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Real-Time Traffic Analytics Powered by ClickHouse

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The Flock Safety Platform

Detect



• Falcon®



• Raven®



• Condor



• Wing®

Capture evidence with Flock Safety devices and third-party infrastructure

Decode

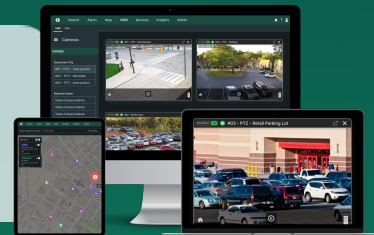
- Real-Time Routing
- Visual Search
- Multi-Geo Search
- Vehicle Fingerprint® Search
- Gunshot Localization
- Convoy Analysis
- Fireworks

Make sense of mountains of evidence instantly with AI

Deliver

- Search
- Map
- Mobile App
- Real-time Alerts
- Actionable Insights
- License Plate Lookup
- Situational Awareness

Get the right evidence into the right hands at the right time with FlockOS®



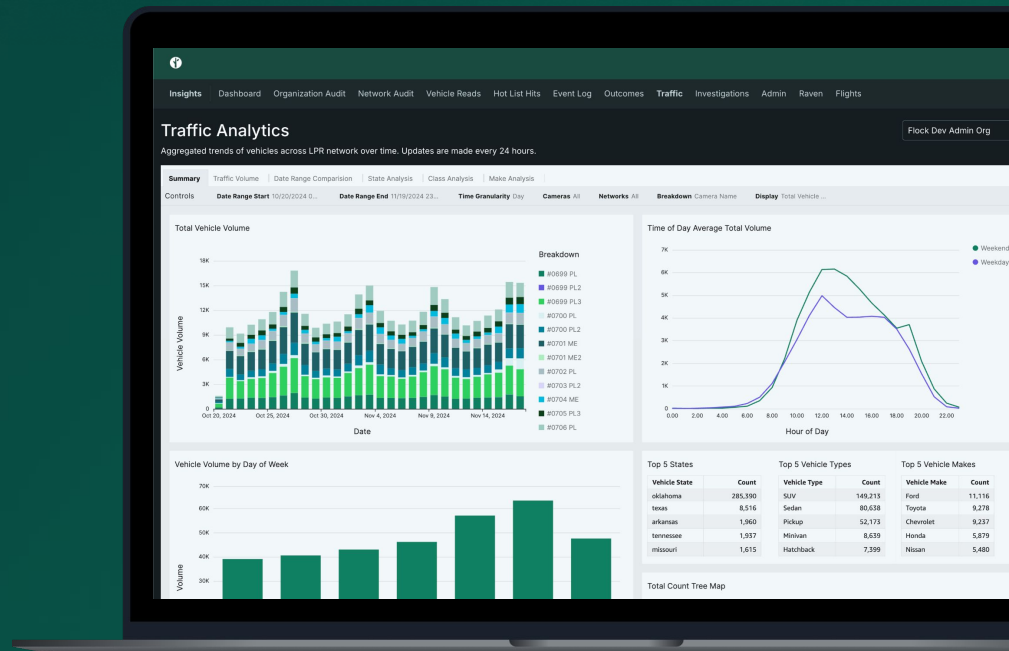
Capture more evidence. Solve more crime.

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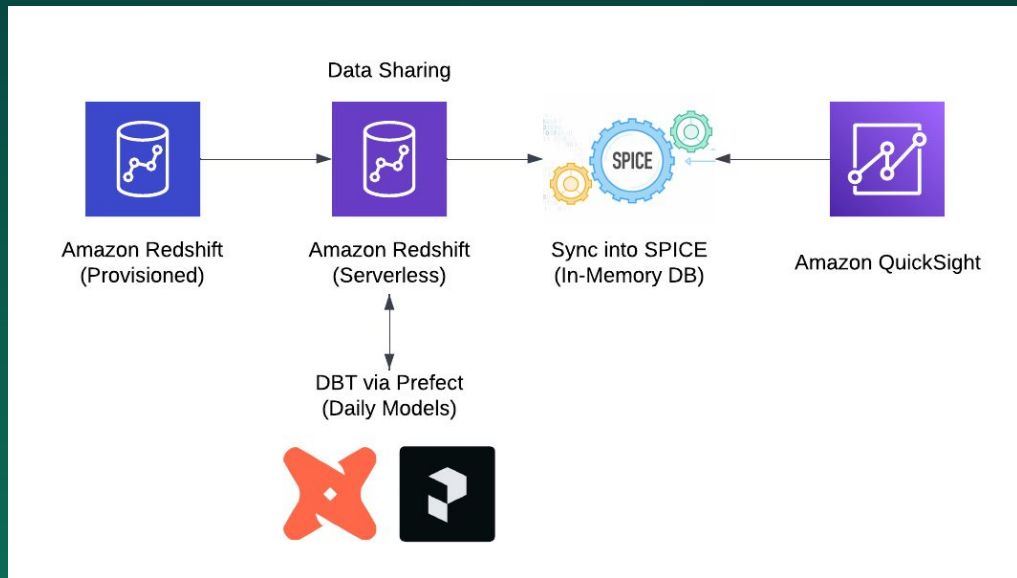
What is Traffic Analytics?

