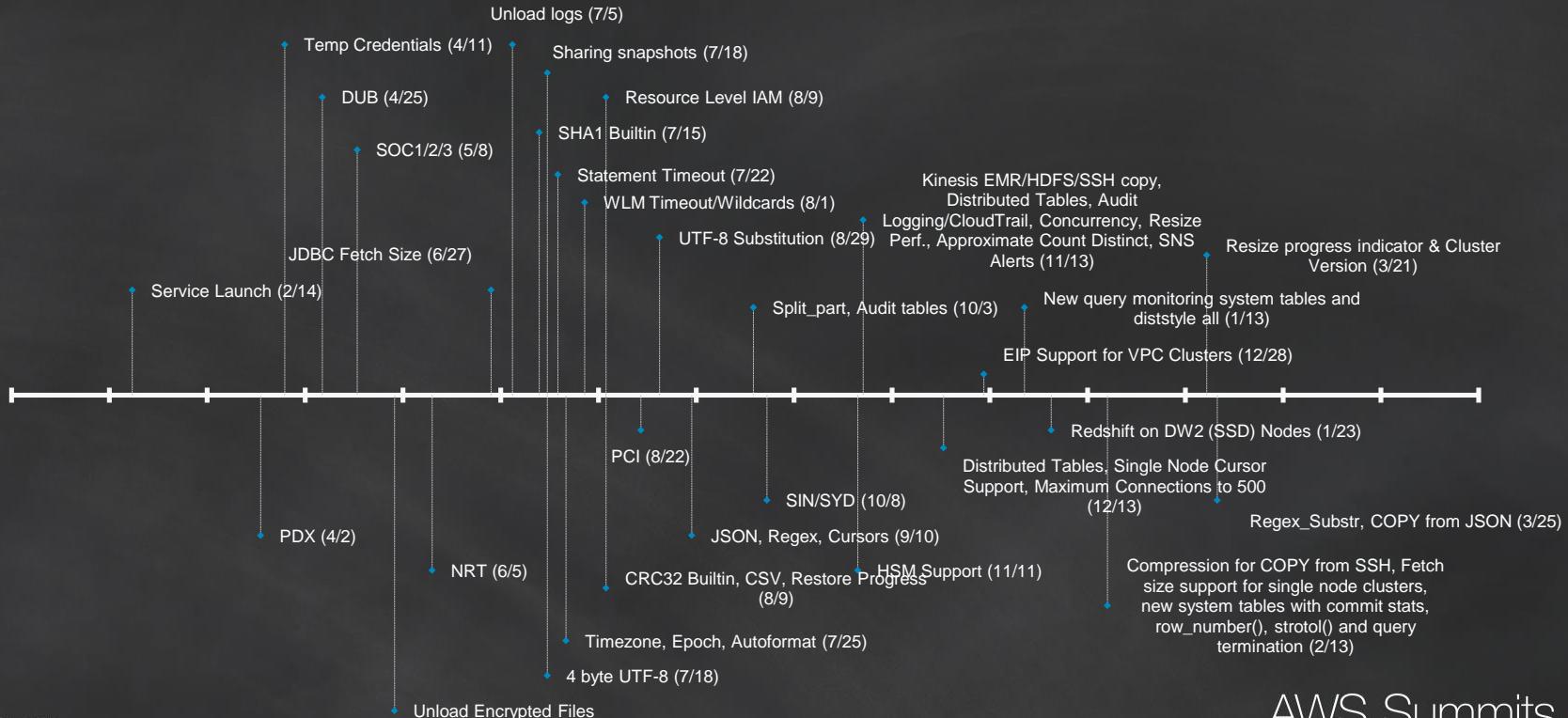


# 50+ new features since launch

- Regions – N. Virginia, Oregon, Dublin, Tokyo, Singapore, Sydney
- Certifications – PCI, SOC 1/2/3
- Security – Load/unload encrypted files, Resource-level IAM, Temporary credentials, HSM
- Manageability – Snapshot sharing, backup/restore/resize progress indicators, Cross-region
- Query – Regex, Cursors, MD5, SHA1, Time zone, workload queue timeout, HLL
- Ingestion – S3 Manifest, LZOP/LZO, JSON built-ins, UTF-8 4byte, invalid character substitution, CSV, auto datetime format detection, epoch, Ingest from SSH



