
AWS
re:Invent

WPS206

Detecting extreme weather events from space

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Fireball.International

AWS re:Invent

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Agenda

Natural disasters

Latest from AWS Ground Station

AWS Machine Learning stack

Architecture and demo

Multi-sensor rapid wildfire intelligence with Fireball.International



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Increased frequency of natural disasters



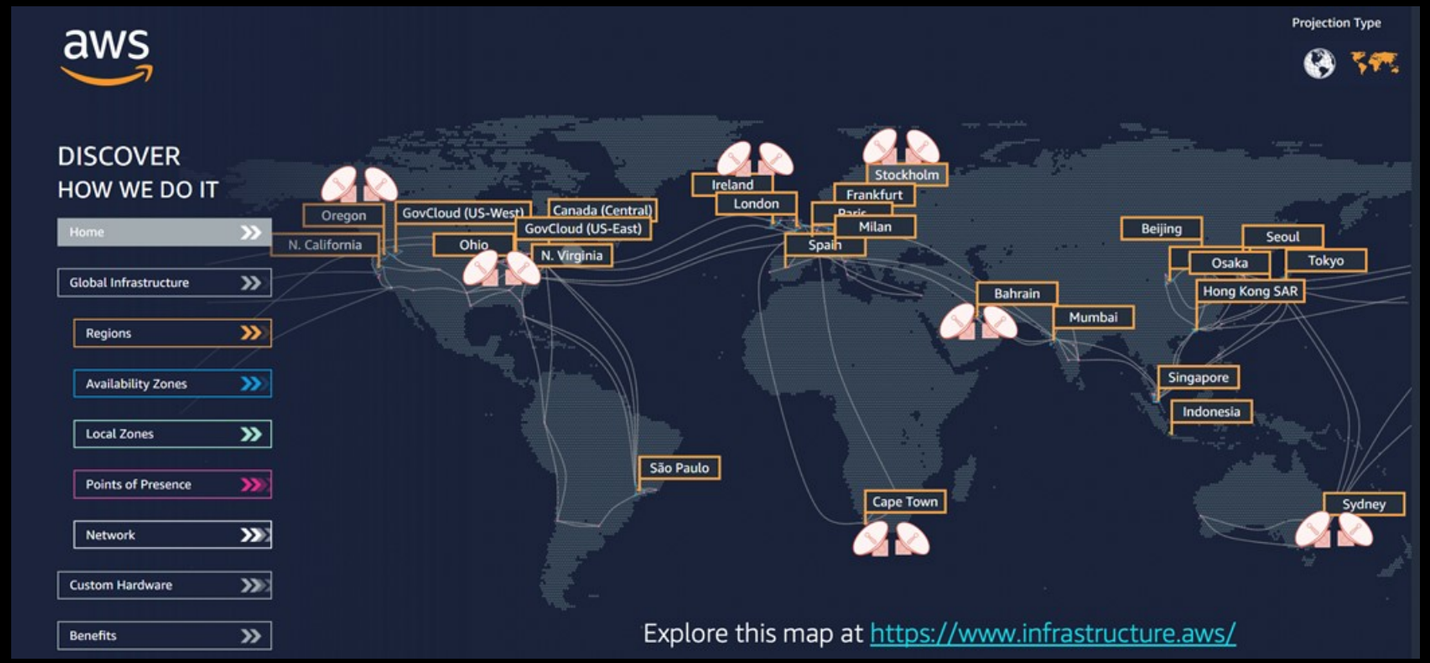
Damage to life and property

High risk and future uncertainty

What can we do to be prepared?

AWS Ground Station

- Fully managed AWS Ground Station as a service
- Self-service scheduling
- Co-located at AWS data centers
- Produce near real-time products



The AWS Machine Learning Stack

AI SERVICES

VISION	SPEECH		TEXT			SEARCH	CHATBOTS	PERSONALI-ZATION	FORECASTING	FRAUD	DEVELOPMENT	CONTACT CENTERS
Amazon Rekognition	Amazon Polly	Amazon Transcribe *+Medical*	Amazon Comprehend *+Medical*	Amazon Translate	Amazon Textract	Amazon Kendra	Amazon Lex	Amazon Personalize	Amazon Forecast	Amazon Fraud Detector	Amazon CodeGuru	Contact Lens *For Amazon Connect*

ML SERVICES

Amazon SageMaker	Ground Truth	AWS Marketplace for ML	SageMaker Studio IDE								Neo	Augmented AI
			Built-in algorithms	Note-books	Experiments	Processing	Model training and tuning	Debugger	Autopilot	Model hosting	Model monitor	

ML FRAMEWORKS AND INFRASTRUCTURE

TensorFlow, mxnet, PYTORCH	GLUON, Keras, Scikit-learn, Deep Graph Library, Horovod	Deep Learning AMIs and Containers	GPUs and CPUs	Elastic inference	Inferentia	FPGA	