Traffic Analytics unlocks the potential of a customer's existing Flock Safety License Plate Recognition technology for critical traffic management insights.

This software solution captures unique and total vehicle counts across the LPR network. Data is aggregated in 15 minute bins for fine-grained analysis



Pre-ClickHouse Architecture



- Daily refresh cadence
- Long refresh times

Traffic: Vehicle Make 1.95 hours ↑ 1.24%	Traffic: License Plate 3.69 hours ↓ -15.4%	Traffic: Vehicle Type 3.95 hours ↓ -7.19%
Traffic: Vehicle Make 456 Mil ↑ 0.74%	Traffic: License Plate 744 Mil ↓ -0.54%	Traffic: Vehicle Type 957 Mil ↓ -0.469%

- Data unavailable during refresh
- Hard size constraints
 - 1 TB or 1 billion rows*
 - 256 RLS keys

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* All of our reports were capped to 30 days (or less) due to size limitations of SPICE

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Row Level Security and Sharing

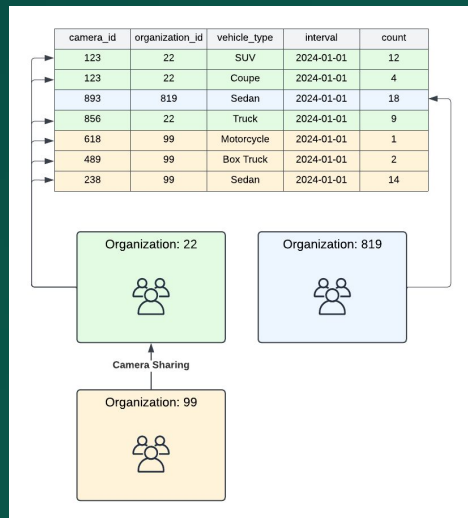
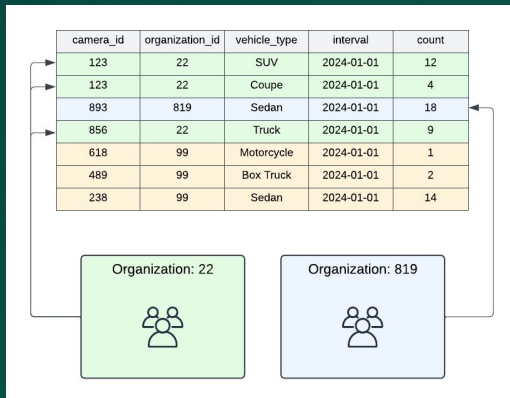
Data security is paramount at Flock, RLS rules were enforced using QuickSight to ensure only data owned by an organization can be viewed in analytics

Constraint:

- Only 256 unique key are supported with Amazon QuickSight

Problem:

- Organization can share cameras with other organizations based on roles
 - **In many scenarios users will have access to more than 256 cameras**



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Key Issues:

- Limited retention due to SPICE dataset size limits
- Downtime associated with datasets refreshes
- 256 key limit for row level security with SPICE
- Daily refresh cadence (gap in reporting intra-day)

What we tried:

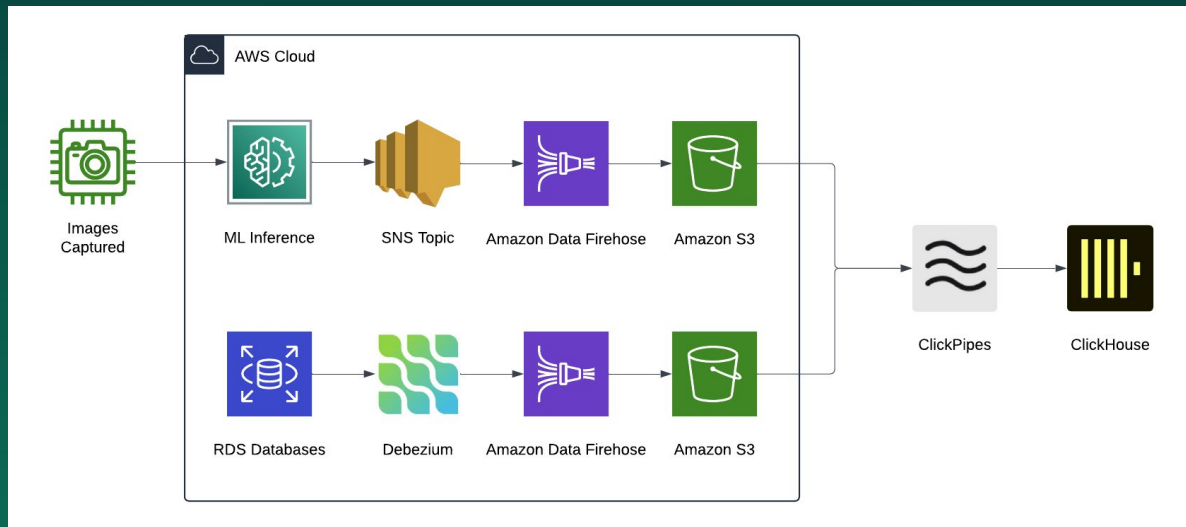
- Redshift (Prefect + DBT)
 - Daily → SPICE
- Aurora Postgres (Prefect + DBT)
 - Daily → Direct Query
- S3 + Trino (Prefect + DBT)
 - Daily → Direct Query
- Clickhouse + AMT & MV
 - Real-time → Direct Query