# Amazon Redshift Feature Delivery



# COPY from JSON

```
{  
  "jsonpaths":  
  [  
    "$['id']",  
    "$['name']",  
    "$['location'][0]",  
    "$['location'][1]",  
    "$['seats']"  
  ]  
}
```

```
COPY venue FROM 's3://mybucket/venue.json' credentials  
'aws_access_key_id=ACCESS-KEY-ID; aws_secret_access_key=SECRET-ACCESS-KEY'  
JSON AS 's3://mybucket/venue_jsonpaths.json';
```



# REGEX\_SUBSTR()

```
select email, regexp_substr(email,'@[^.]*')  
from users limit 5;
```

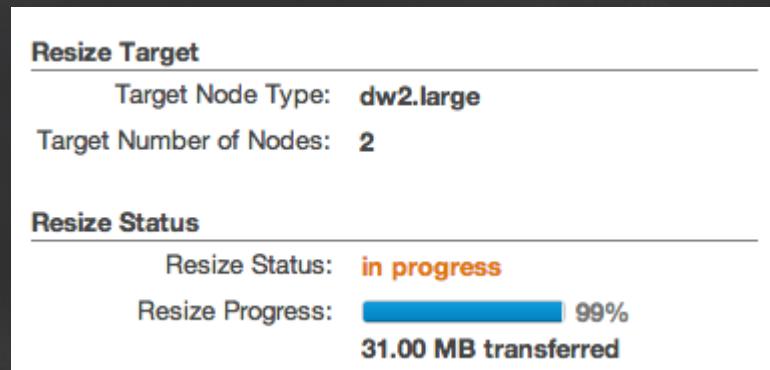
email	regexp_substr
Suspendisse.tristique@nonnisiAenean.edu	@nonnisiAenean
sed@lacusUtnec.ca	@lacusUtnec
elementum@semperpremiumneque.ca	@semperpremiumneque
Integer.mollis.Integer@tristiquealiquet.org	@tristiquealiquet
Donec.fringilla@sodalesat.org	@sodalesat