Demo architecture

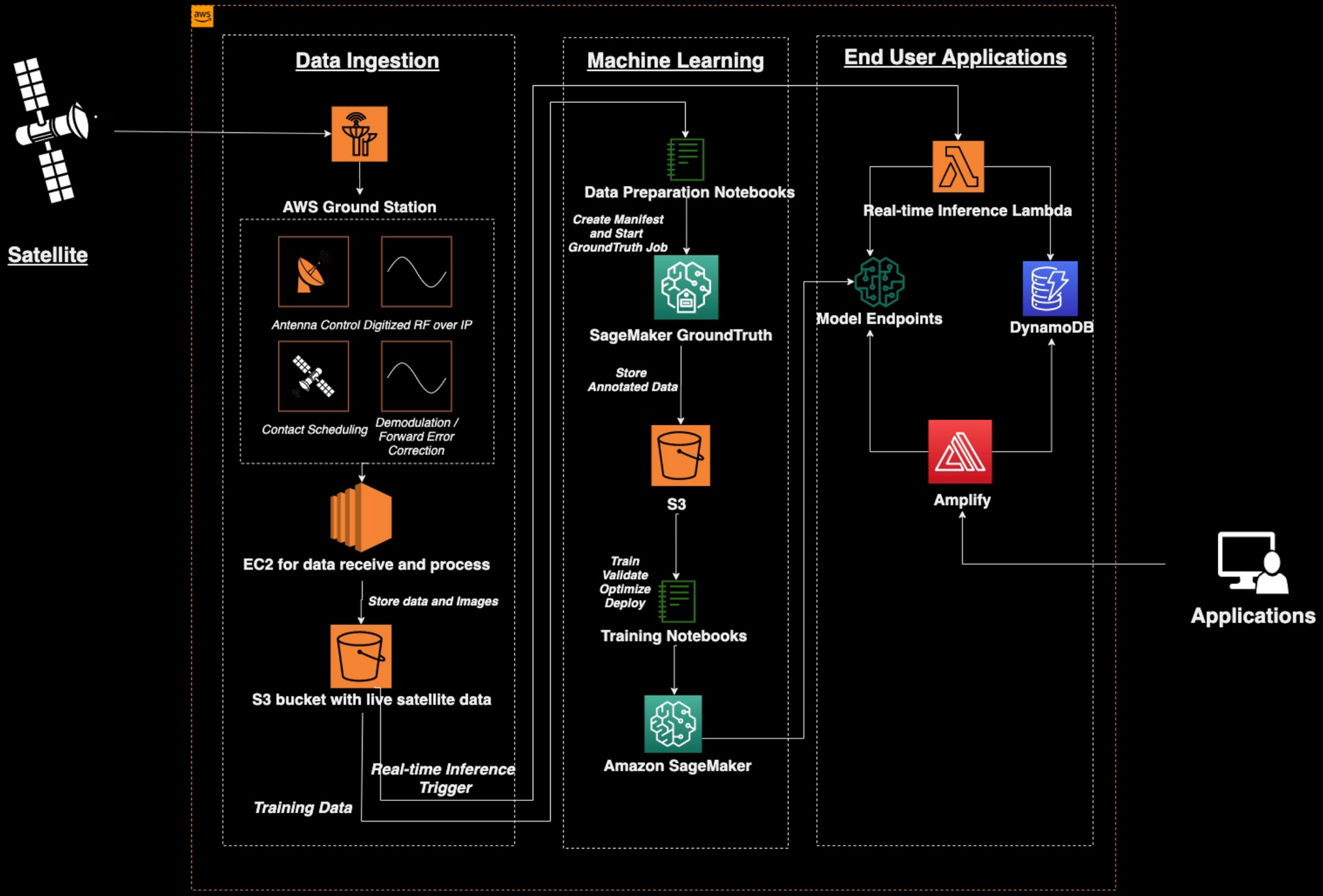
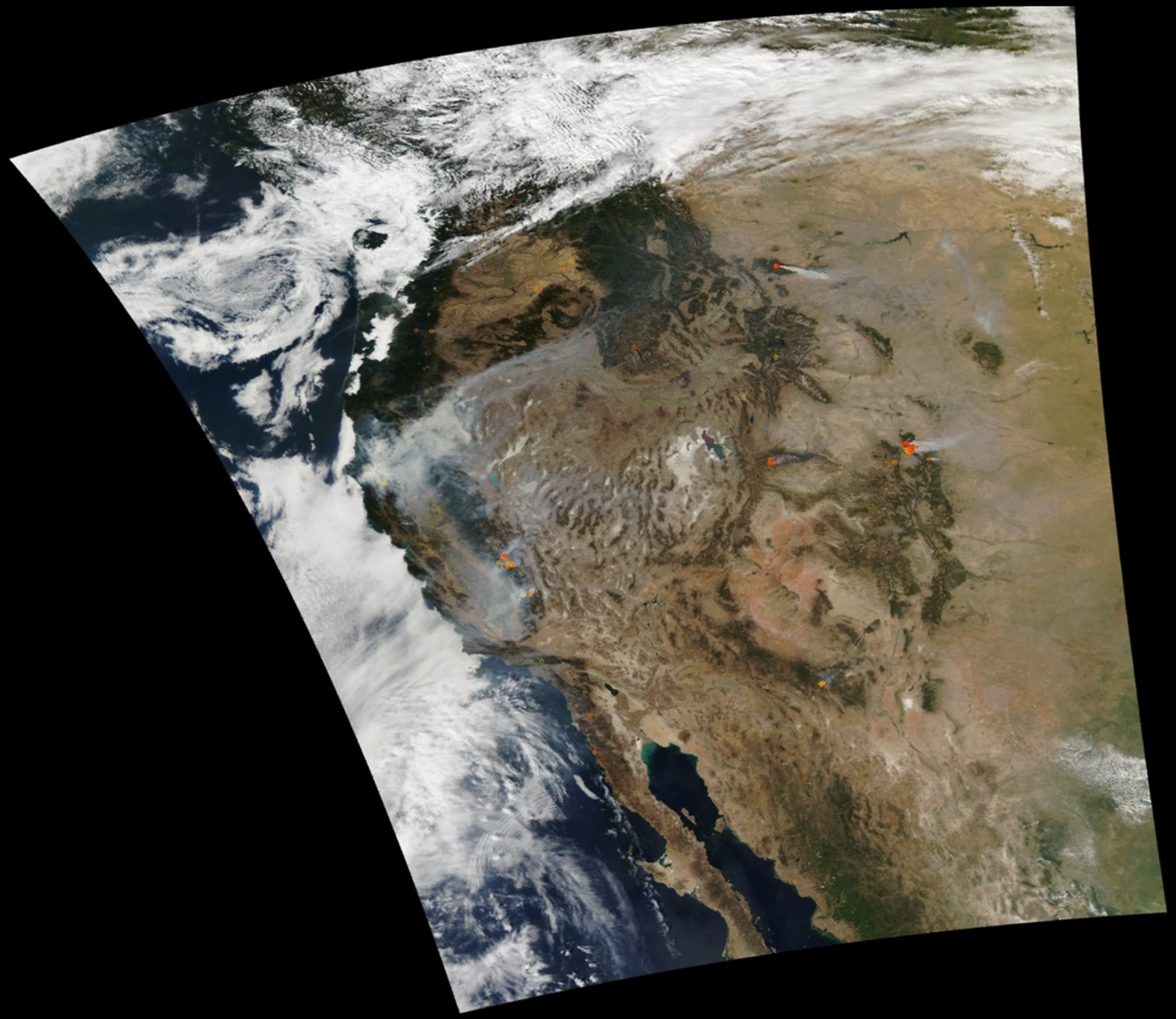
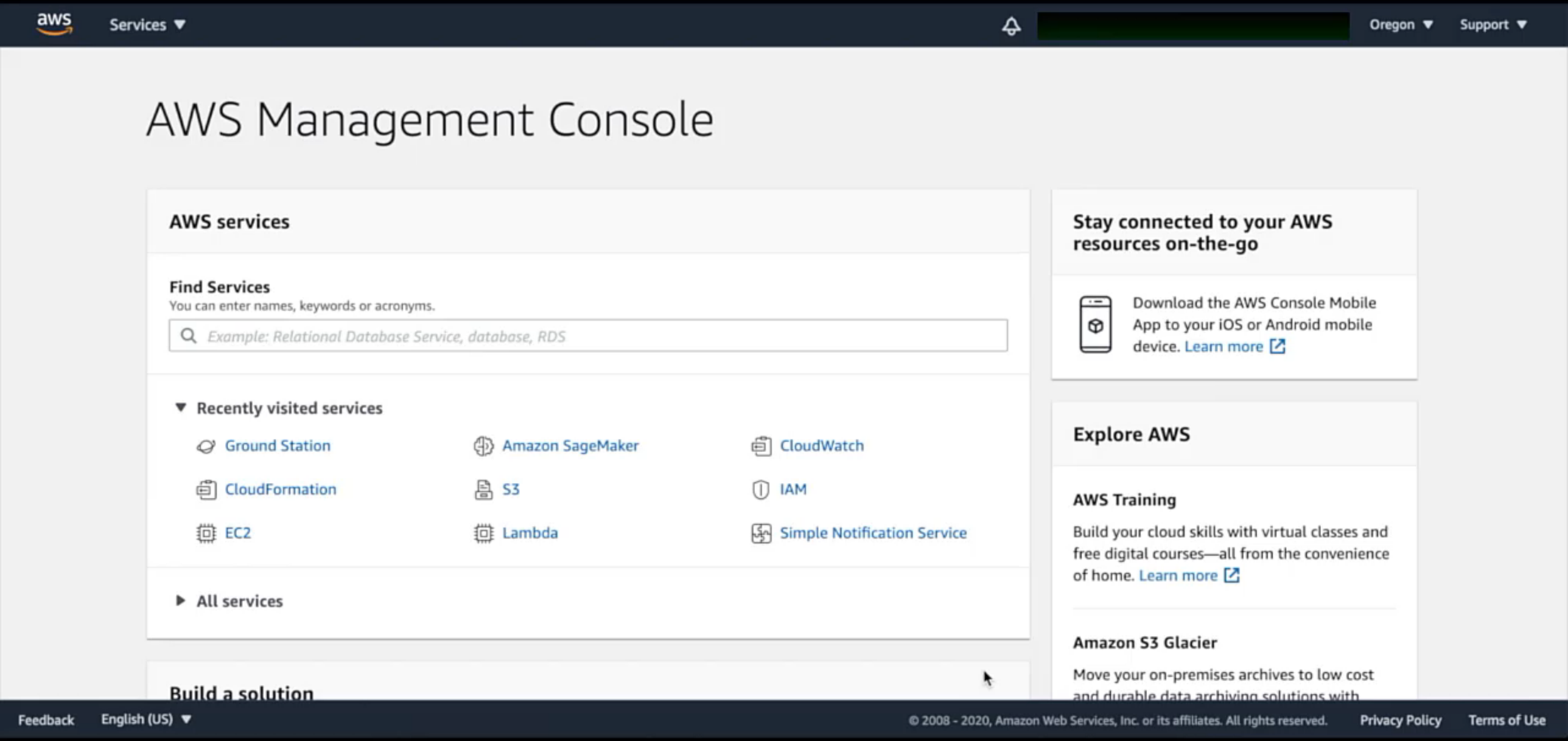


