



# Monitoring and Observability on AWS

# Agenda

- Introduction
- Amazon CloudWatch
- AWS X-Ray and CloudWatch Synthetics
- Amazon VPC FlowLogs
- Managed Open Source Tools for Observability
- Cost Monitoring

Observability describes how well you can **understand what is happening in a system**, often by instrumenting it to collect metrics, logs, and traces.

To **achieve operational excellence and meet business objectives**, you need to understand how your systems are performing.

# Business Goals

- WHY DO YOU NEED OBSERVABILITY?



Create new  
revenue streams



Improve Operational  
and Financial  
efficiency



Lower  
Business Risk

# What is Observability?



# AWS Observability

## Sources & Workloads

- Cloud environment
- Consume multiple data sources from third parties
- On-premises, hybrid and, containerized systems
- Open source systems



### Data Collection

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- Open source or AWS native, via AWS Distro for OpenTelemetry and Amazon CloudWatch
- Traces, metrics, logs



### Event Analysis

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- Monitoring
- Alarms
- Insights
- Anomaly Detection
- Root cause analysis


















### End-to-end Observability

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- Infrastructure Monitoring
- Network Monitoring
- Application Performance Monitoring
- Cost monitoring & optimization

# AWS Services for Observability

• CUSTOMER CHOICES

	AWS NATIVE	OPEN SOURCE	PARTNER
 <b>INFRASTRUCTURE</b> <i>VMs, Containers, OS</i>	 Amazon CloudWatch	 Amazon Managed Service for Prometheus  Amazon Managed Service for Grafana	APN
 <b>AWS SERVICES</b> <i>Vended Monitoring</i>	 Amazon CloudWatch  AWS X-Ray	 Amazon Distro for Open Telemetry	X
 <b>APPLICATION PERFORMANCE</b> <i>Tracing and Profiling</i>	 Amazon CloudWatch  AWS X-Ray  Amazon CodeGuru	 Amazon Distro for Open Telemetry	APN
 <b>END-USER</b> <i>Synthetic Monitoring</i>	 Amazon CloudWatch	X	APN

# Amazon CloudWatch



# Amazon CloudWatch

- **OBSERVABILITY OF YOUR AWS RESOURCES AND APPLICATIONS**



Observability  
on a single  
platform  
across  
accounts,  
applications  
and  
infrastructure



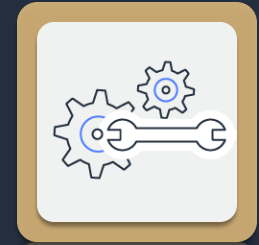
Easiest way to  
collect metrics  
in AWS and on-  
premises



Improve  
operational  
performance  
and resource  
optimization



Get  
operational  
visibility and  
insight



Derive  
actionable  
insights  
from logs

# Amazon CloudWatch Concepts

- Metrics
- Namespaces
- Dimensions
- Time Stamps
- Units
- Statistics
- Periods
- Aggregation
- Alarms
- Regions

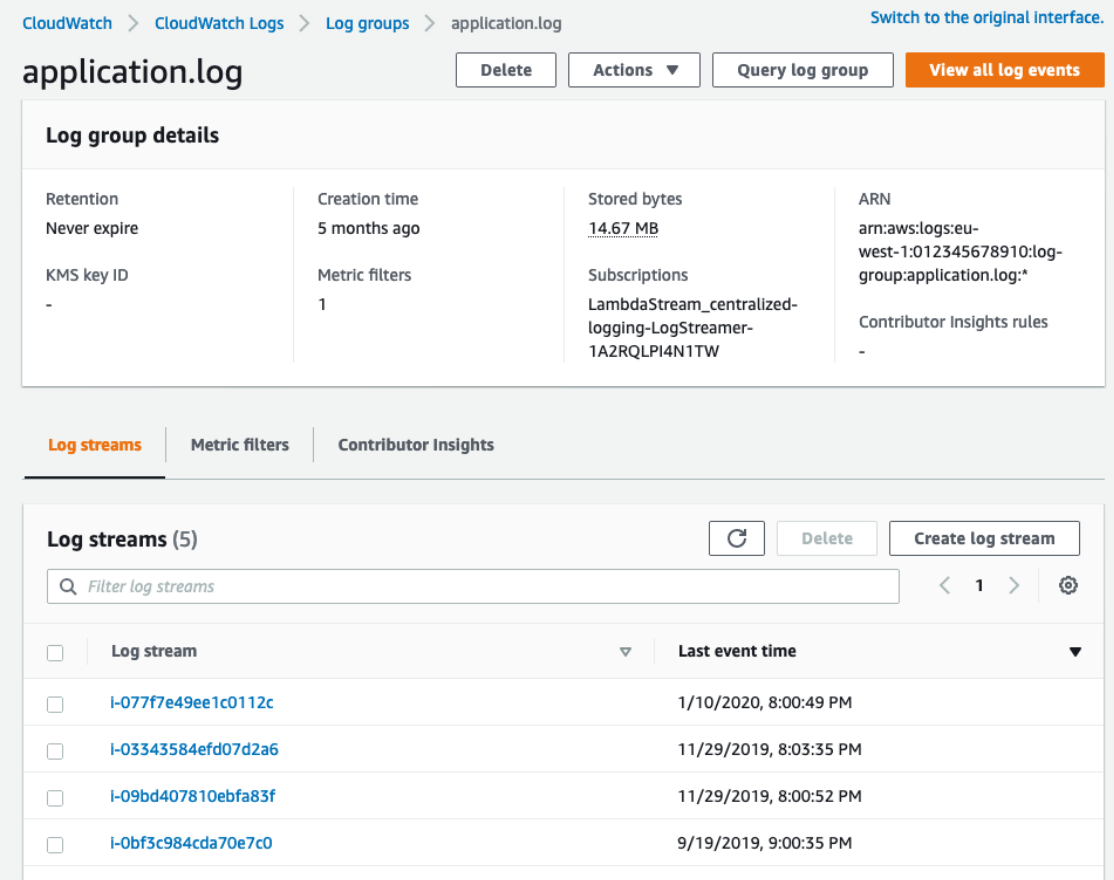
# CloudWatch Logs

- STORE LOGS IN NEAR REAL-TIME

## Collect logs from:

- Amazon EC2 instances
- On-premises servers
- VPC Flow Logs
- AWS CloudTrail
- AWS Lambda
- Other AWS Services

Log data can be stored and accessed indefinitely in highly durable, low-cost storage so you don't have to worry about filling up hard drives. Define and apply data protection policies for sensitive data.



The screenshot displays the AWS CloudWatch Logs console interface. At the top, the breadcrumb navigation shows 'CloudWatch > CloudWatch Logs > Log groups > application.log'. A 'Switch to the original interface.' link is in the top right. Below the breadcrumb, the page title is 'application.log', followed by 'Delete', 'Actions' (dropdown), 'Query log group', and 'View all log events' buttons.