# Resize Progress

- Progress indicator in console
- New API call

DescribeResize





# Powering interactive data analysis by Amazon Redshift

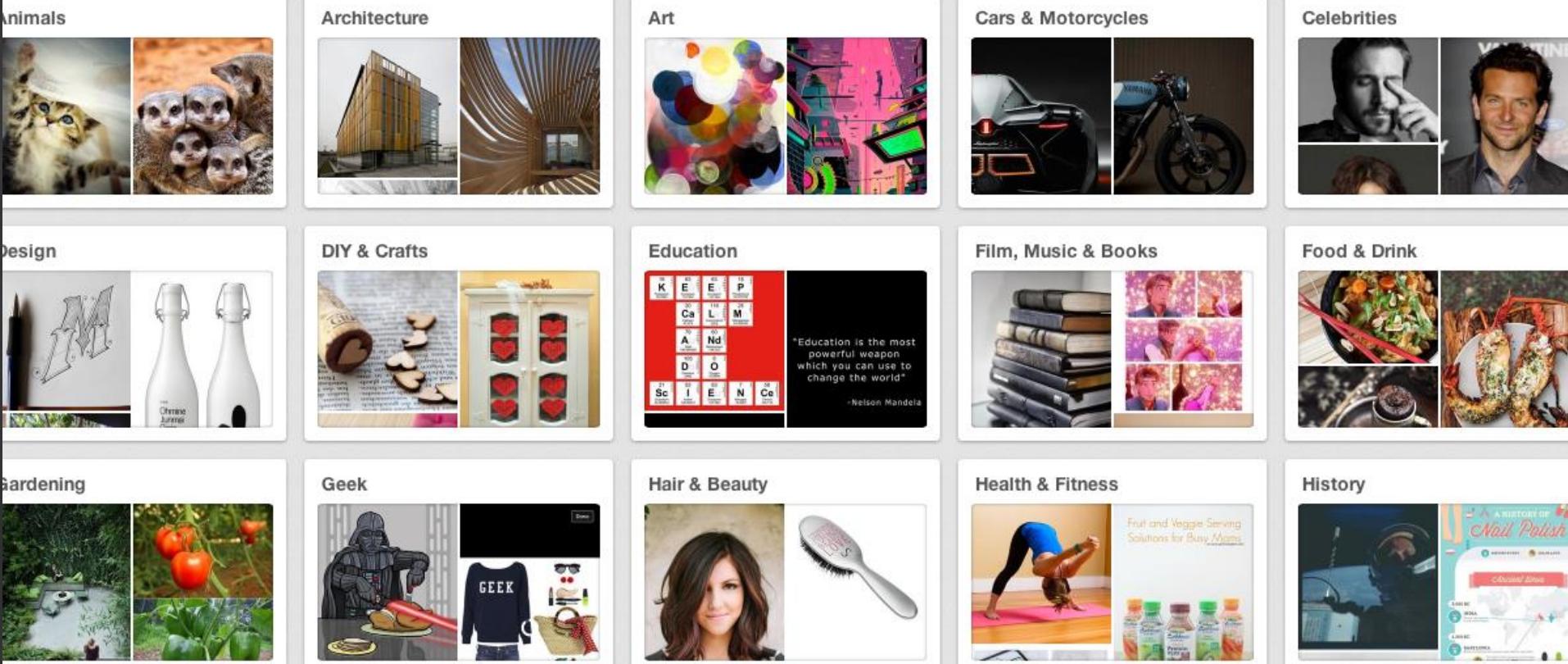
Jie Li  
Data Infra at Pinterest



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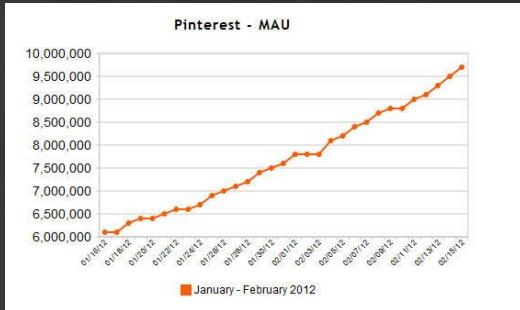


