Intelligent Transportation Analytics With Google Cloud

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Customer Engineer

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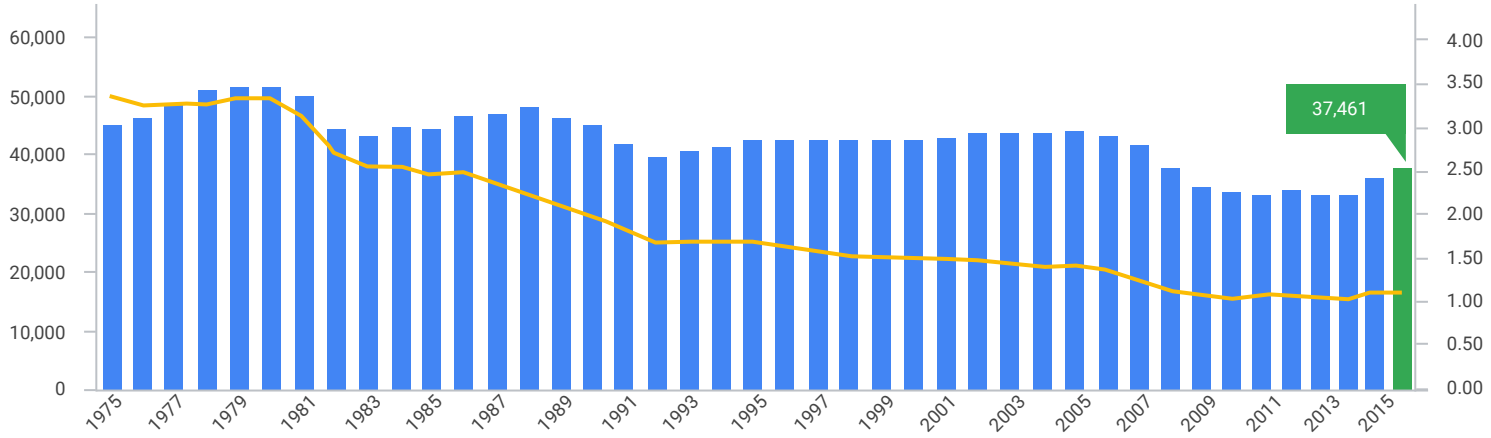
Years of steady improvement in highway safety is over



Fatalities and Fatality Rate per 100 Million VMT, by Year, 1975 - 2016

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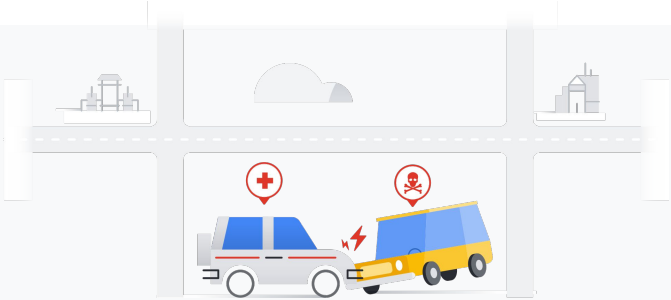
Sources: FARS 1975 - 2015 Final File, 2016 ARF, Vehicle Miles Travelled (VMT): FHWA

Roads are busier, heavily congested...

The average commuter in metropolitan areas experience **4 hours of road congestion** every day. [1]



...and dangerous

Current trends show that by **2030,** road traffic injuries will become the seventh leading cause of death globally.[2]

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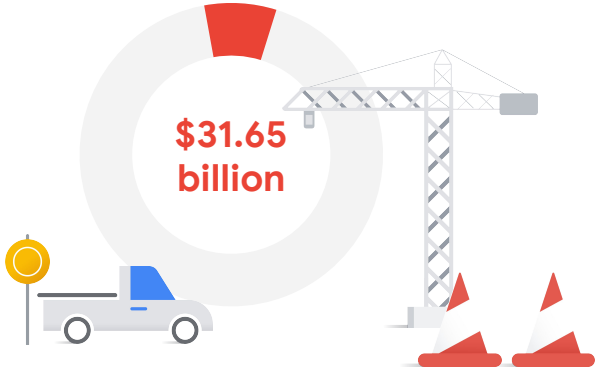
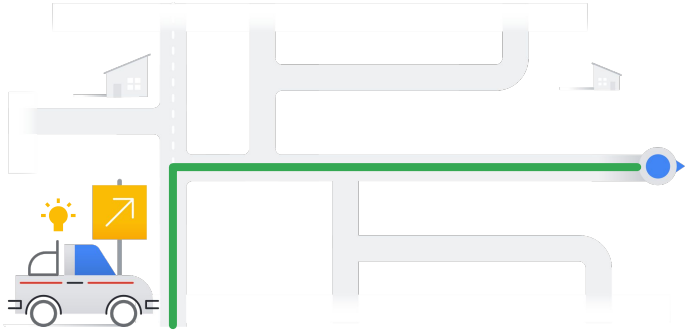
1. U.S. Department of Transportation, Federal Highway Administration Congestion Trends Report
2. CDC

The solution isn't building more roads

State and local government construction costs rose **13%** in the last five years[1]





It's harnessing your data to optimize those roads

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1. U.S. Census Bureau, Seasonally Adjusted Data

But that data exists in silos, making it difficult to use

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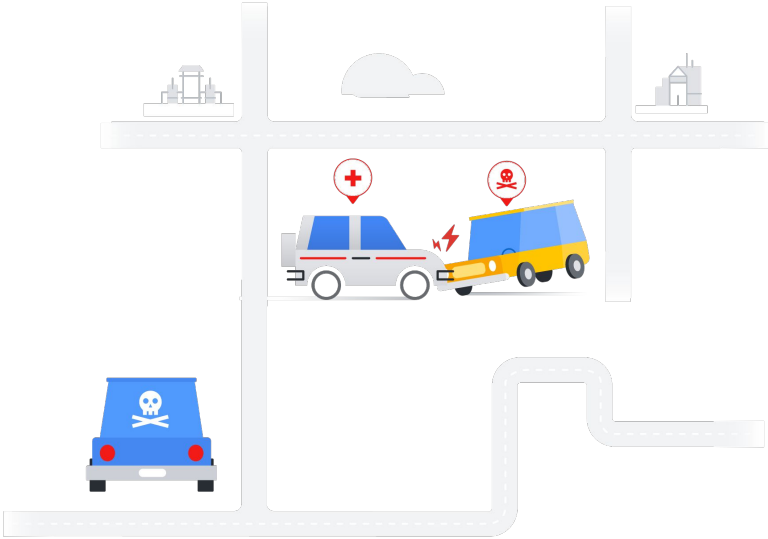
Disconnected data is costing us too much

NSC estimates the cost of motor-vehicle deaths, injuries, and property damage in 2016 was **$416.2 billion.** [1]



More than **37,000** people died in motor vehicle crashes in 2017.[2]