The 'Log group details' section contains a table with the following information:

Retention	Creation time	Stored bytes	ARN
Never expire	5 months ago	14.67 MB	arn:aws:logs:eu-west-1:012345678910:log-group:application.log:*
KMS key ID	Metric filters	Subscriptions	Contributor Insights rules
-	1	LambdaStream_centralized-logging-LogStreamer-1A2RQLPI4N1TW	-

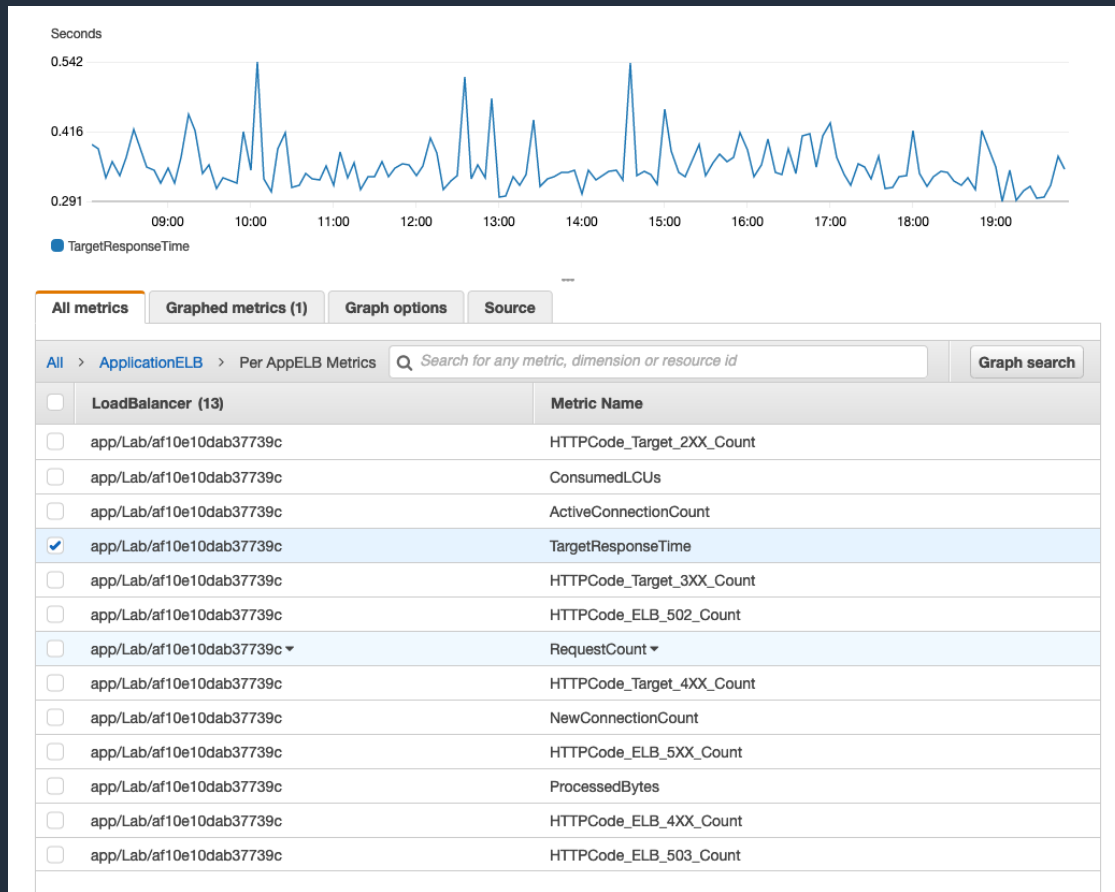
Below the details, there are tabs for 'Log streams' (selected), 'Metric filters', and 'Contributor Insights'.

The 'Log streams (5)' section includes a search bar labeled 'Filter log streams', a refresh button, a 'Delete' button, and a 'Create log stream' button. Below this is a table listing the log streams:

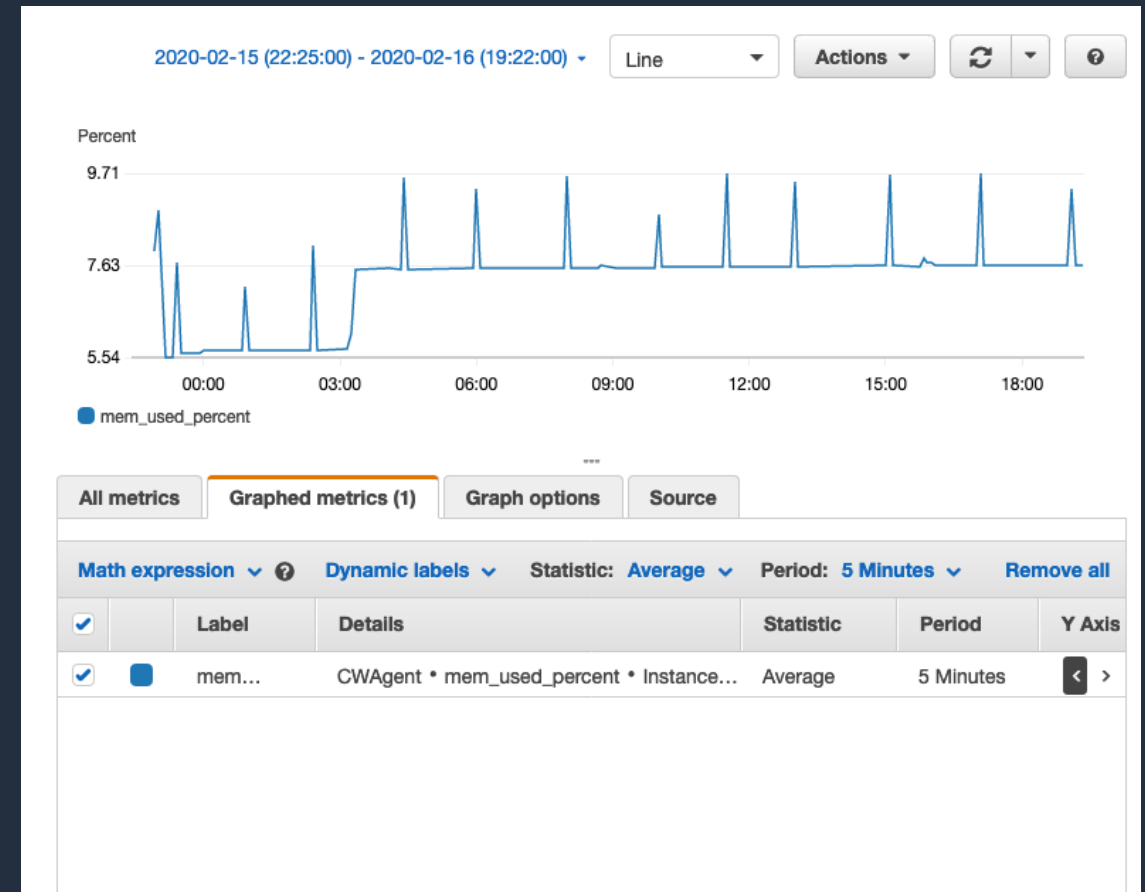
Log stream	Last event time
<a href="#">i-077f7e49ee1c0112c</a>	1/10/2020, 8:00:49 PM
<a href="#">i-03343584efd07d2a6</a>	11/29/2019, 8:03:35 PM
<a href="#">i-09bd407810ebfa83f</a>	11/29/2019, 8:00:52 PM
<a href="#">i-0bf3c984cda70e7c0</a>	9/19/2019, 9:00:35 PM