# Pinterest: a visual discovery and collection tool

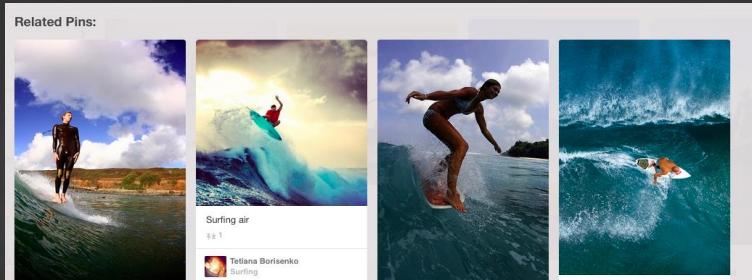


# How we use data

## KPI



## Recommendations



## A/B Experiments

Find Friends

Alex Bao  
Follow

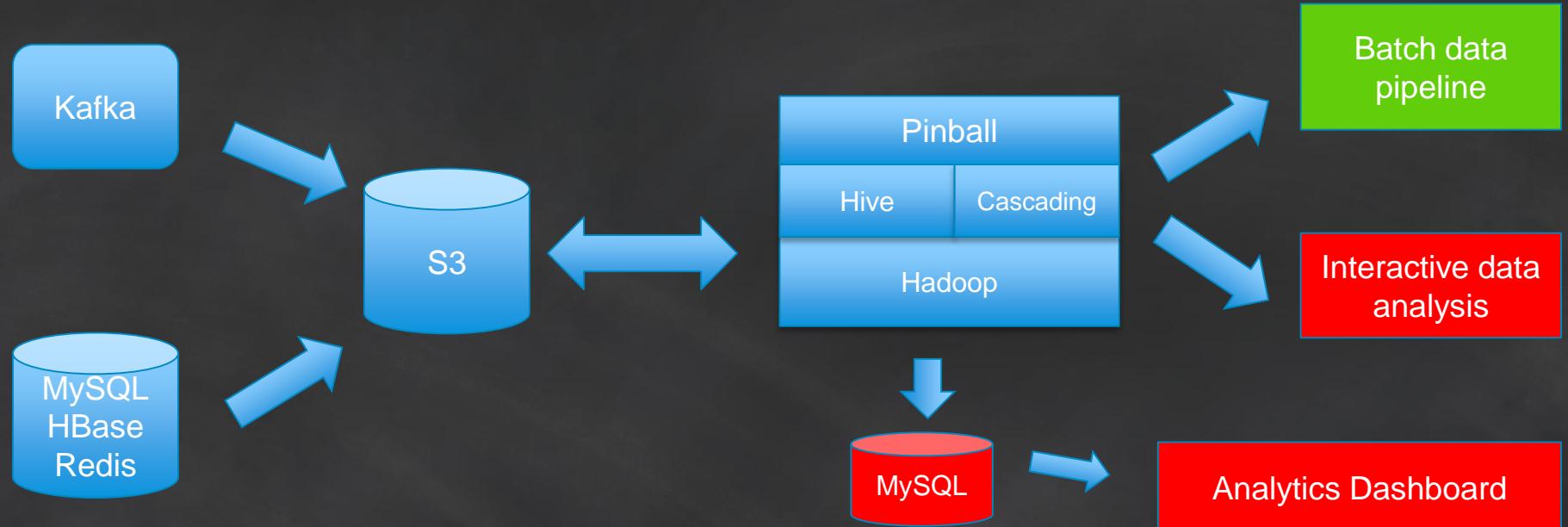
Ryan Probasco  
Follow

Jason Costa  
Follow

Invite Friends to Pinterest



# Data Infra at Pinterest (early 2013)



# Low-latency Data Warehouse

- SQL on Hadoop
  - Shark, Impala, Drill, Tez, Presto, ...
  - Open source but **immature**
- Massive Parallel Processing (MPP)
  - Asterdata, Vertica, ParAccel, ...
  - Mature but **expensive**
- Amazon Redshift
  - ParAccel on AWS
  - **Mature but also cost-effective**



# Highlights of Amazon Redshift

## Low Cost

- On-demand \$0.85 per hour
- 3yr Reserved Instances \$999/TB/year
- Free snapshots on Amazon S3



# Highlights of Amazon Redshift

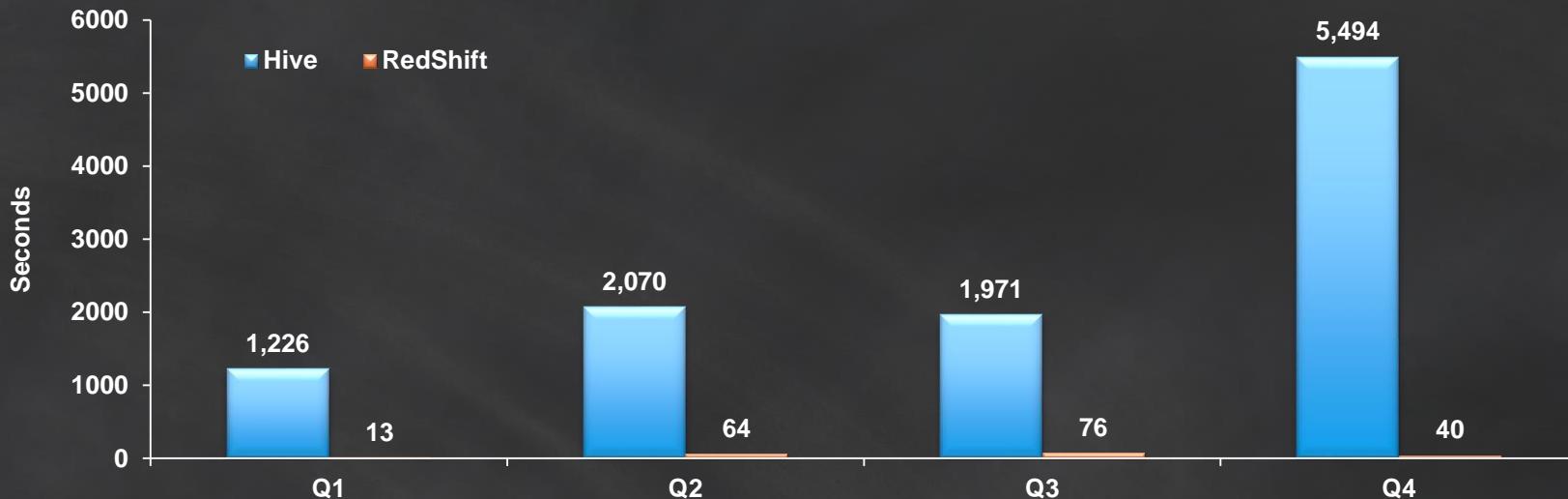
## Low maintenance overhead

- Fully self-managed
- Automated maintenance & upgrades
- Built-in admin dashboard



# Highlights of Amazon Redshift

Superior performance (25-100x over Hive)



Note: based on our own dataset and queries.