Image from AQUA over Oregon, USA

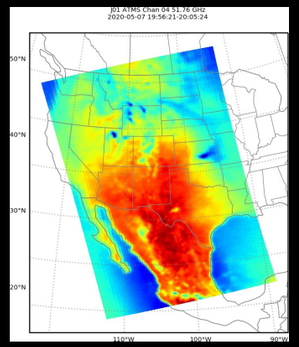



aws
Services
Oregon
Support
AWS Management Console
AWS services
Find Services
You can enter names, keywords or acronyms.
Example: Relational Database Service, database, RDS
Recently visited services
Ground Station
Amazon SageMaker
CloudWatch
CloudFormation
S3
IAM
EC2
Lambda
Simple Notification Service
All services
Build a solution
Stay connected to your AWS resources on-the-go
Download the AWS Console Mobile App to your iOS or Android mobile device. Learn more
Explore AWS
AWS Training
Build your cloud skills with virtual classes and free digital courses—all from the convenience of home. Learn more
Amazon S3 Glacier
Move your on-premises archives to low cost and durable data archiving solutions with
Feedback
English (US)
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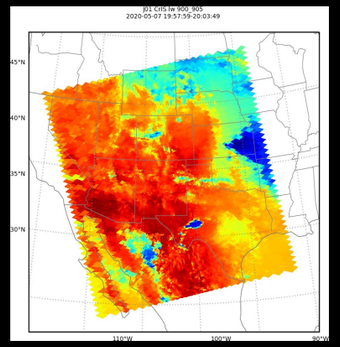
FY 20 AWS Ground Station Service Testing and Evaluation with the JPSS-01 Satellite

A To obtain direct broadcast imagery from 3 sensors

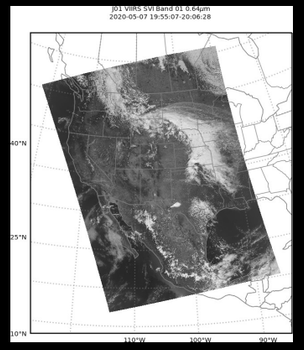
ATMS
Advanced Technology Microwave Sounder



CrIS
Cross-track Infrared Sounder



VIIRS
Visible Infrared Imaging Radiometer Suite



The Aerospace Corporation – POC: Stew Sutton
Approved for public release; distribution unlimited

B Take advantage of a worldwide distribution of ground stations



C



RECEIVER EC2

Data Capture into the EC2 Receiver and then archive the raw TLM to the S3 Logical Store

TCPdump File

S3

Data is live streamed cross-region from the contact aperture

Demodulate / Decode

AWS Ground Station and Receiver

DATA PROCESSING EC2

bash script over SSH to remotely operate

S3

Strip VITA49 Header, and sequenced processing for Level-1 (RT-STPS) and for Level-2 (CSPP) processing

RT-STPS (RDRs)

CSPP (SDRs and Images)

EC2 Compute EBS Processing Storage

Event Sequencing

1. **Schedule Vehicle Contact**
   - Specific Vehicle / Profile
   - Specific Ground Station
   - Available Time of Intersect
2. **Launch Receiver Instance**
3. **Capture Data From Vehicle**
4. **Archive Received Data**
5. **Launch Processing Instance**
6. **Execute Data Processing**
   - RDRs for all instruments
   - SDRs for all instruments
   - Imagery for all instruments
7. **Archive Processed Data**

Approved for public release. OTR 2020-01009.