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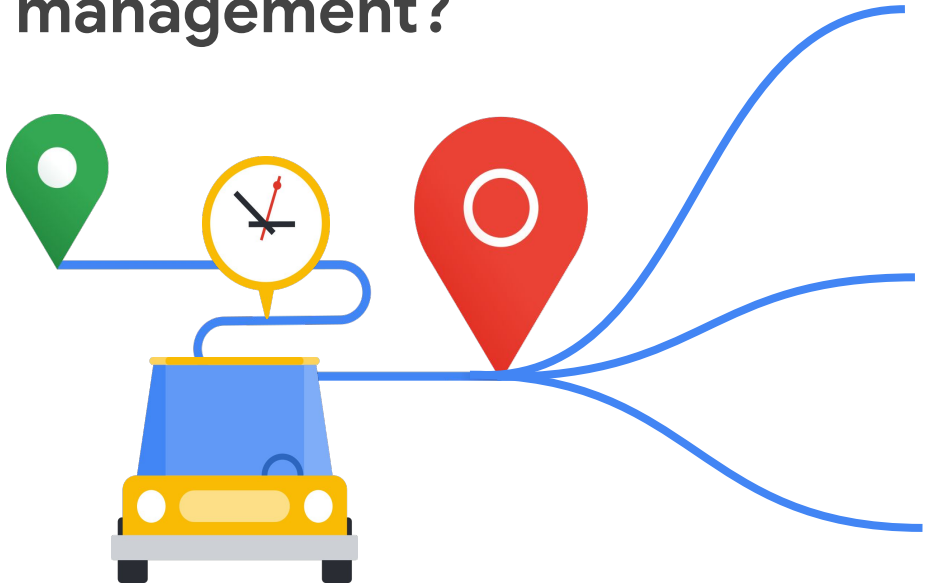
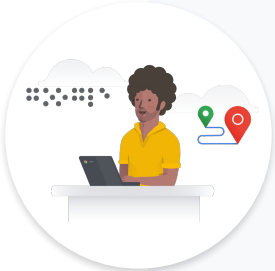
1. National Safety Council
2. US Department of Transportation's National Highway Traffic Safety Administration

What if your data could be the *driver* of traffic management?





Enhance
situational awareness
based on traffic patterns

Coordinate
response based on
real-time insights

Predict
road and device
maintenance

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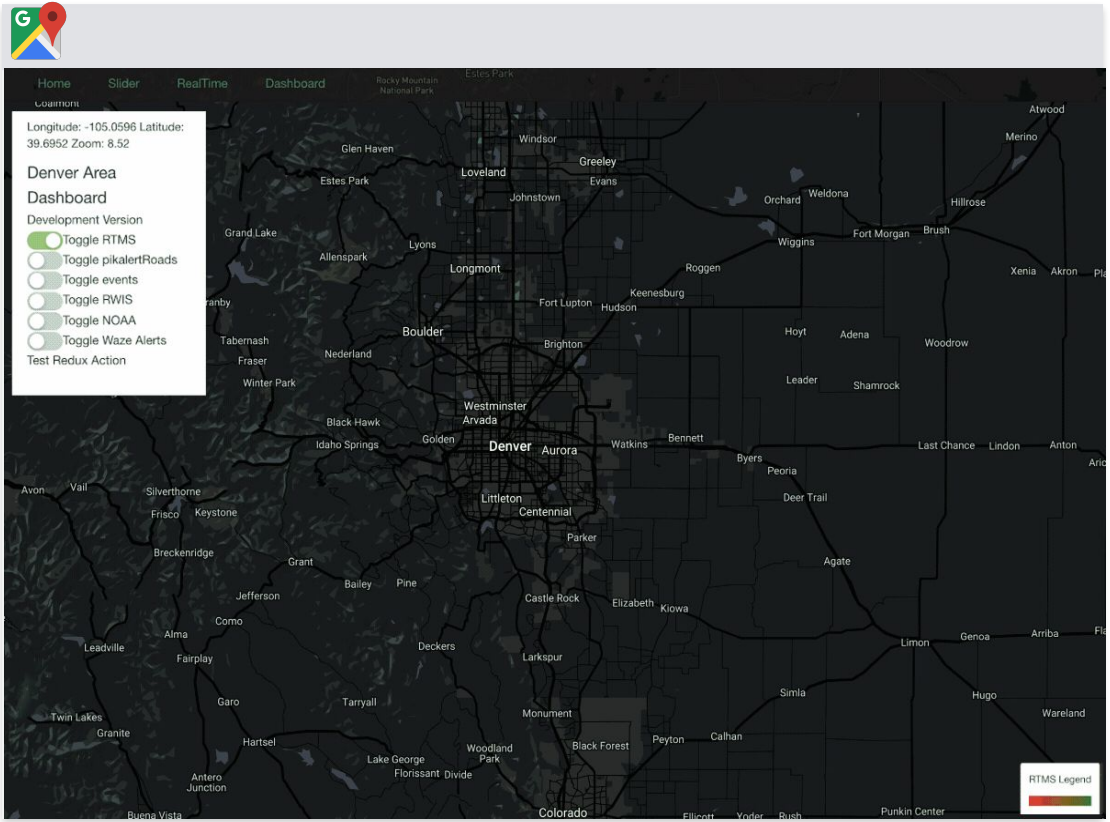
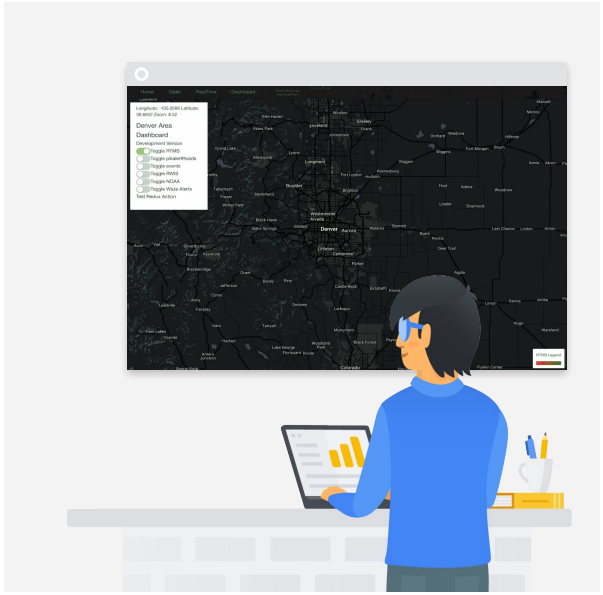
Your data can drive important decisions...



...now and in the future

- Where do I need to reroute traffic?
- Where are crashes occurring most often?
- Which roads will need the most repairs in the future?

Data-driven insights make for a safer, more informed community



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Managing data volume and speed on traditional platforms results in...