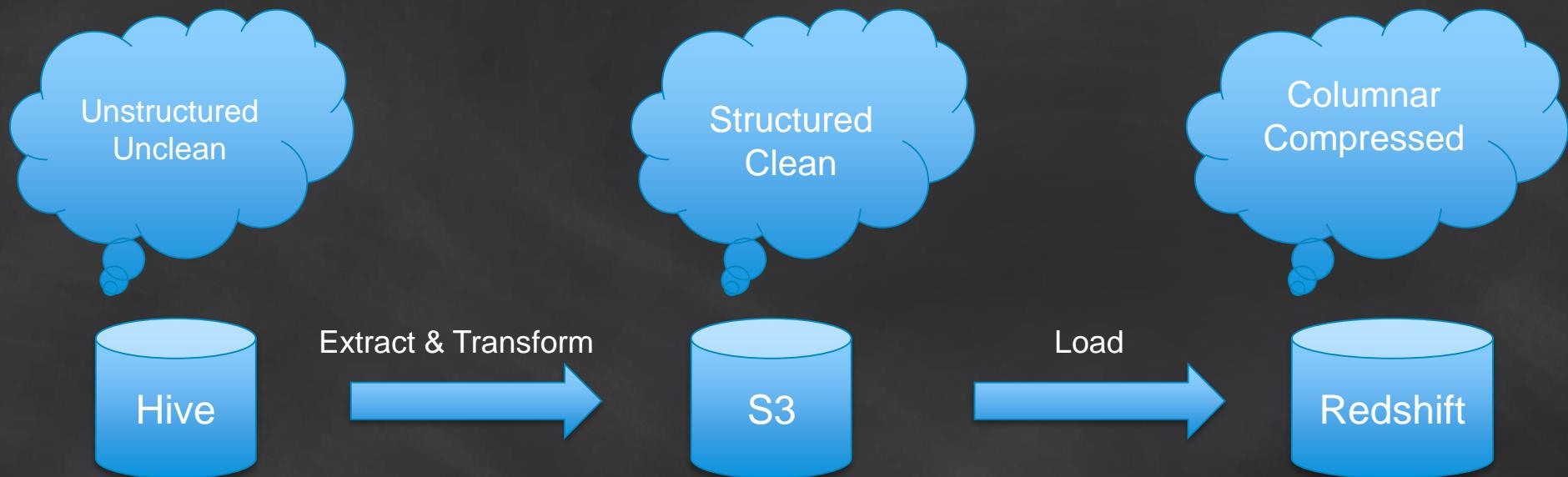
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Cool, but how do we integrate  
Amazon Redshift  
with Hive/Hadoop?