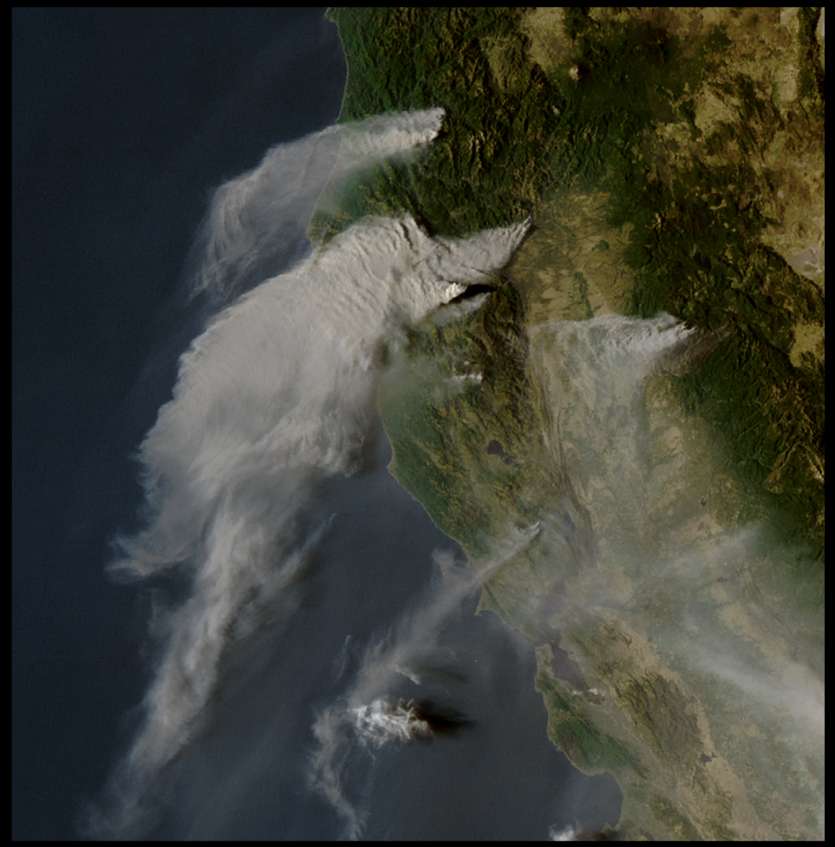
Multi-sensor rapid wildfire intelligence



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Experienced some of the worst fires in history



GOES Sat, Sept 2020



People (and cameras) suffered significant losses

Fire effects are global



California, Sept 2020

Australia, Sept 2019



Require low latency global AWS services

FIREBALL
Intelligence in Time™

- Small fire = 1 bucket of water to extinguish
- Large fire = significant resources, costs, and community risk