# CloudWatch Metrics

## Built-in metrics



## Custom metrics



# CloudWatch Metrics Insights

- **ANALYZE AND VISUALIZE OPERATIONAL METRICS AT SCALE**

- Query across CloudWatch metrics at scale for a high-level overview of your applications and infrastructure.
- Create health and performance dashboards using your query results.
- Quickly isolate, diagnose, troubleshoot, and remediate issues.

Statistic	Period	Y axis	Actions
<div>Edit query <a href="#">Info</a></div> <div><pre>1 SELECT SUM(RequestCount) 2 FROM SCHEMA("AWS/ApplicationELB", LoadBalancer)</pre></div> <div><div>Run</div><div>Use Ctrl + Enter to run query, Ctrl + Space to autocomplete.</div></div>			

# CloudWatch Internet Monitor

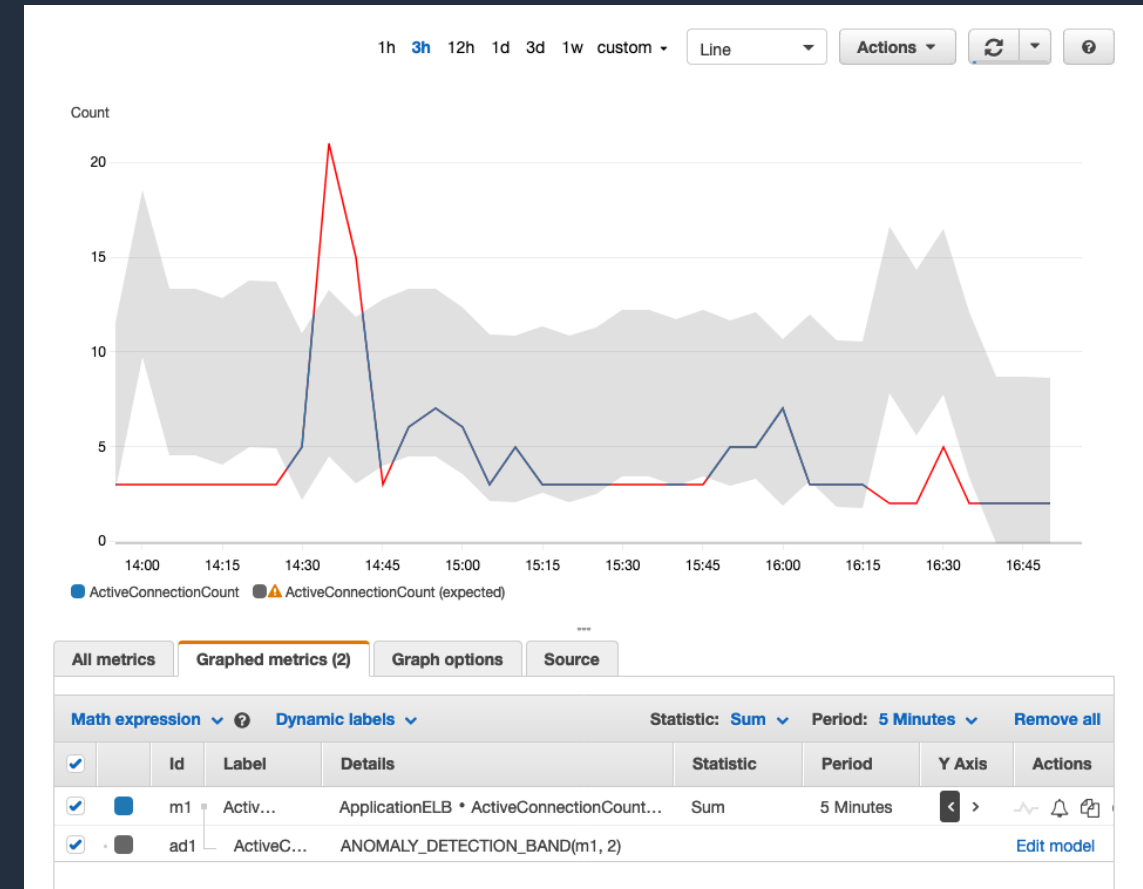
Continually monitor internet availability and performance metrics between your AWS-hosted applications and application end users.

- Quickly visualize the impact of issues, pinpoint locations and providers that are affected, and take action to improve your end users' network experience.
- You can see a global view of traffic patterns and health events, and easily drill down into information about events at different geographic granularities.

# Anomaly Detection

When you enable anomaly detection for a metric, CloudWatch applies machine learning algorithms to the metric's past data to create a model of the metric's expected values.