# First, build ETL from Hive into Amazon Redshift

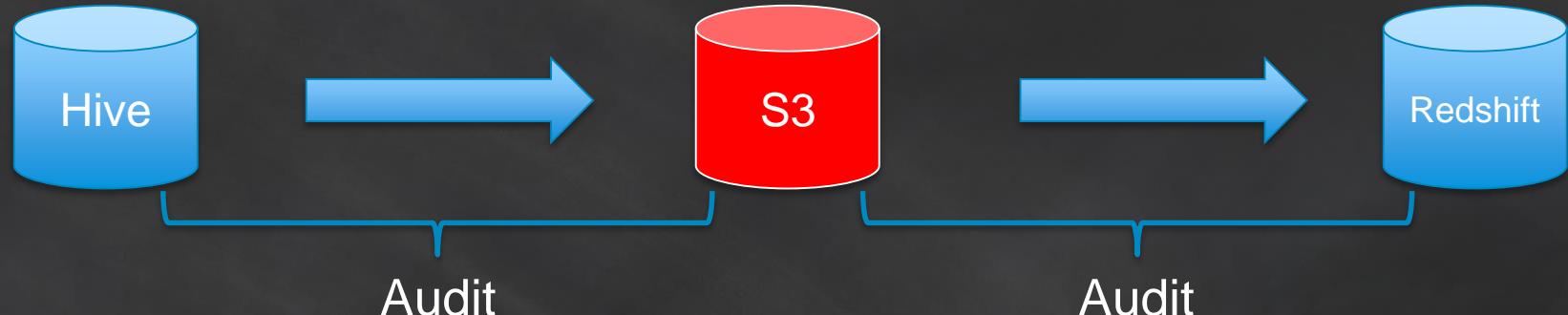


Hadoop/Hive is perfect for heavy-lifting ETL workloads😊



# Audit ETL for Data Consistency

Amazon S3 is eventually consistent in US Standard (EC) ! 😞



Also reduce number of files on S3 to alleviate EC

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# ETL Best Practices

Activity	What worked	What didn't work
Schematizing Hive tables	Writing column-mapping scripts to generate ETL queries	N/A
Cleaning data	Filtering out non-ASCII characters	Loading all characters
Loading big tables with sortkey	Sorting externally in Hadoop/Hive and loading in chunks	Loading unordered data directly
Loading time-series tables	Appending to the table in the order of time (sortkey)	A table per day connected with view performing poorly
Table retention	Insert into a new table	Delete and vacuum (poor performance)

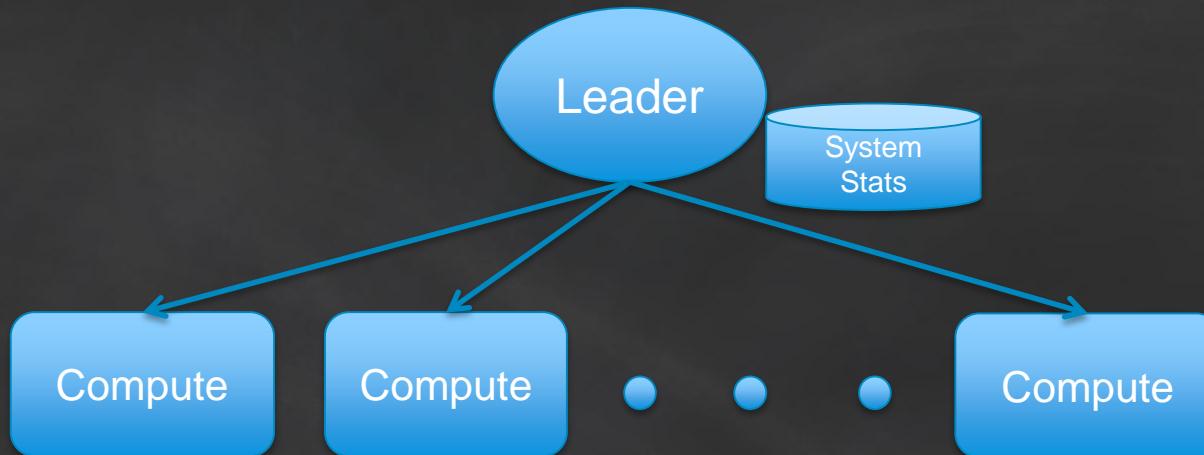


Now we've got the data.

Is it ready for superior performance?



# Understand the performance



- ① Keep system stats up to date
- ② Optimize your data layout with sortkey and distkey

# Performance debugging

- Worth doing your own homework
  - Use “EXPLAIN” to understand the query execution
- Case
  - One query optimized from 3 hours to 7 seconds
  - Caused by outdated system stats



# Educate users with best practices 😊

Best Practice	Details
Select only the columns you need	Redshift is a columnar database and it only scans the columns you need to speed things up. “SELECT *” is usually bad.
Use the sortkey (dt or created_at)	Using sortkey can skip unnecessary data. Most of our tables are using dt or created_at as the sortkey.
Avoid slow data transferring	Transferring large query result from Redshift to the local client may be slow. Try saving the result as a Redshift table or using the command line client on EC2.
Apply selective filters before join	Join operation can be significantly faster if we filter out irrelevant data as much as possible.
Run one query at a time	The performance gets diluted with more queries. So be patient.
Understand the query plan by EXPLAIN	EXPLAIN gives you idea why a query may be slow. For advanced users only.