60–80%

Higher up-front, operational and maintenance costs

60%

Higher risk of failure

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*Gartner

How Capable is Your Data Enterprise?

Storage Program

Standardized retention windows across data stores; granular, historic data can be retrieved in a few days

Data Warehouse Reporting

Analysts work out of one or more data warehouses used to build reports from aggregated data

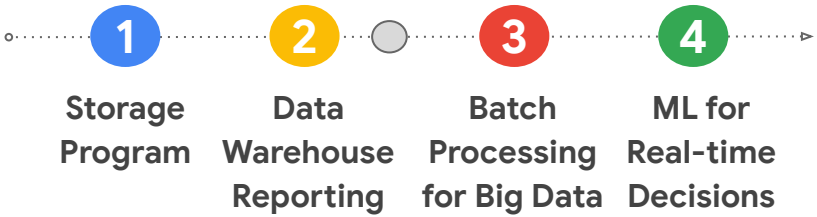
Batch Processing for Big Data

Distributed processing frameworks allow organization-wide data to be used in complex analytic processing

ML for Real-time Decisions

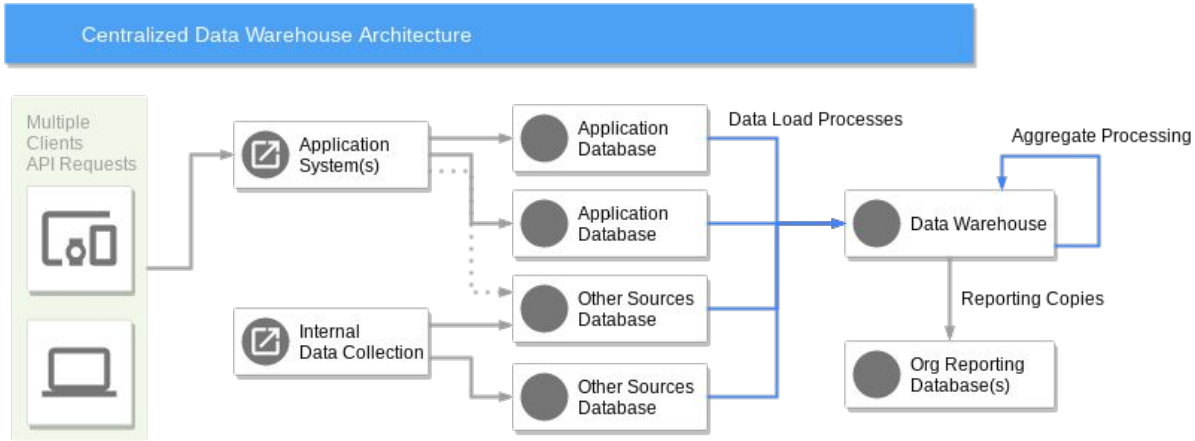
Machine Learning models actively deployed to increase enterprise efficiency

Organizations are Struggling to Move Past the Traditional Warehouse



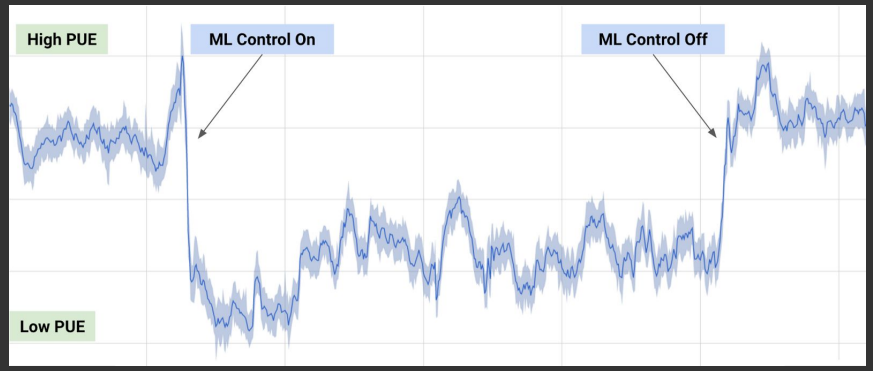
The Traditional Warehouse is not Enough

- Minimal support for realtime data
- Coarse-grain aggregates used to compensate for scaling complexities
- Prohibitive licensing costs and terms
- Multi-tenancy issues lead to new data silos



Supporting Sustainability

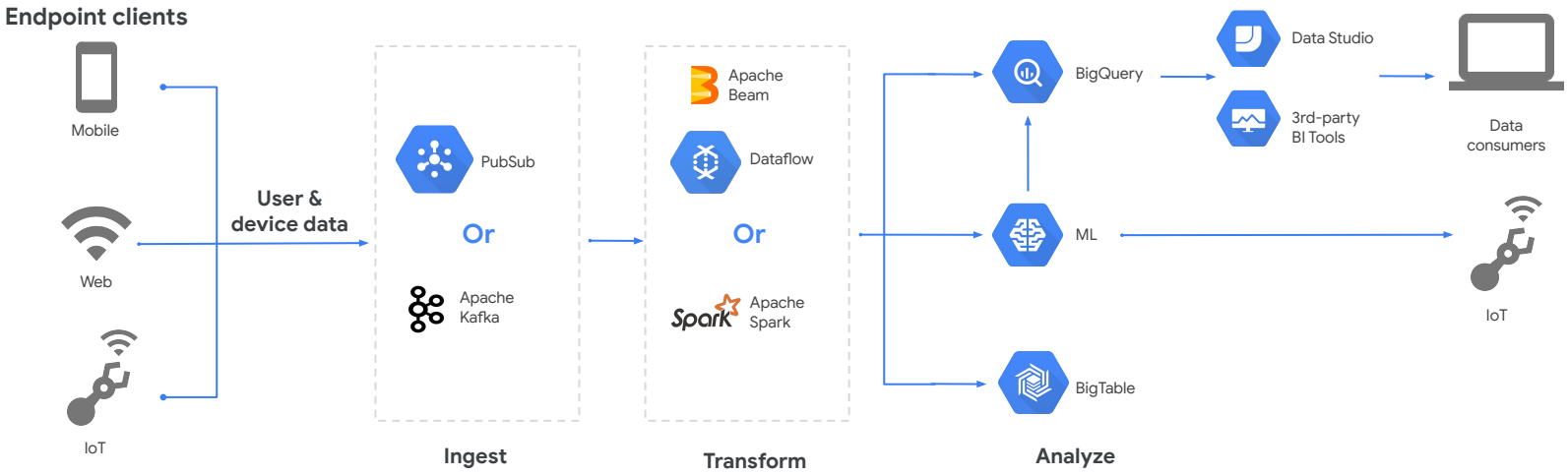
Google datacenters already have **half the overhead** of typical datacenters