First smoke
3:28pm



Alert sent
3:30pm



Large fire
3:44pm

Fireball.International

DELIVERING EARLY WILDFIRE DETECTION SERVICES

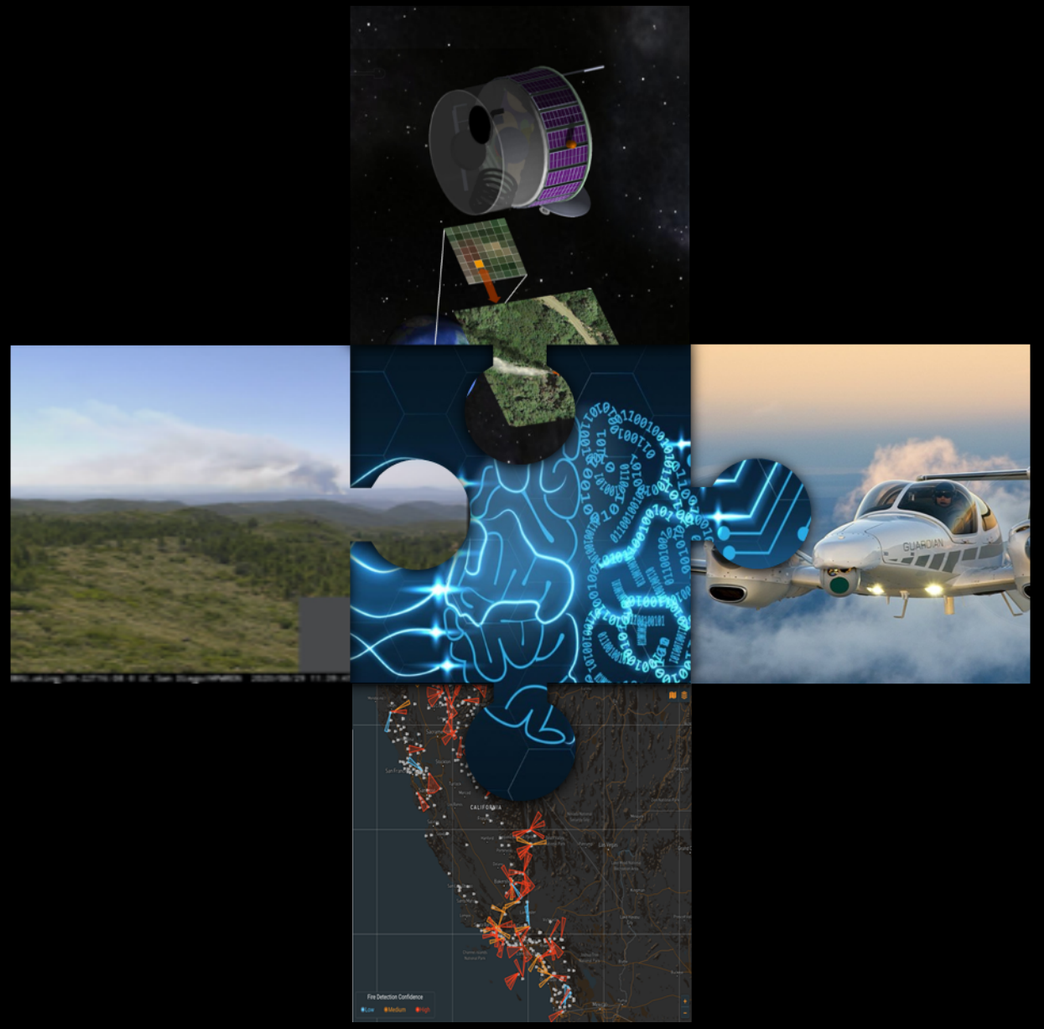
FIREBALL
Intelligence in Time™

Globally distributed team

- Machine learning
- Engineering
- Fire research

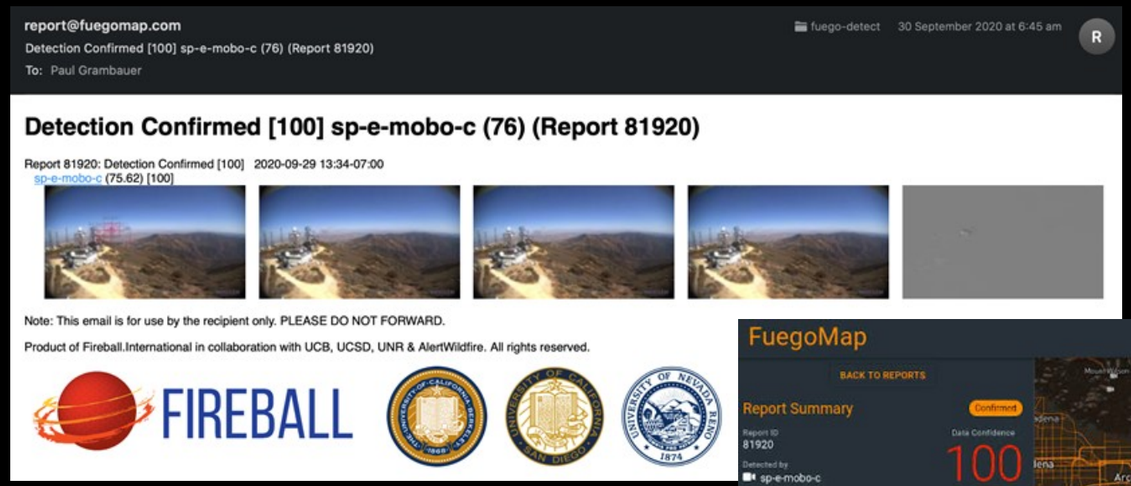
FUEGO-Intelligence

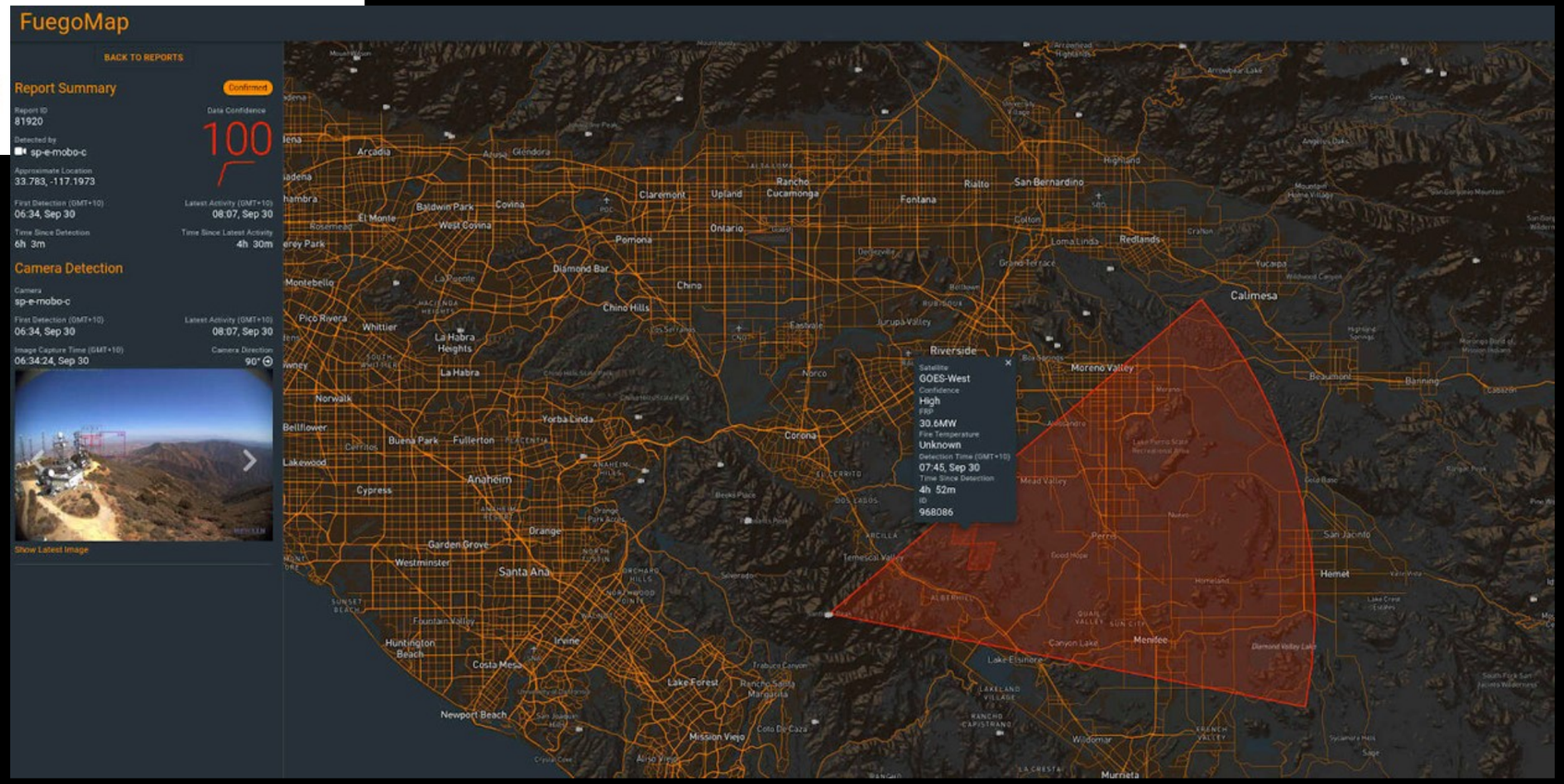
- FUEGO-Ground
- FUEGO-Space
- FUEGO-Air
- FUEGO-Maps