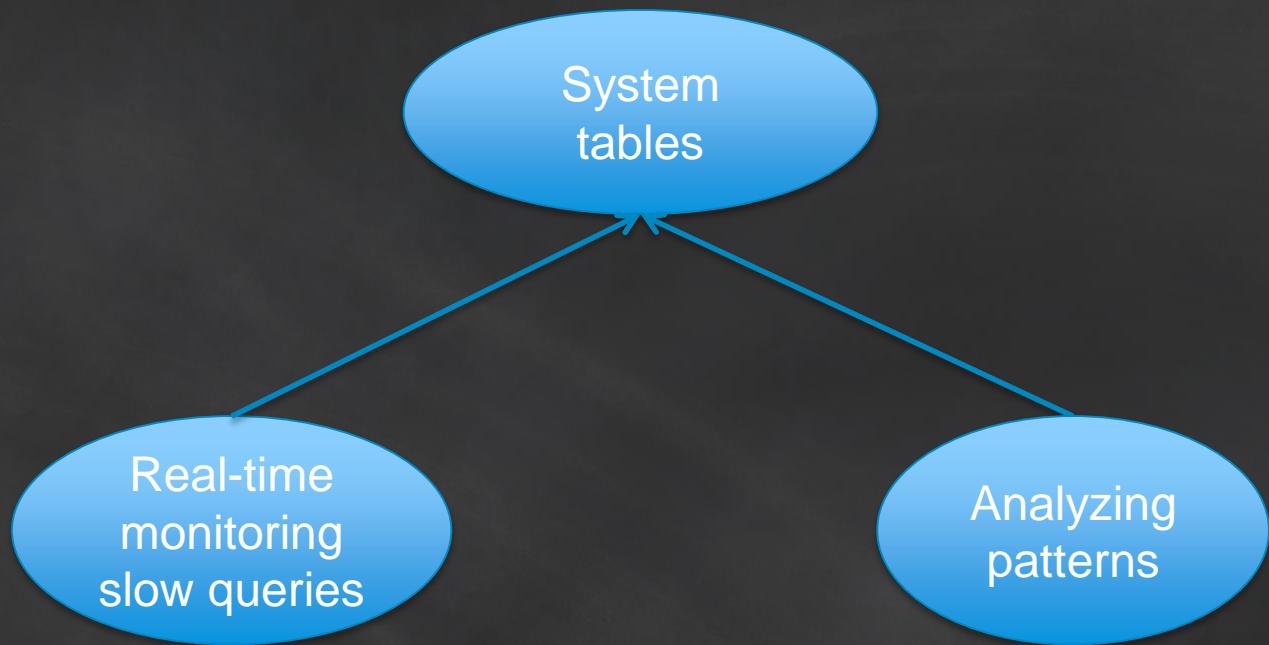
But Redshift is a shared service

One query may slow down the whole cluster

And we have 100+ regular users



# Proactive monitoring



# Reducing contention

- Run heavy ETL during night
- Time out user queries during peak hours

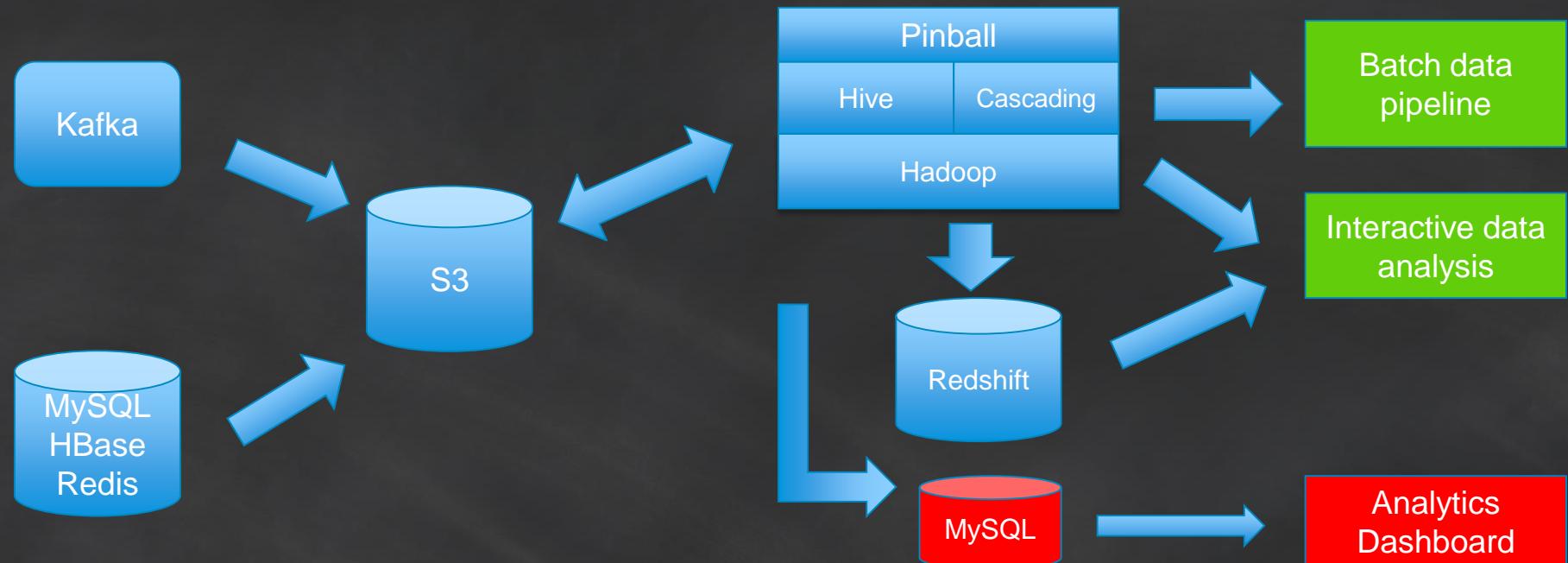


# Amazon Redshift at Pinterest Today

- 16 node 256TB cluster
- 2TB data per day
- 100+ regular users