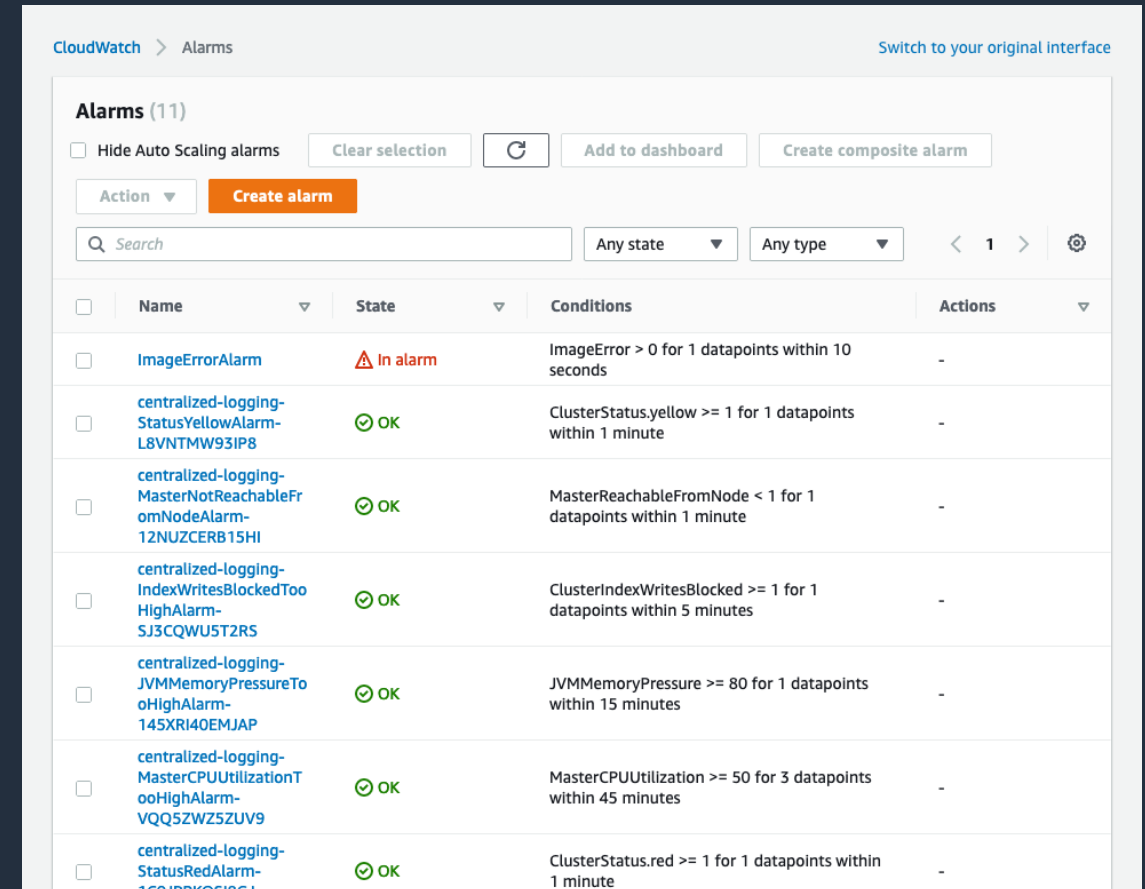
- Create alarms that auto-adjust thresholds based on natural metric patterns
- Alarm when the metric value is above or below the band, or both
- Visualize metrics with anomaly detection bands on dashboards



# CloudWatch Alarms

Amazon CloudWatch alarms allow you to set a threshold on metrics and trigger an action.

- Watch a single metric or the result of a math expression
- Perform actions based on the value of metrics
  - Send a notification to an SNS topic
  - Auto Scaling action
  - EC2 Action (Stop, Terminate, Reboot or Recover)
- Add alarms to dashboards to visualize them



The screenshot displays the Amazon CloudWatch Alarms console. At the top, there's a navigation bar with 'CloudWatch > Alarms' and a link to 'Switch to your original interface'. Below this, the 'Alarms (11)' section is visible. It includes a 'Hide Auto Scaling alarms' checkbox, a 'Clear selection' button, a refresh icon, and buttons for 'Add to dashboard' and 'Create composite alarm'. There's also an 'Action' dropdown menu and a prominent orange 'Create alarm' button. A search bar and filters for 'Any state' and 'Any type' are present. The main area contains a table of alarms:

<input type="checkbox"/>	Name	State	Conditions	Actions
<input type="checkbox"/>	ImageErrorAlarm	<span style="color: red;">⚠ In alarm</span>	ImageError > 0 for 1 datapoints within 10 seconds	-
<input type="checkbox"/>	centralized-logging-StatusYellowAlarm-L8VNTMW93IP8	<span style="color: green;">✅ OK</span>	ClusterStatus.yellow >= 1 for 1 datapoints within 1 minute	-
<input type="checkbox"/>	centralized-logging-MasterNotReachableFromNodeAlarm-12NUZCERB15HI	<span style="color: green;">✅ OK</span>	MasterReachableFromNode < 1 for 1 datapoints within 1 minute	-
<input type="checkbox"/>	centralized-logging-IndexWritesBlockedTooHighAlarm-SJ3CQWU5T2RS	<span style="color: green;">✅ OK</span>	ClusterIndexWritesBlocked >= 1 for 1 datapoints within 5 minutes	-
<input type="checkbox"/>	centralized-logging-JVMMemoryPressureTooHighAlarm-145XRI40EMJAP	<span style="color: green;">✅ OK</span>	JVMMemoryPressure >= 80 for 1 datapoints within 15 minutes	-
<input type="checkbox"/>	centralized-logging-MasterCPUUtilizationTooHighAlarm-VQQ5ZWZ5ZUV9	<span style="color: green;">✅ OK</span>	MasterCPUUtilization >= 50 for 3 datapoints within 45 minutes	-
<input type="checkbox"/>	centralized-logging-StatusRedAlarm-1C0IBPKQSI8GJ	<span style="color: green;">✅ OK</span>	ClusterStatus.red >= 1 for 1 datapoints within 1 minute	-



# CloudWatch Events

Provides a near real-time stream of system events that describe changes to your AWS resources.

Write rules to indicate which events are of interest to your application and what automated actions to take when a rule matches an event.

**Rules** > **ChangeInstanceSize** Actions ▾

**Summary**

**ARN** ⓘ `arn:aws:events:eu-west-1:180304385487:rule/ChangeInstanceSize`

**Schedule** Cron expression `0 6 ? * 6L *`

**Next 10 Trigger Date(s)**

- 1. Fri, 28 Feb 2020 06:00:00 GMT
- 2. Fri, 27 Mar 2020 06:00:00 GMT
- 3. Fri, 24 Apr 2020 06:00:00 GMT
- 4. Fri, 29 May 2020 06:00:00 GMT
- 5. Fri, 26 Jun 2020 06:00:00 GMT
- 6. Fri, 31 Jul 2020 06:00:00 GMT
- 7. Fri, 28 Aug 2020 06:00:00 GMT
- 8. Fri, 25 Sep 2020 06:00:00 GMT
- 9. Fri, 30 Oct 2020 06:00:00 GMT
- 10. Fri, 27 Nov 2020 06:00:00 GMT