Delivery via web, email, and SMS

FIREBALL
Intelligence in Time™

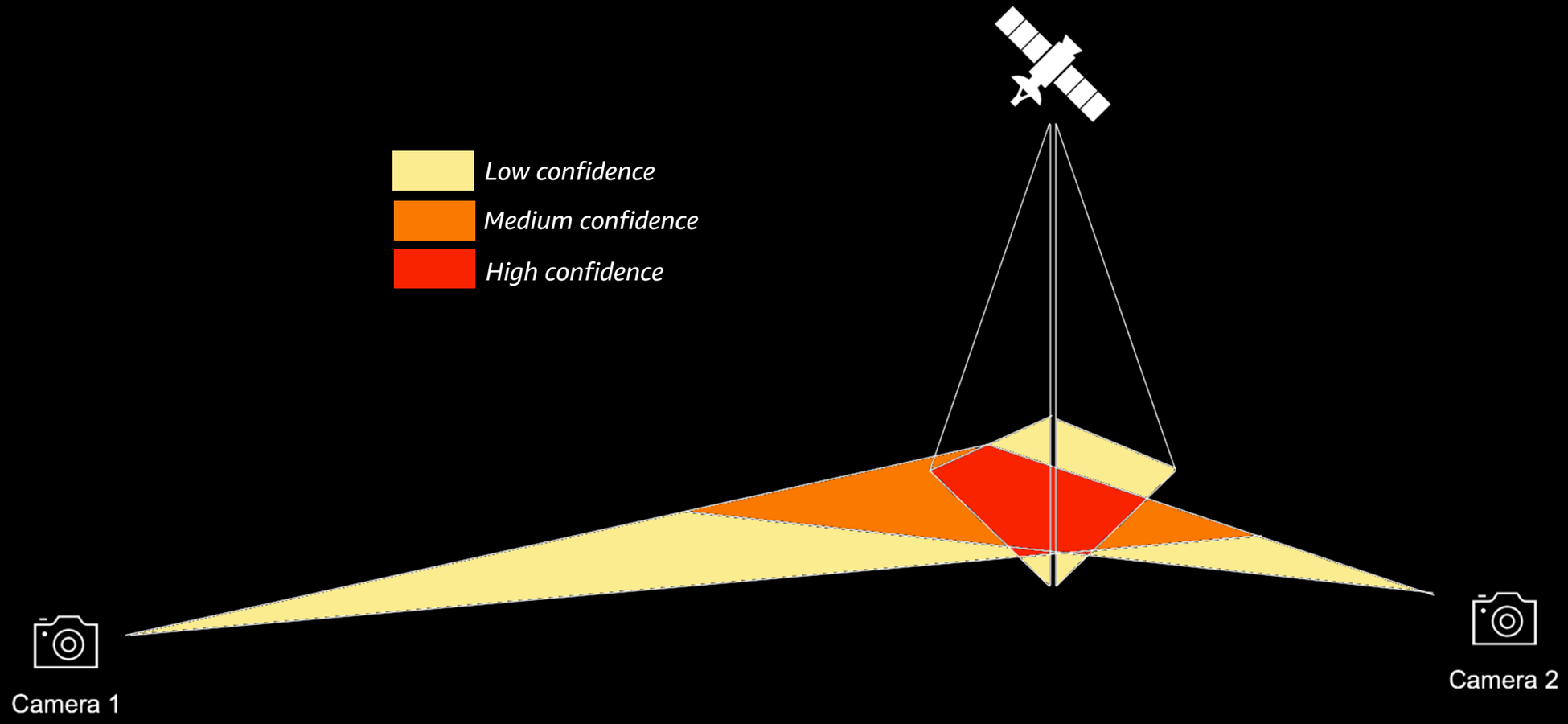




Benefits of multiple sensors

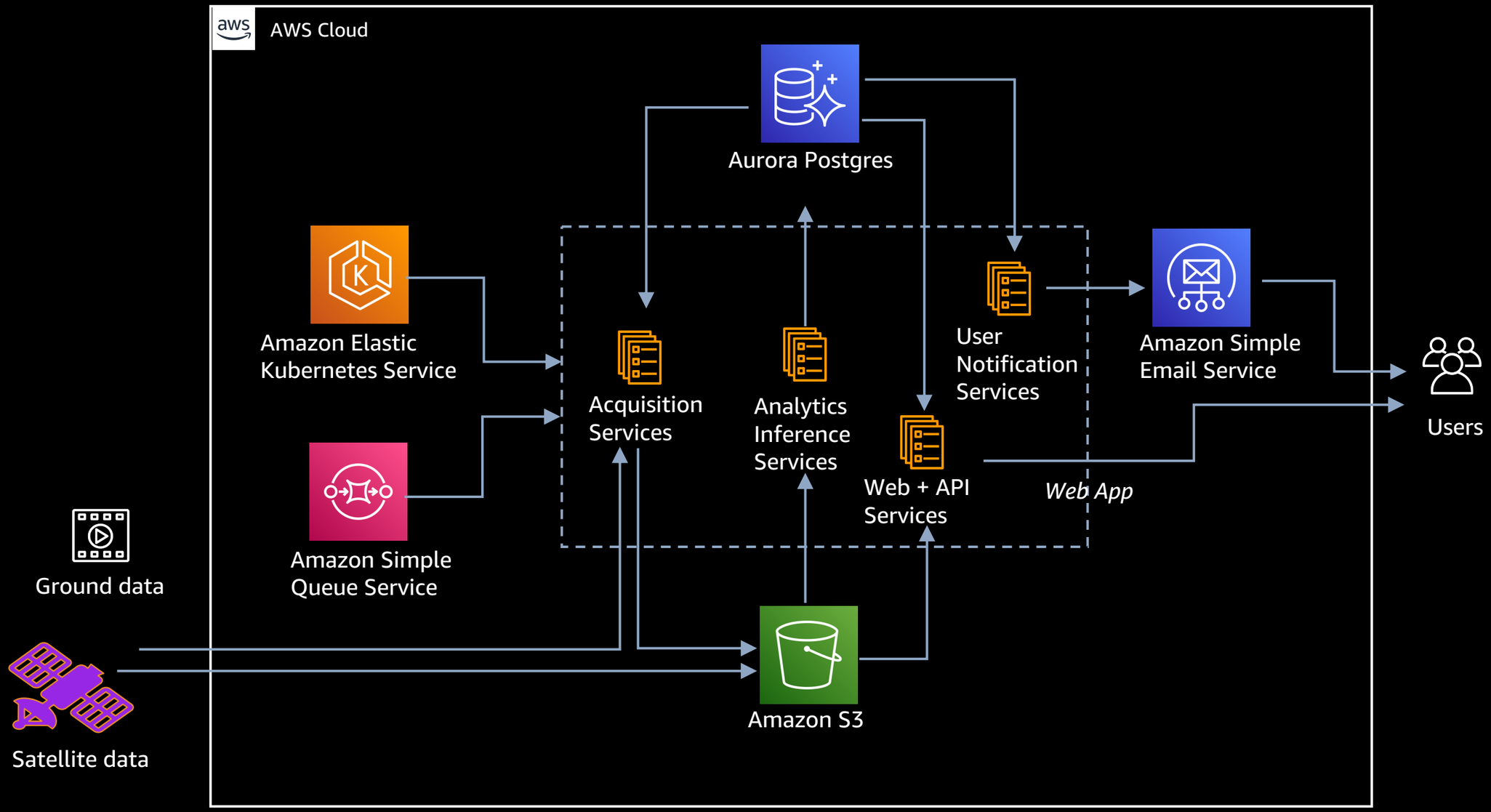
FIREBALL
Intelligence in Time™

More sources = higher confidence



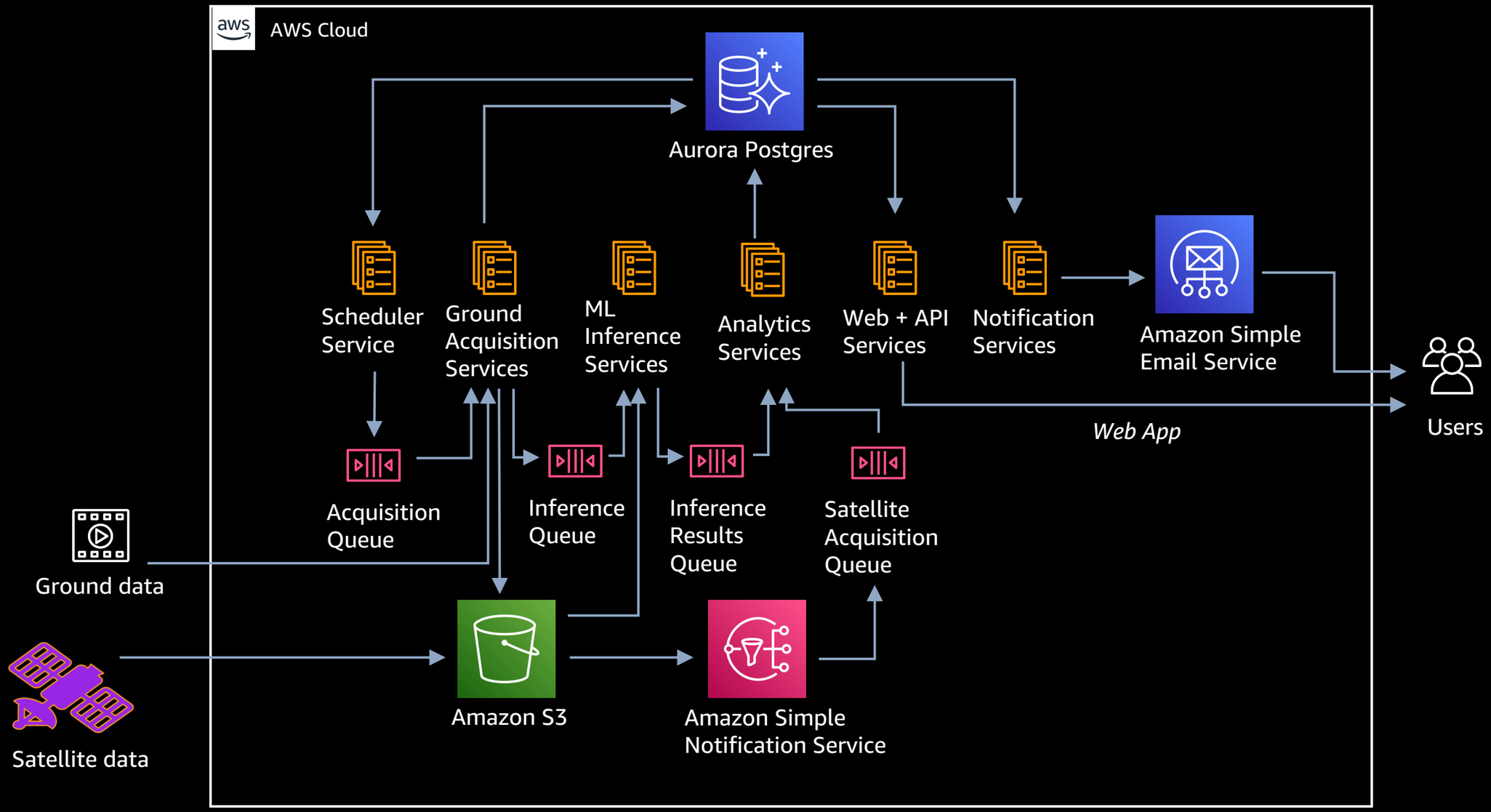
Fuego-Intelligence platform architecture

FIREBALL
Intelligence in Time™



Fuego-Intelligence data flow

FIREBALL
Intelligence in Time™



Top tech tip #1



- Capture Kubernetes metrics for resource tuning
- Burstable may be auto-terminated, use guaranteed