Applying Machine Learning produced **40% reduction in cooling energy**

Google

Building the Data Platform for Modern Problems



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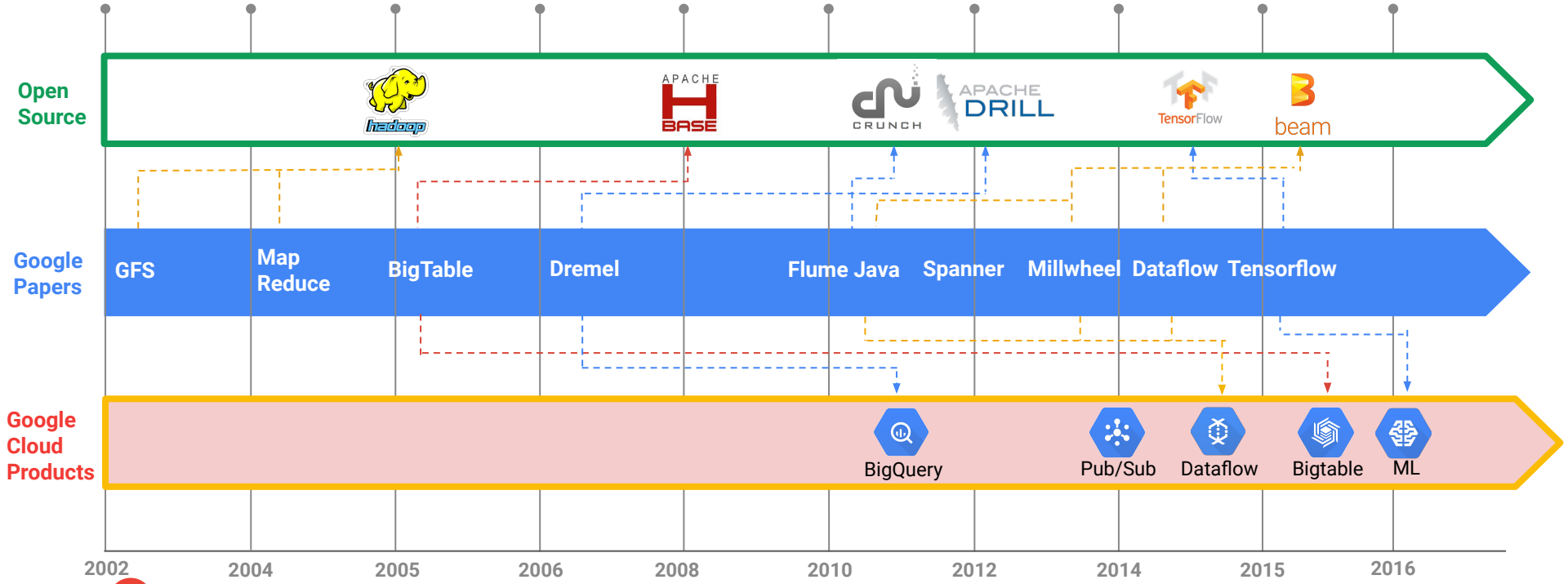
Why Google Cloud for Solving this Problem?

15 Years of Tackling Big Data Problems



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Our data analytics design principles

Focus on analytics not infrastructure

Develop comprehensive solutions

End-to-end ML lifecycle

Innovation and proven results

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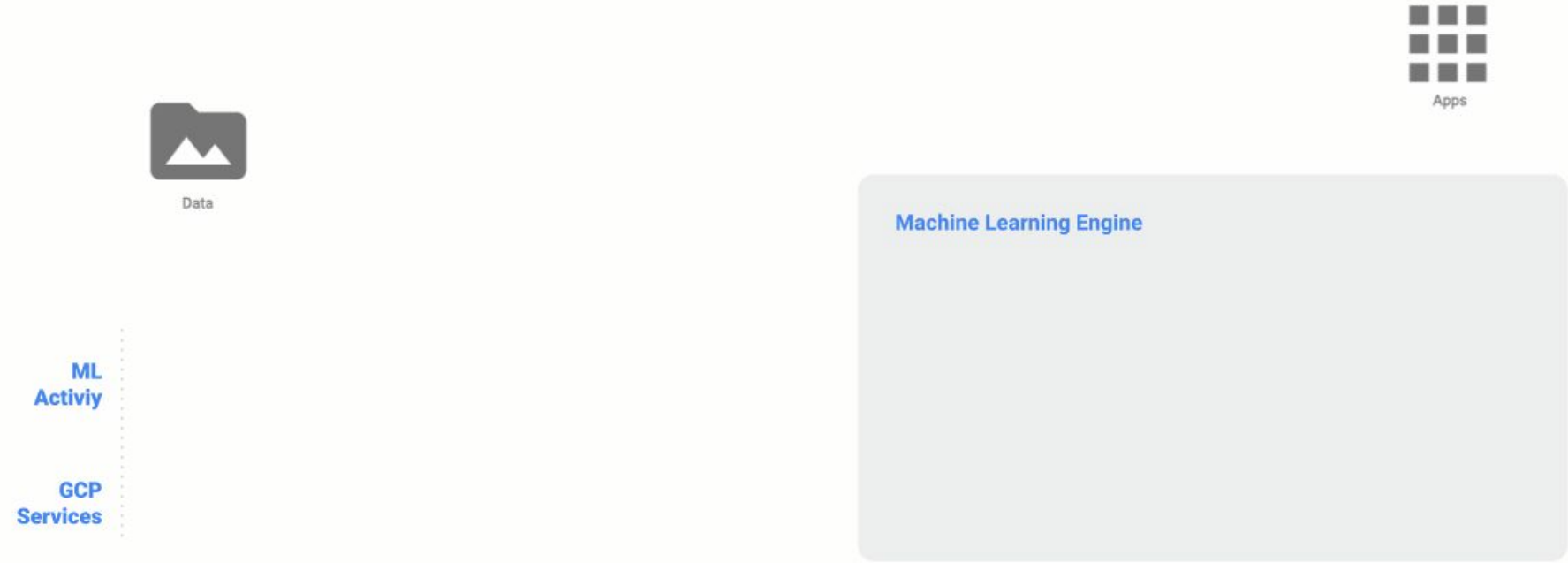
Serverless analytics for complete ML lifecycle



Innovators in Transportation

Google Maps

Offers visualization, navigation, and analytics

Waze

Exchanges publicly-available incidents and slow-down data

Waymo

Aiming to bring fully self-driving technology to improve mobility

What is DAISy?