**Status** Enabled

**Description**

**Monitoring** [Show metrics for the rule](#)

**Targets**

**Filter:**

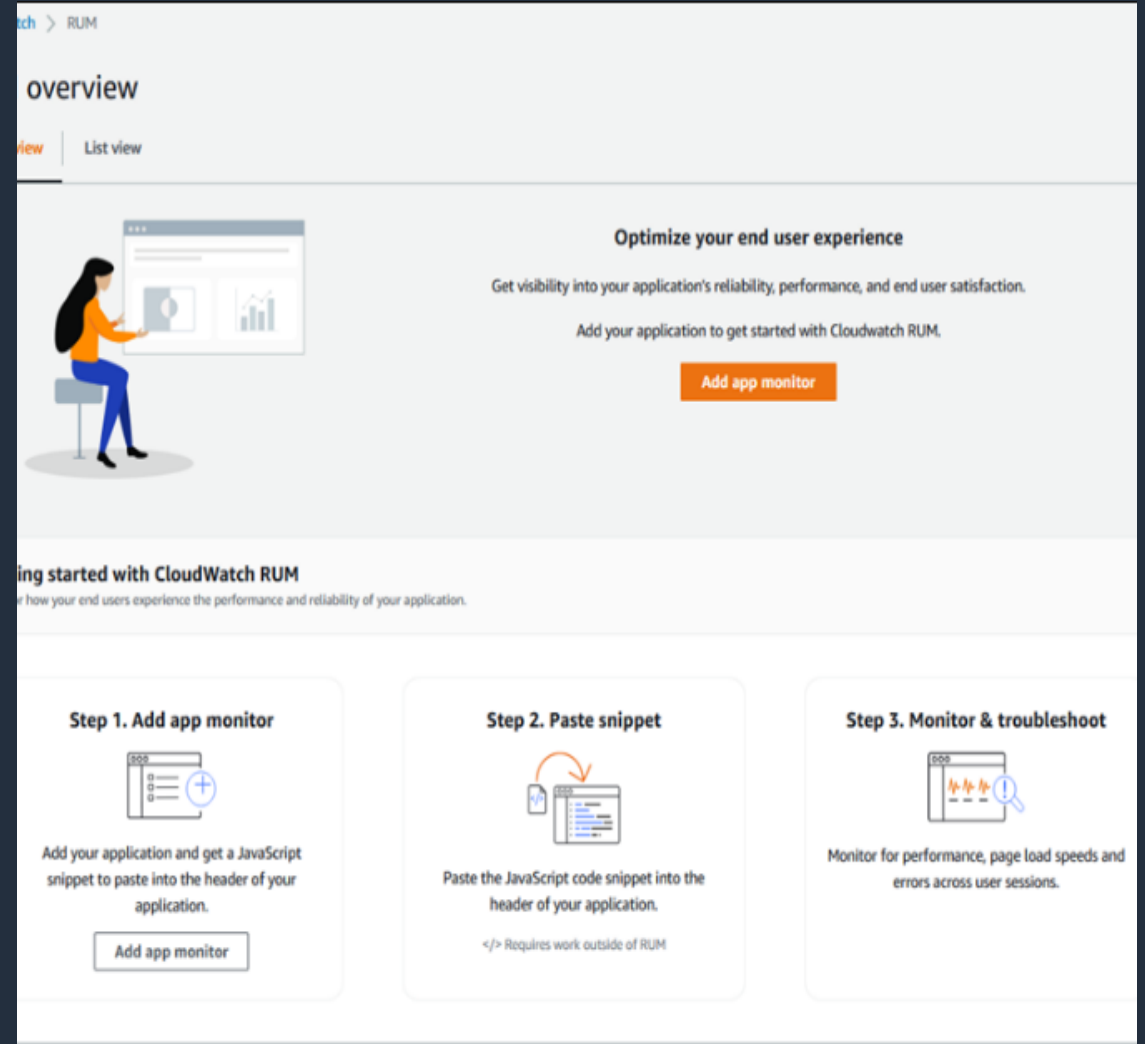
Type	Name	Input
SSM Automation	<a href="#">ChangeInstanceSize (version \$DEFAULT)</a>	<b>Constant:</b> <code>{"InstanceId":["i-0cb0104ddf22a"]}</code>

# CloudWatch RUM

RUM will help you to collect the metrics that give you the insights that will help you to identity, understand, and improve this experience.

## End-to-End monitoring.

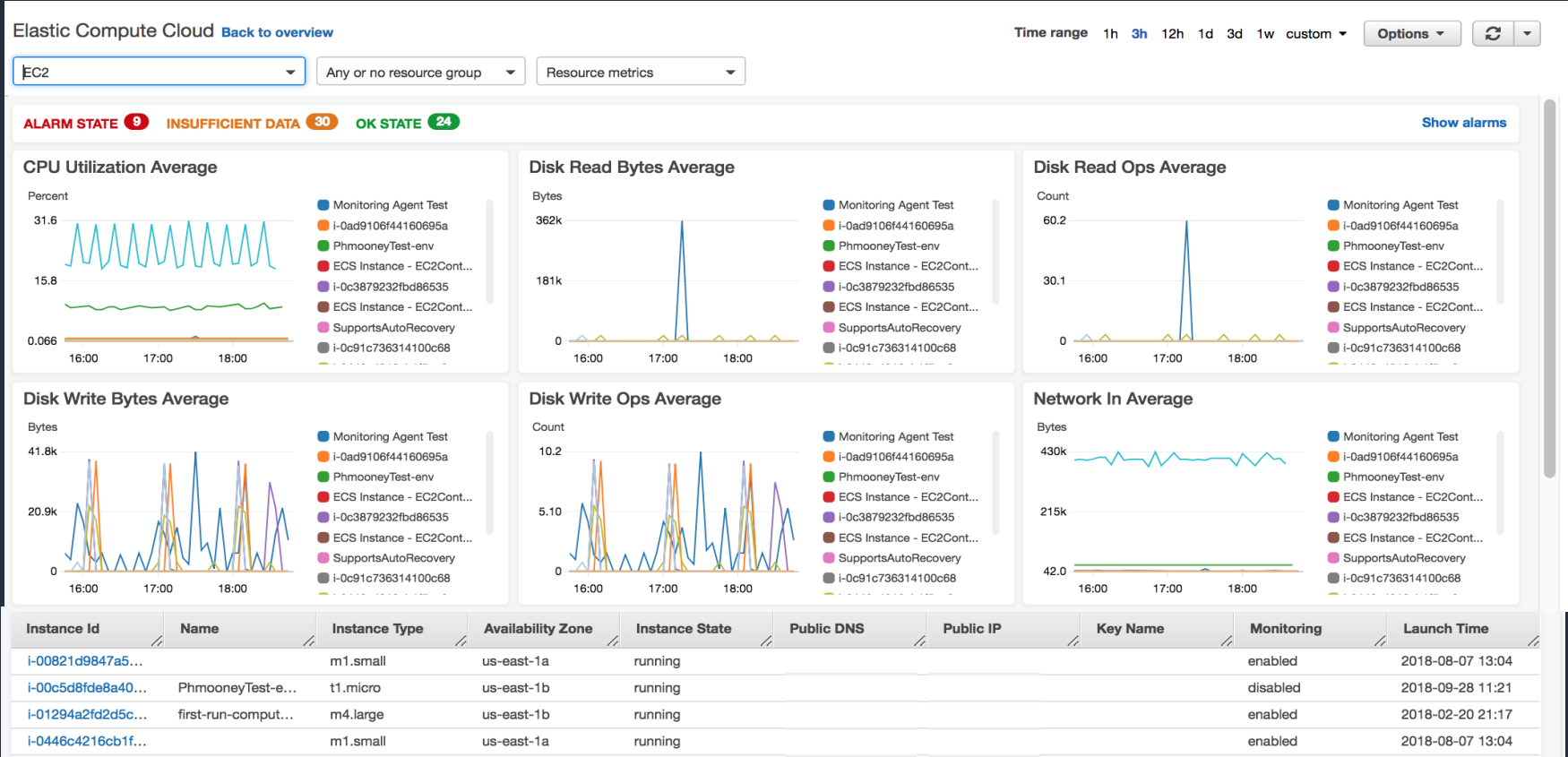
- ✓ View how your applications are performing in near real-time across different geolocations, browsers, and devices, enabling you to optimize their performance.
- ✓ Use CloudWatch RUM's curated dashboards to view anomalies in application's performance including page load steps, core web vitals, and JavaScript and Http errors.
- ✓ Correlate traces from client-side to backend infrastructure nodes through integration with CloudWatch ServiceLens and AWS X-Ray