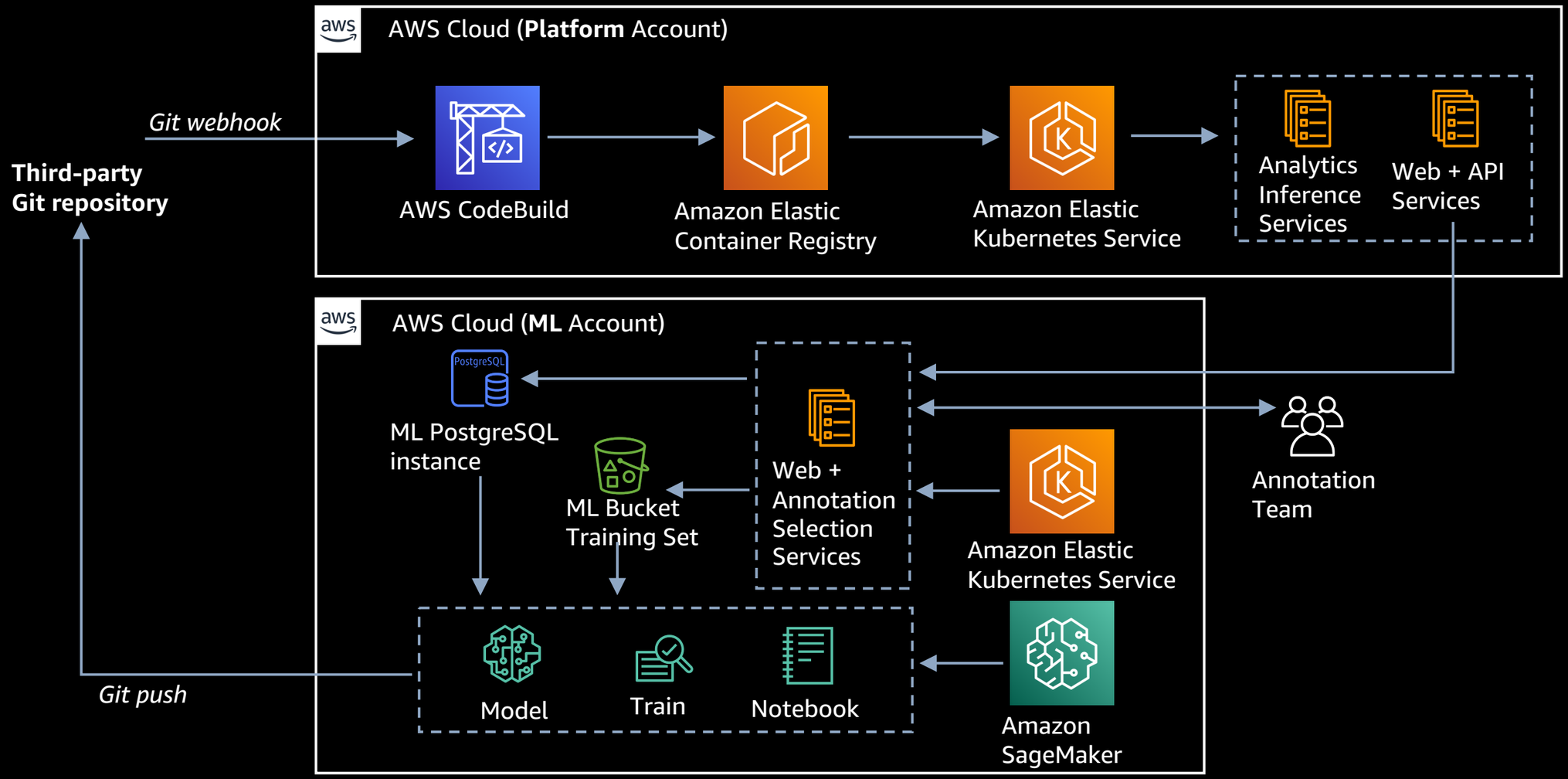
Burstable Configuration



Guaranteed Configuration

Continuous machine learning

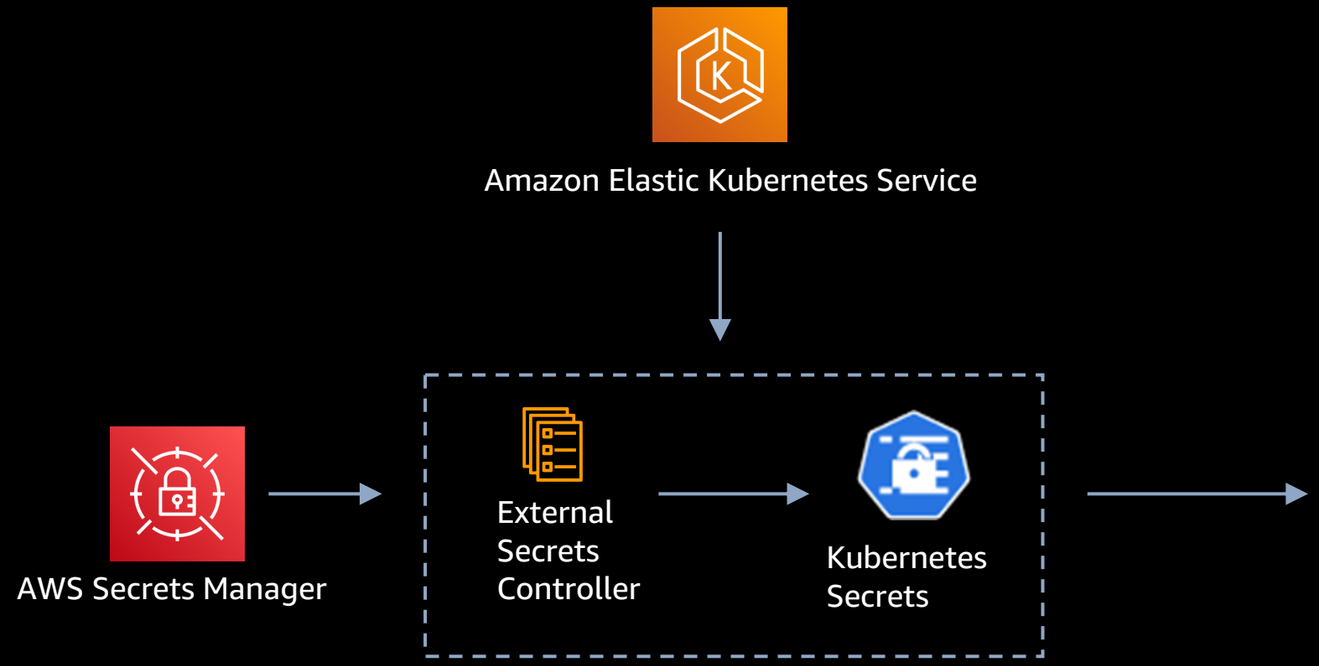
FIREBALL
Intelligence in Time™



Top tech tip #2

FIREBALL
Intelligence in Time™

Use AWS Secrets Manager for Kubernetes deployments




```
      resources:
        limits:
          memory: "100Mi"
          cpu: "0.1"
      name: db
      env:
        - name: PG_USER
          valueFrom:
            secretKeyRef:
              name: service-db-secret
              key: username
        - name: PG_PASSWORD
          valueFrom:
            secretKeyRef:
              name: service-db-secret
              key: password
```

Kubernetes deployment

What else?



- Aggregated EKS performance monitoring, Prometheus, Grafana
- Rapid building with supporting AWS services

Domain and certificate management



Amazon Route 53



AWS Certificate Manager



Elastic Load Balancer

Infrastructure and service deployment



AWS CodePipeline



AWS CloudFormation

Development tools and data movement



AWS Tools and SDKs



AWS Command Line Interface

Authentication and communication services



Amazon Cognito



AWS Secrets Manager



Amazon Simple Email Service



Amazon Simple Notification Service

File system storage



Amazon Elastic File System



AWS Backup

Top tech tip #3

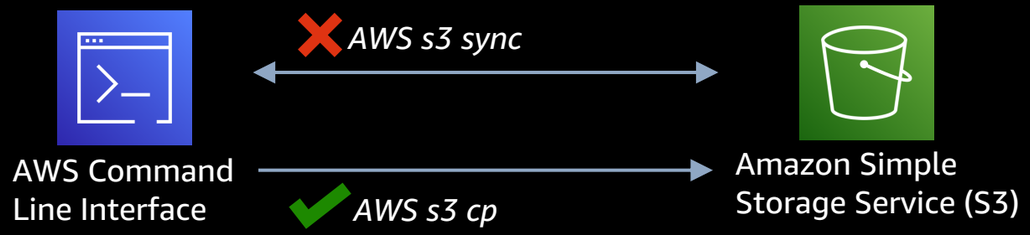
Monitor and optimize API calls for large data stores

DO:

Use AWS CLI S3 copy for uploading objects into a large Amazon S3 bucket.

DON'T:

Use AWS CLI sync commands if you only intend to copy in one direction.

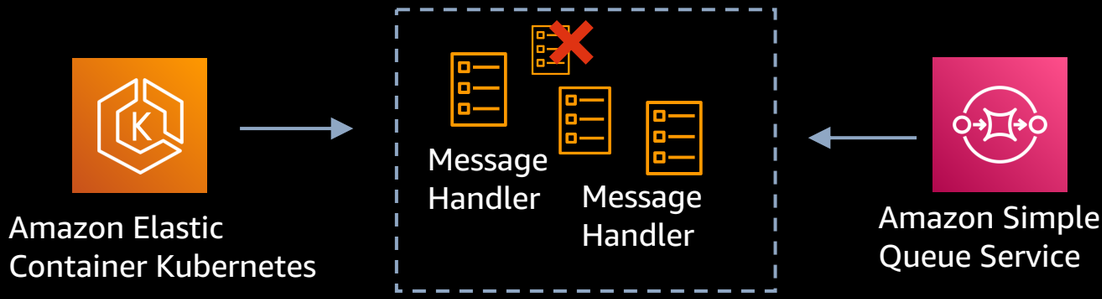


DO:

Scale the number of Amazon EKS pods to be performant.

DON'T:

Run more pods than required. Empty receives from SQS are costed per API call.



What’s next?



- Soon—deploying a network of ground cameras with edge compute into Australian hotspots
- Soon—Amazon EKS cost optimization using spot instances or savings plans
- During 2022, we’ll be launching an Australian satellite and require robust ground stations

Where to learn more



Find more information on Fireball.International: fireball.international

Read the blog at: aws.amazon.com/blogs/publicsector/earth-observation-using-aws-ground-station

Visit our website: https://aws.amazon.com/government-education/aerospace-and-satellite/

Thank you!

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