Data Analytics Intelligence System (DAISy) is a cloud-based data analytics platform that brings intelligence, efficiency, and interoperability to CDOT's existing transportation network while enabling world-leading roadway operations for **a safer, more reliable, connected, and autonomous future.**

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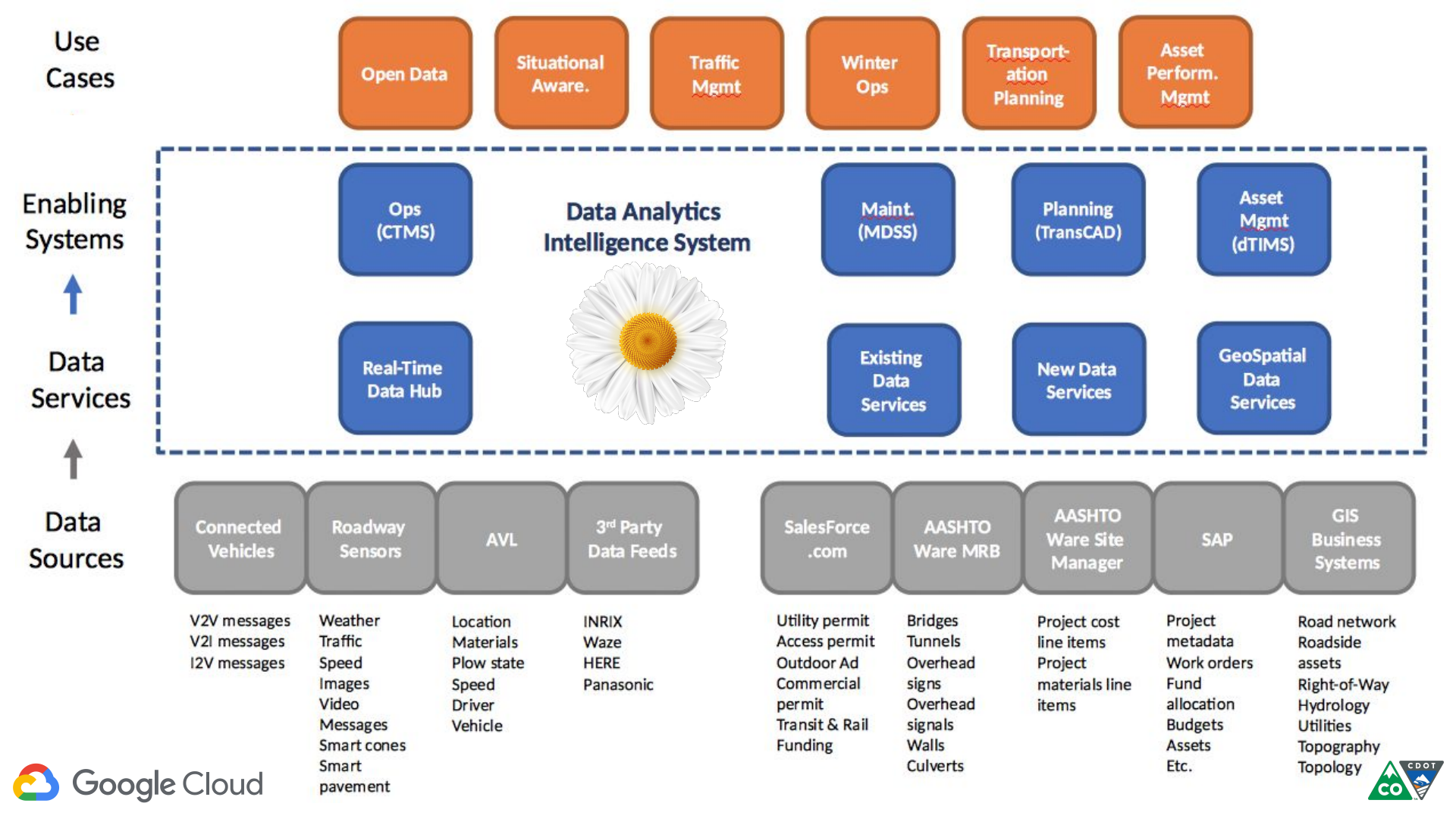
COLORADO
Department of Transportation


Use Cases
Open Data
Situational Aware.
Traffic Mgmt
Winter Ops
Transport-ation Planning
Asset Perform. Mgmt
Enabling Systems
Data Services
Data Sources
Ops (CTMS)
Data Analytics Intelligence System
Maint. (MDSS)
Planning (TransCAD)
Asset Mgmt (dTIMS)
Real-Time Data Hub
Existing Data Services
New Data Services
GeoSpatial Data Services
Connected Vehicles
Roadway Sensors
AVL
3rd Party Data Feeds
SalesForce .com
AASHTO Ware MRB
AASHTO Ware Site Manager
SAP
GIS Business Systems
V2V messages
V2I messages
I2V messages
Weather
Traffic
Speed
Images
Video
Messages
Smart cones
Smart pavement
Location
Materials
Plow state
Speed
Driver
Vehicle
INRIX
Waze
HERE
Panasonic
Utility permit
Access permit
Outdoor Ad
Commercial permit
Transit & Rail
Funding
Bridges
Tunnels
Overhead signs
Overhead signals
Walls
Culverts
Project cost line items
Project materials line items
Project metadata
Work orders
Fund allocation
Budgets
Assets
Etc.
Road network
Roadside assets
Right-of-Way
Hydrology
Utilities
Topography
Topology
Google Cloud
CDOT

Enabling New Applications

COtrip

Public Messaging

Traffic Management Center

Safety Patrol

Winter Weather Operations

V2X Applications

Mobility on Demand

Freight Platooning & Movement

Signals

Management Dashboards

Variable Speed Limits

Intelligent Transportation Systems

Future Applications

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Building DAISy with Data

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Two major categories

Geospatial

Streaming Video

Organizing & Enriching Datasets

	Speed	Weather	Incidents	
Historical	✓ Speed Readings ✓ Speed Aggregates	✓ Roadside Weather	✓ DOT Road Events ✓ Highway Messaging	Legacy Datasets
Real-Time IoT Data	✓ Speed Radars	✓ Roadside Weather	✓ DOT Events ✓ Construction Data	Legacy Datasets
3rd Party	✓ Waze Jams	✓ NCAR Pikalert ✓ Weather Data	✓ Waze Accidents ✓ Snow Plow locations	New Datasets