# CloudWatch Automatic Dashboards

- CloudWatch simplifies infrastructure monitoring with a default, getting started experience.

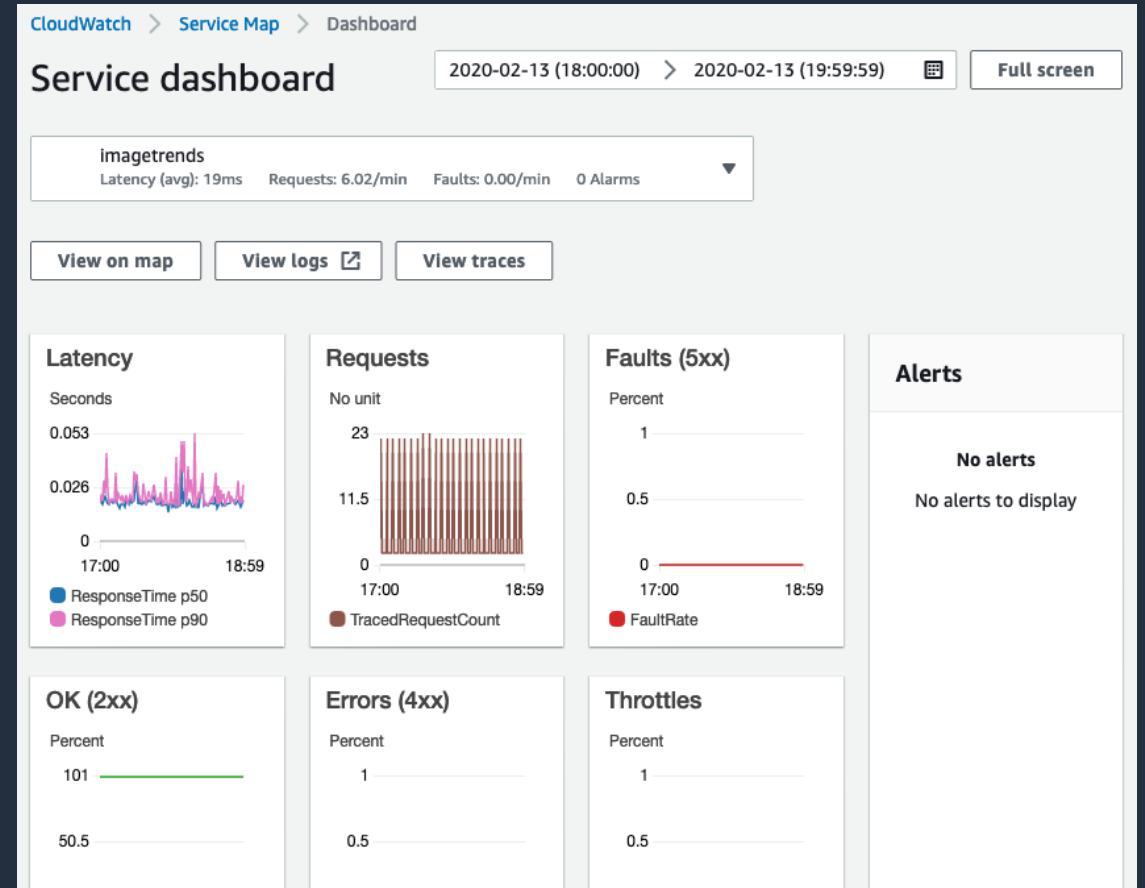
Dynamic, self-updating AWS infrastructure dashboards



# CloudWatch ServiceLens

Visualize and analyze the health, performance, and availability of your applications in a single place.

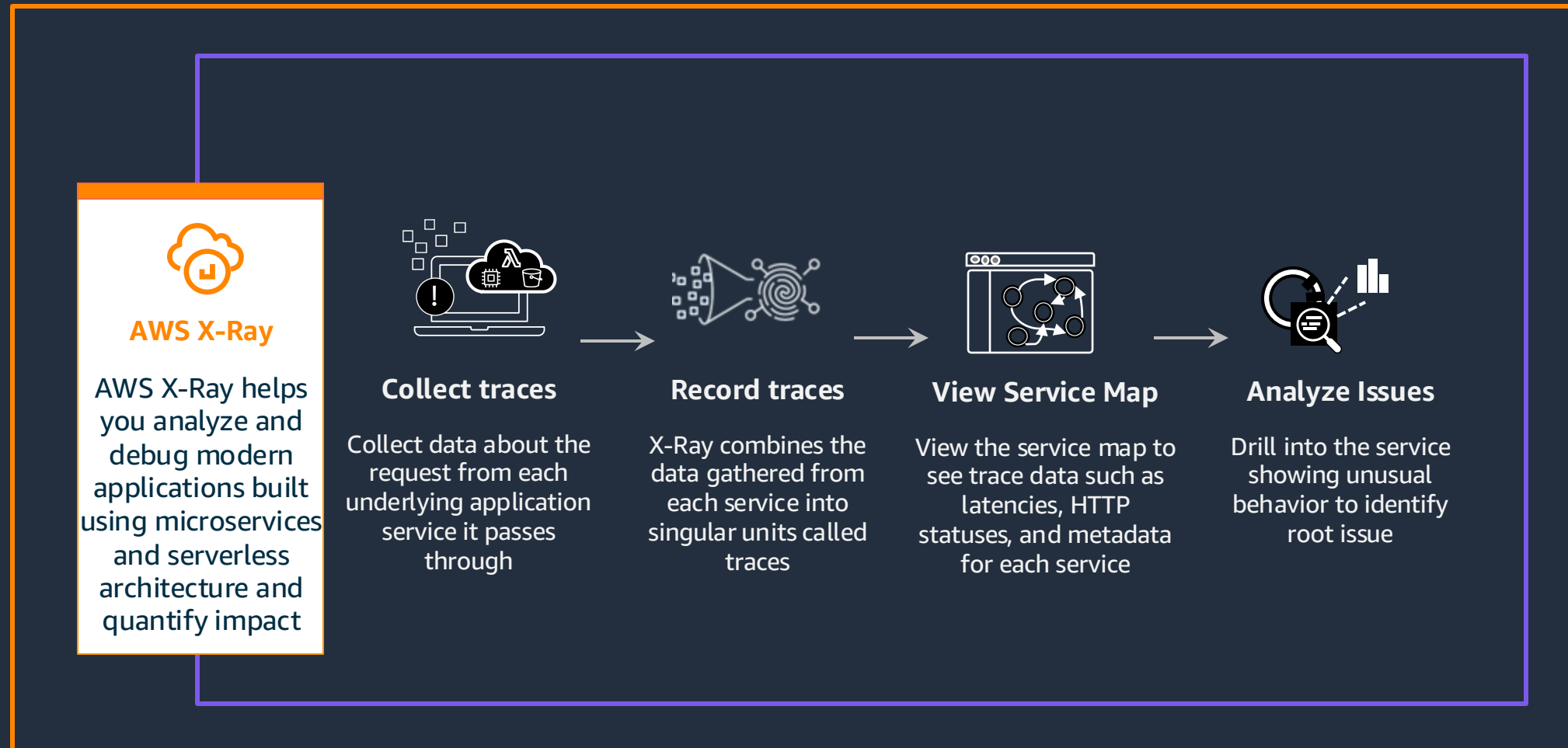
- Integrates CloudWatch with AWS X-Ray to provide an end-to-end view of your application
- A service map displays your service endpoints and resources as “nodes” and highlights the traffic, latency, and errors for each node and its connections
- You can choose a node to see detailed insights about the correlated metrics, logs, and traces associated with that part of the service