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POC Results

1. Redshift (via Prefect & DBT) → SPICE
 - a. SPICE refreshes make data unavailable for 3+ hours
 - b. Camera sharing support blocked by 256 RLS key limit
 - c. Reporting not real time (daily)
2. Aurora (via Prefect & DBT) → Direct Query
 - a. Reached maximum timeout for Amazon Quicksight
 - b. Reporting not real time (daily)
3. S3 + Trino (via Prefect & DBT) → Direct Query
 - a. Reached maximum timeout for Amazon Quicksight
 - b. Reporting not real time (daily)

ClickHouse: Ingestion and Data Volume



**1+ Billion ML
Predictions**

Daily Events Ingested

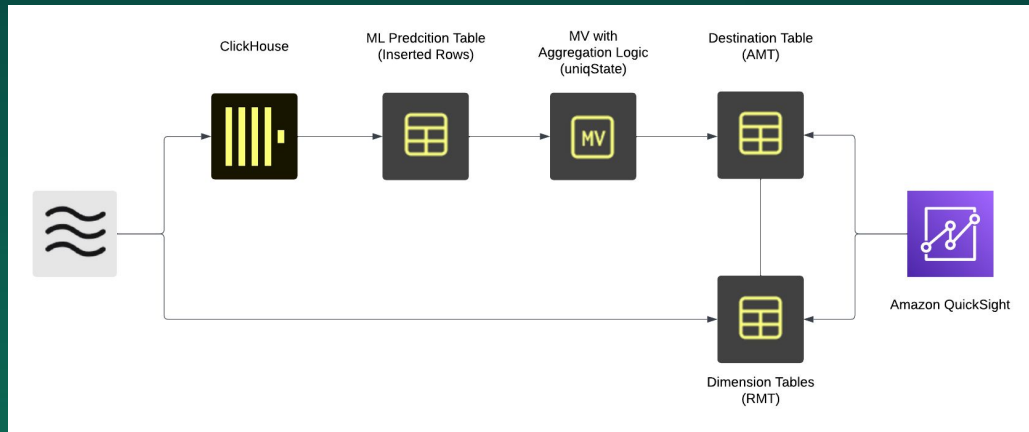


**~20+ MB/s via
ClickPipes**

Peak Data Size Ingested

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ClickHouse Architecture Diagram



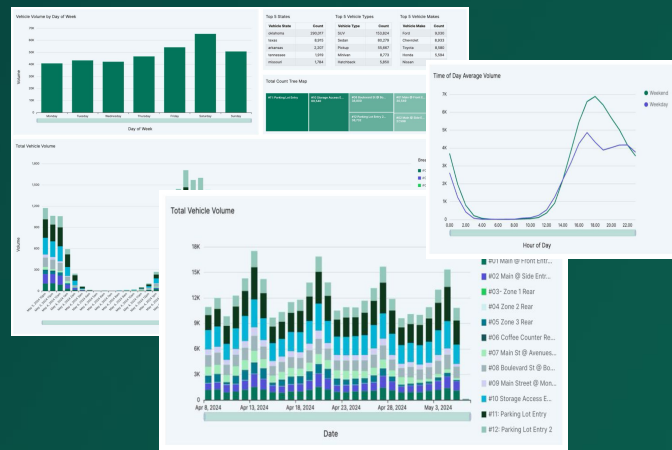
- Use uniqMerge to query destination table
- Join dimension tables to enrich reporting layer + support camera sharing via multiple RLS keys
- Use Direct Query via Amazon QuickSight to remove size constraints that we had with SPICE
 - Unlimited retention
 - Full scope of client data
 - Richer insights
 - Real-time + no refreshes

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Results of Traffic Analytics on ClickHouse

ClickHouse has unlocked zero downtime, enablement of shared camera data availability, and extended retention for our customers



0 sec

Downtime due to removal
of SPICE datasets

Intra-day

Full scope of intra-day
data available

<5 sec

Query time for real time
counts

>1 year

Historical traffic counts
for our customers

Final Thoughts & Next Steps

Impact: ClickHouse has unlocked the following concepts for Flock's Traffic Analytics Product

- Real-time analytics
- Camera sharing support
- Extended retention
- Zero downtime

Next Steps

- Continue moving more analytics use cases to ClickHouse