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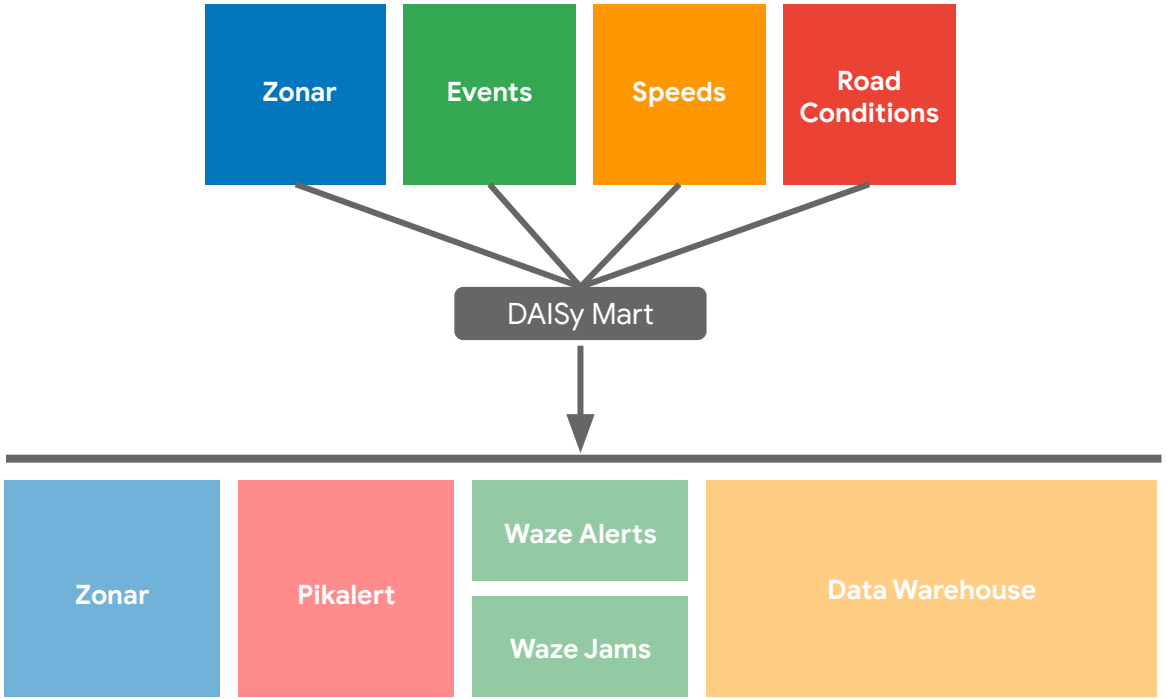
CO CDOT

Making Data Accessible

View Level

Logical Level

Internal Level (Source Systems)



* example

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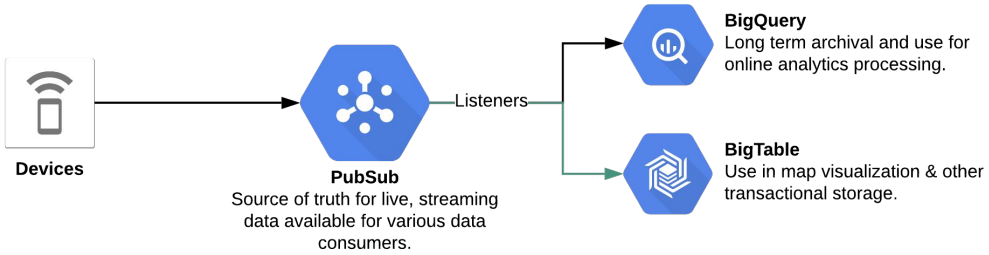
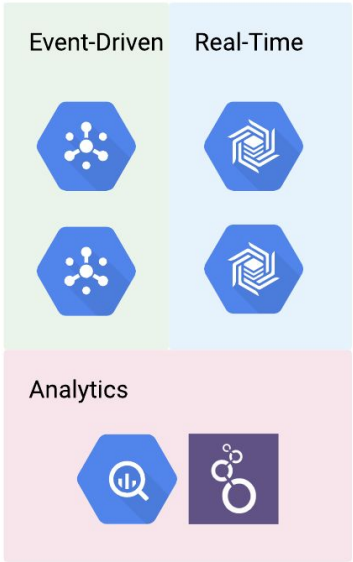
Bringing it all together





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Geospatial Data

Open source tool for massive geospatial querying.

- Storage in Google Cloud BigTable
- Processors in Spark
- Transforms, indexes, and stores geography data for rapid access.

Open source tool for sharing geospatial data.

- Uses GeoMesa datastores
- Runs on Google Kubernetes Engine
- Publishes data to any geographic data standard, including GeoJSON

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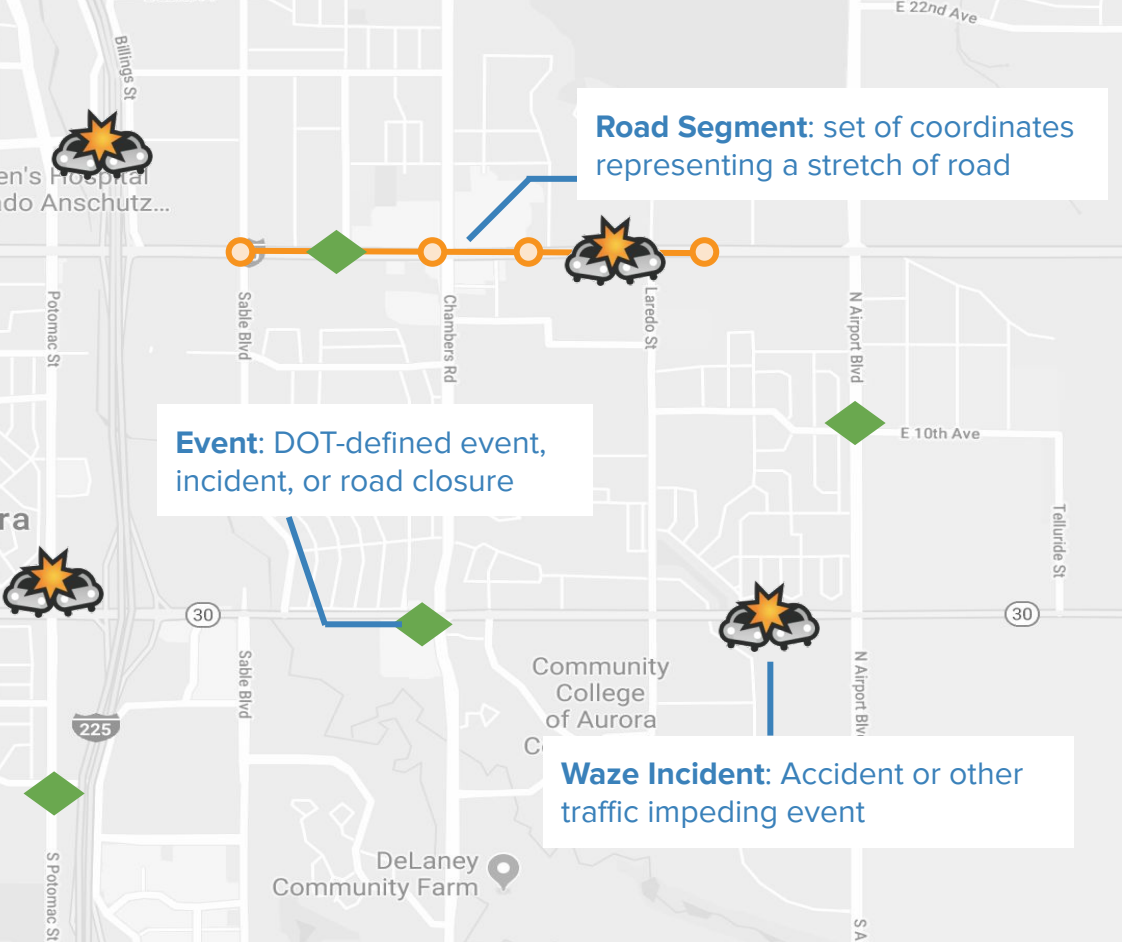