# AWS X-Ray and CloudWatch Synthetics

# AWS X-Ray

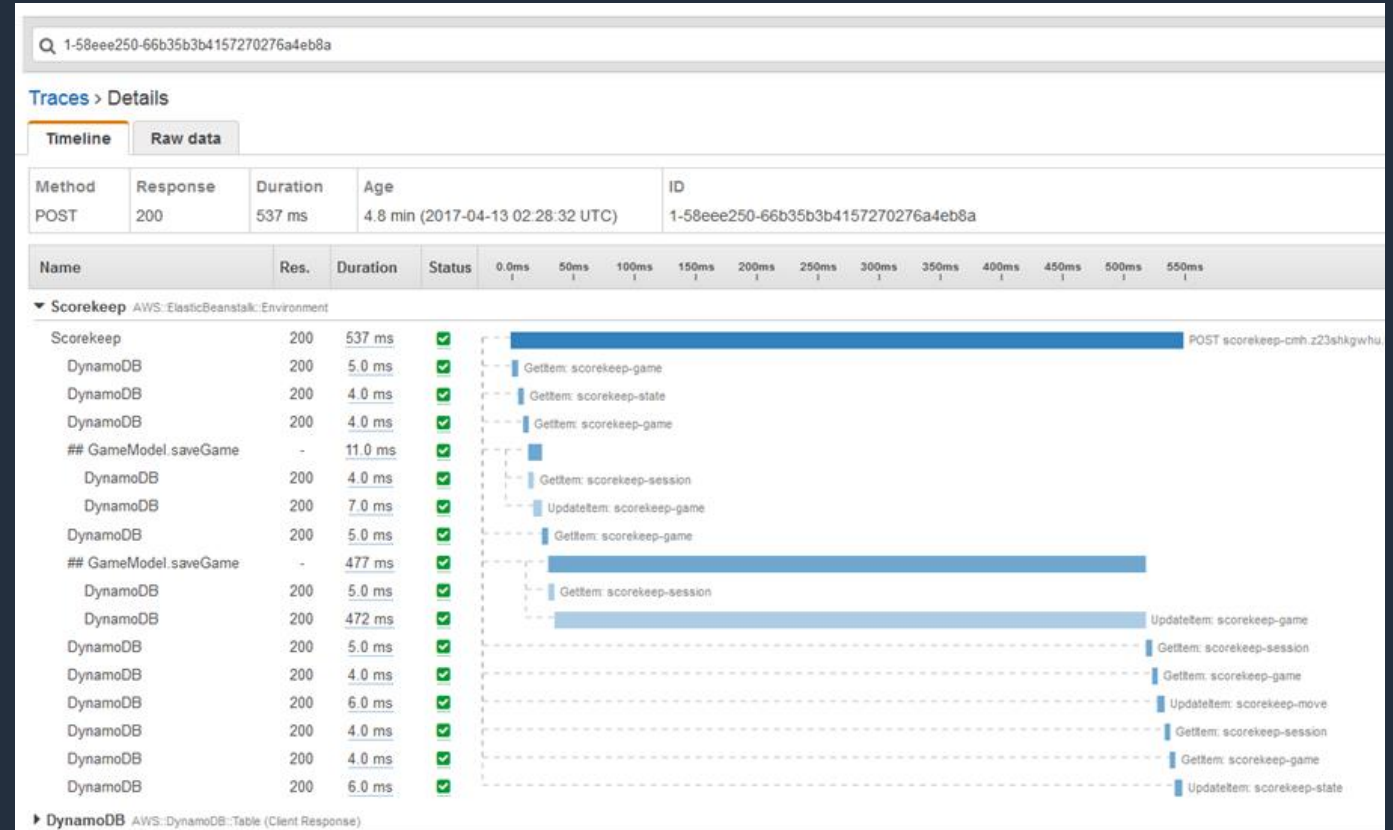
- ANALYZE AND DEBUG PRODUCTION, DISTRIBUTED APPLICATIONS



# End to End Tracing

An view of requests flowing through your application by aggregating the data gathered from individual services into a single unit called a trace.