- 500+ queries per day
  - 75% <= 35 seconds, 90% <= 2 minute
- Operational effort <= 5 hours/week



# Redshift integrated at Pinterest



# Acknowledgements

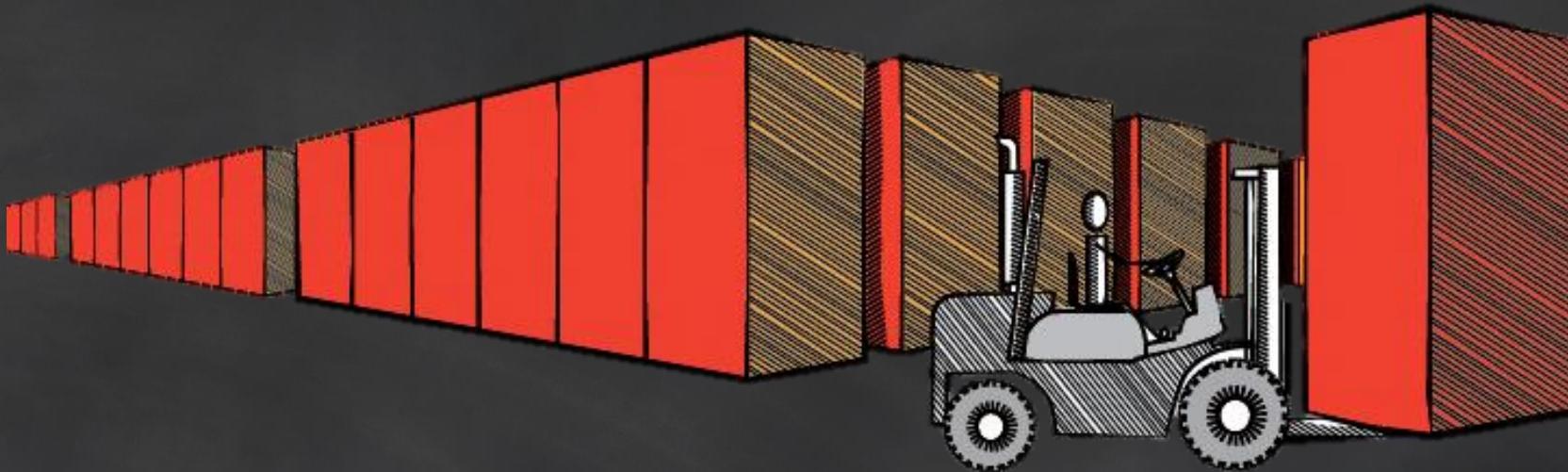
- Redshift team
  - Bug free technology
  - Timely support
  - Open feature request



# Thank You!



# Amazon Redshift



Fast, simple, petabyte-scale data warehousing for less than \$1,000/TB/Year