Joining Waze Incidents to Road Segments

- 600,000 road segment coordinates
- Millions of Waze Incidents
- Join using distance between Waze Incident and nearest road segment coordinate

- Group together Waze Incidents and DOT Events
- Better overall picture of highway system health

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Enabling Situational Awareness & Replay

Bomb Cyclone makes history, breaks records

Historic storm brings blizzard conditions to seven states, breaks records for intensity, snowfall, rainfall, and causes historic flooding

Strong Winter Storm Classifies as 'Bomb Cyclone' in Colorado

Bomb Cyclone Wasn't Hype. It Closed Front Range Roads, Runways And Just About Everything Else

BY COLORADO PUBLIC RADIO STAFF MAR 13, 2019

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CDOT

Video Intelligence & Analytics

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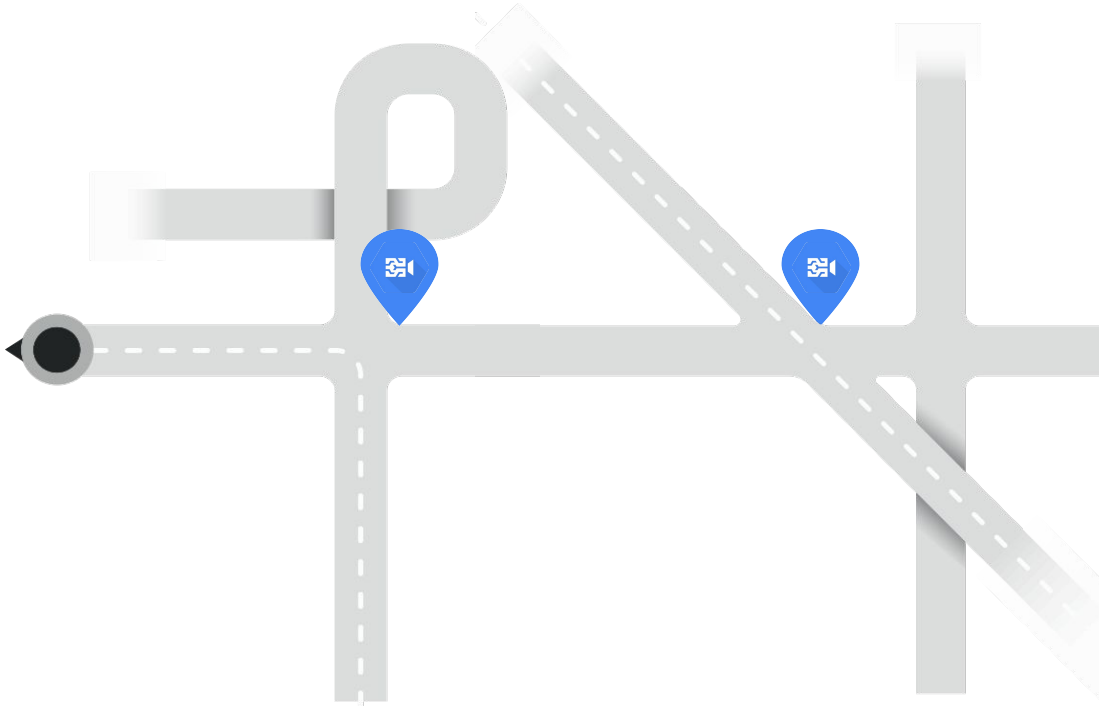
Cloud AI
Video Intelligence

Improving traffic management by adding intelligence to CDOT's legacy cameras.



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Two types of AI building blocks

Video Intelligence API

Pre-trained ML models

Leverage Google's predefined dataset to automatically detect a vast number of scenes, objects, etc.

Coding required

AutoML

Custom ML models

Train your own custom model with an easy-to-use graphical interface.

No coding required

Video Intelligence Streaming API

Real-time video analysis for live video and archived data

01

Batch

Annotate large video archives stored in Google Cloud Storage.

02

Data Streaming

Annotate videos by splitting the video data into chunks and streaming each chunk using gRPC.

03

New

Live Streaming

Annotate live video feeds to take action immediately. Current support for HLS, RTSP, and RTMP.

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Video Intelligence Streaming Features

Detect/track objects

Monitor road conditions

Detect scene changes

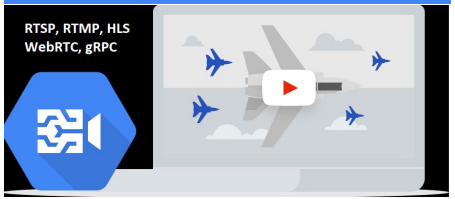
Recognize road signs

Specify region of interest

24x7 live analytics

Hybrid cloud solution

Ingestion Library



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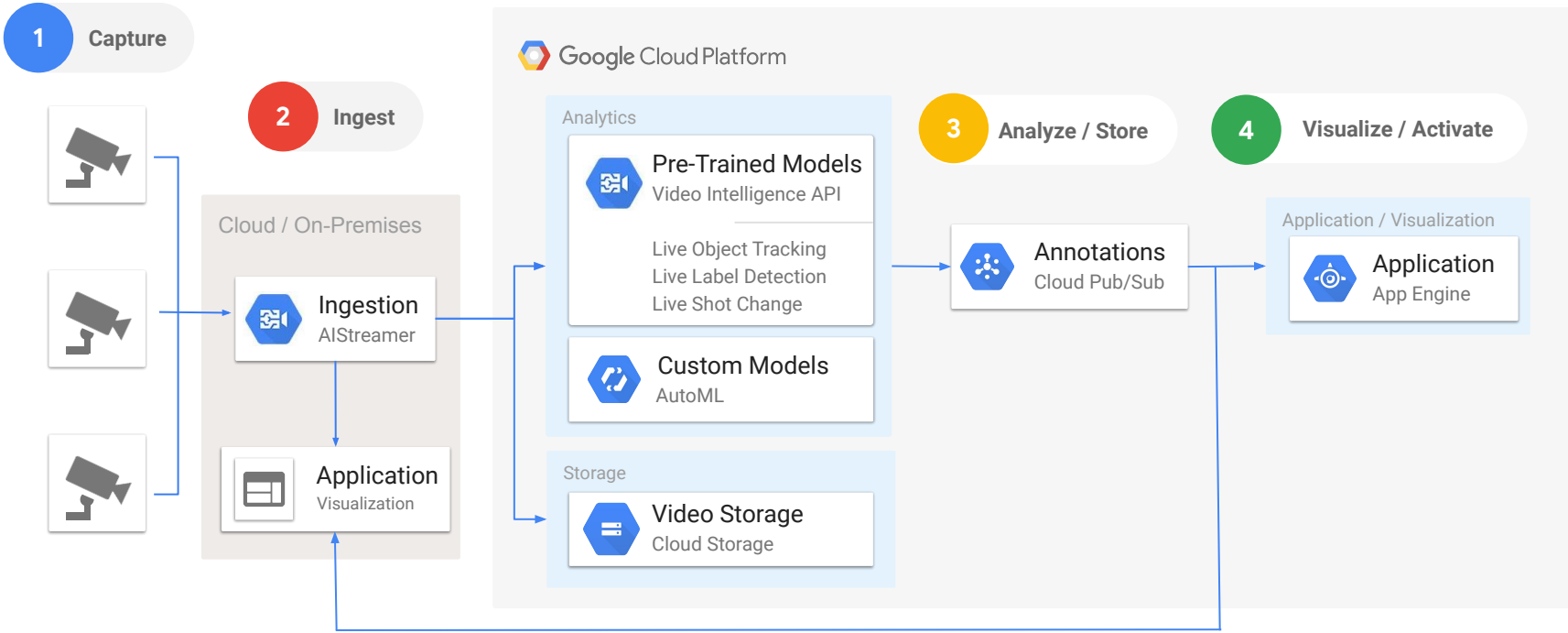
Streaming Video Intelligence Hybrid Architecture



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Solving real-world DOT problems




Cost Reduction

Road Optimization

Predictive Maintenance

Safety Improvements

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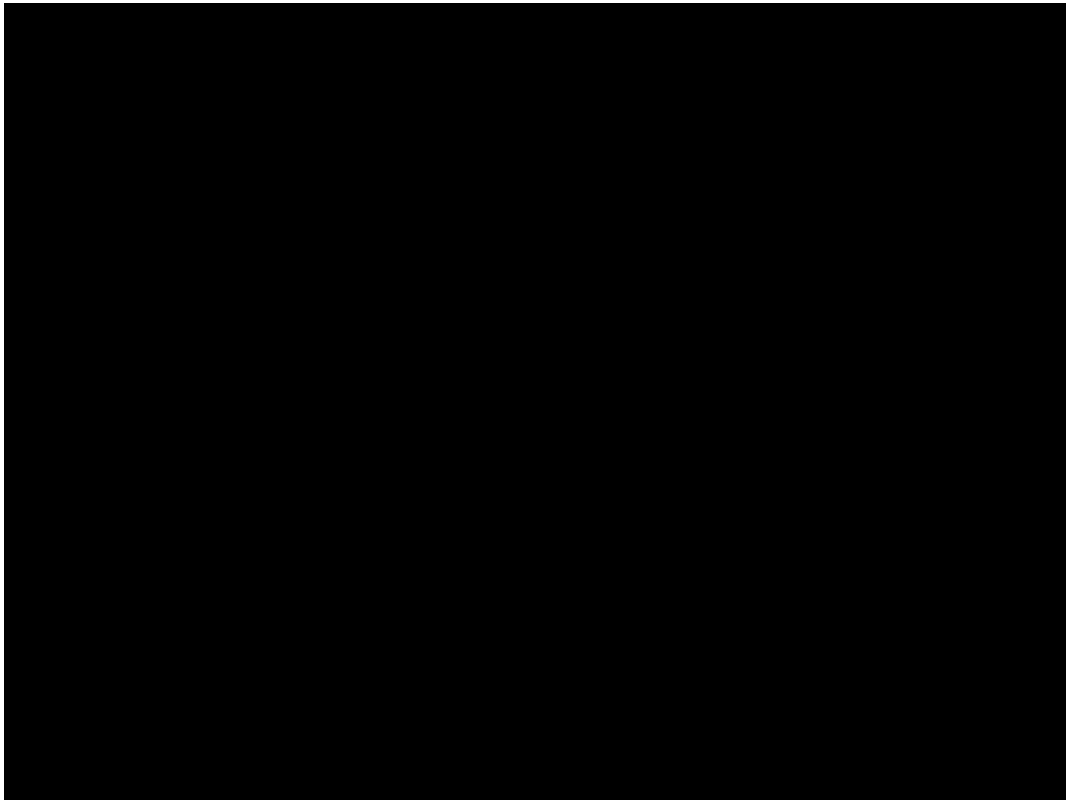
Video Intelligence Demo



Video Intelligence Streaming Service

- Estimate vehicle speed
- Identify vehicle types
- Observe traffic abnormality
- Monitor weather conditions

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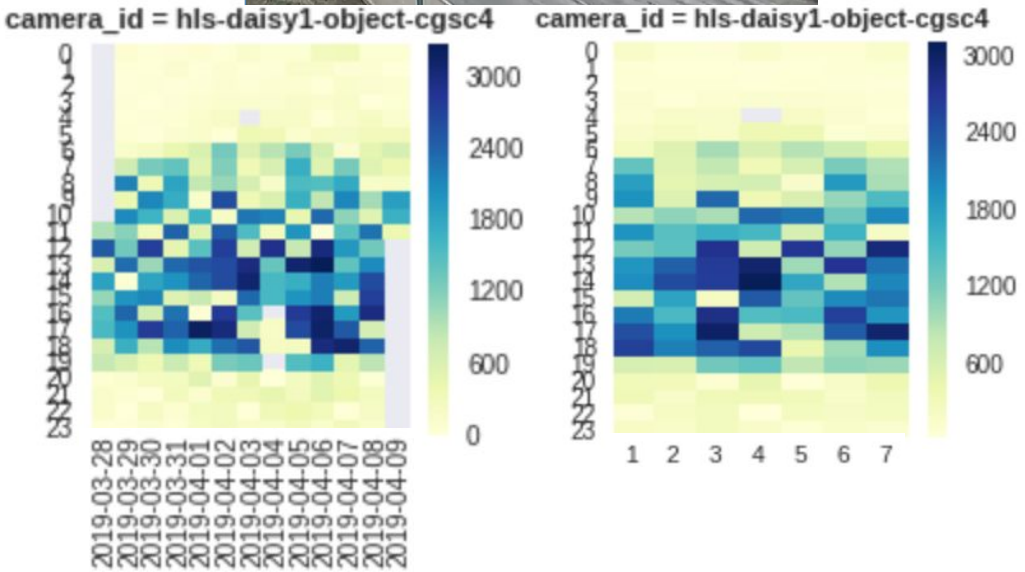
Video Intelligence Analytics

Camera Detected Vehicle Counts

- Hourly Totals By Day
- Hourly Average by Weekday

Data points * 4 cameras over 13 days

- >60M Labels
- >21M Objects



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Supporting CDOT's key performance measures

Increased safety & mobility

Improved social equity, affordability & air quality

Highly responsive roadway operations

Collaborative information sharing & communication with the public

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Questions?