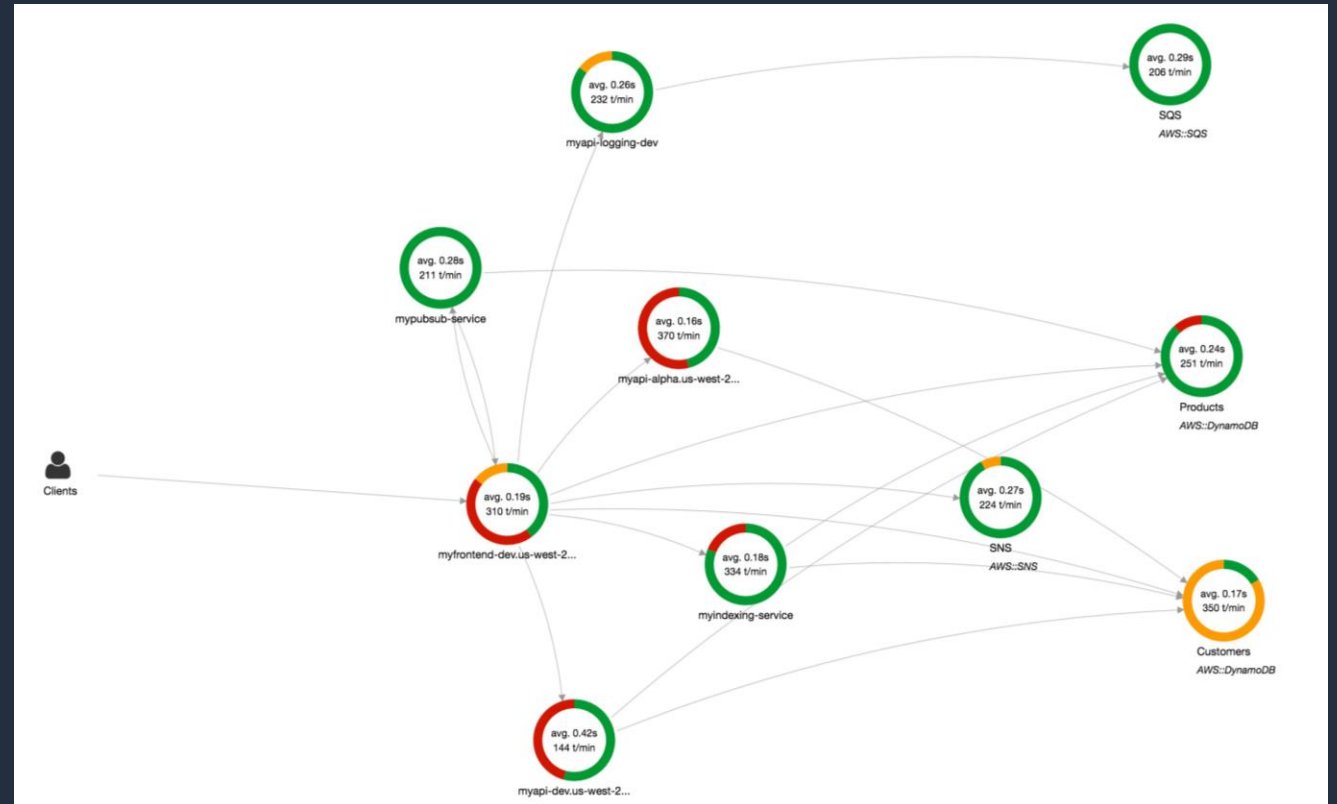
- Identify performance bottlenecks, edge case errors, and other hard to detect issues.
- Use this trace to follow the path of an individual request as it passes through each service in your application to pinpoint where issues are occurring.



# Service Map

A map of services used by your application with trace data that you can use to drill into specific services or issues.

- This provides a view of connections between services in your application and aggregated data for each service, including average latency and failure rates.
- You can create dependency trees, perform cross-availability zone or region call detections, and more

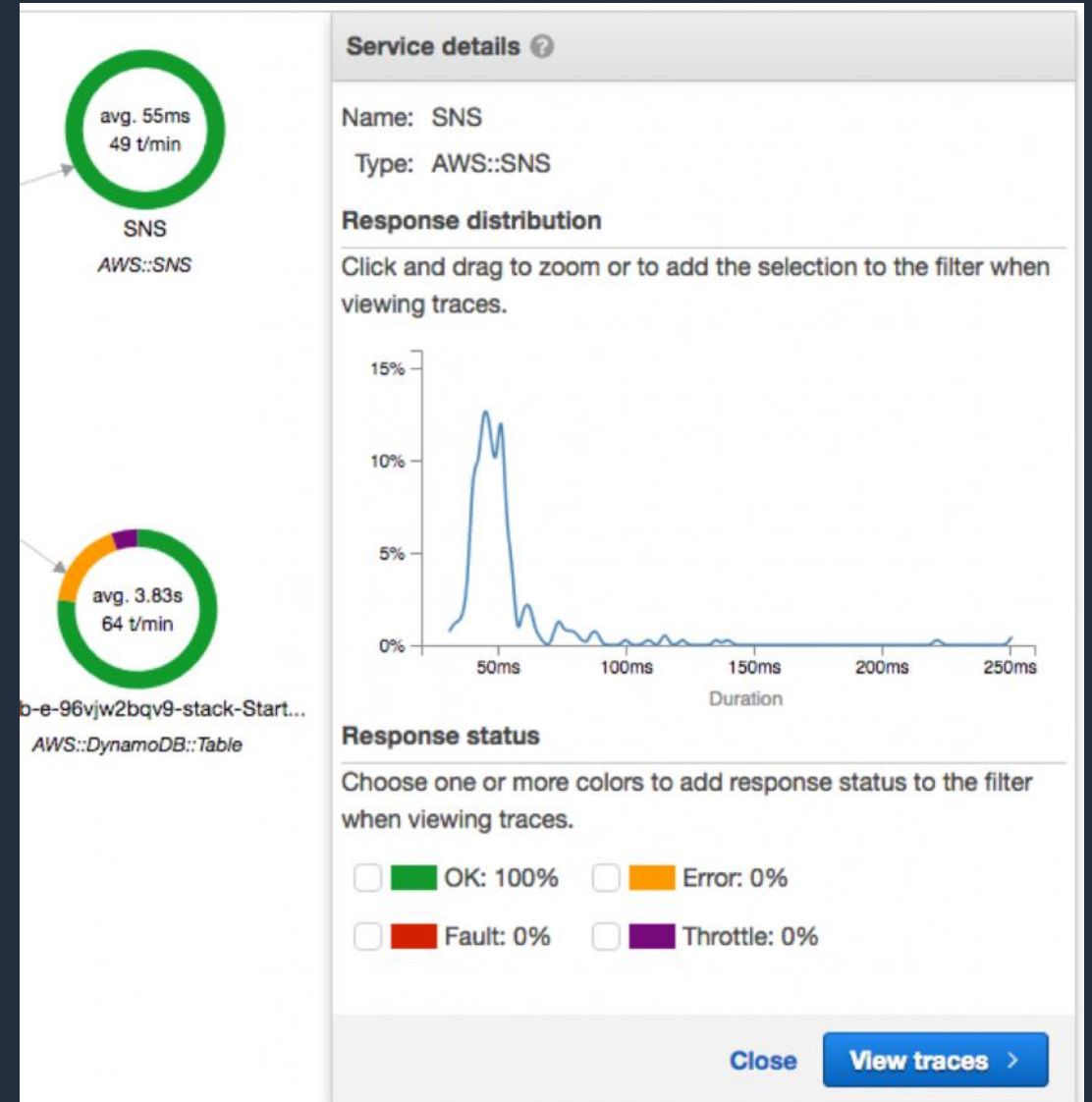




# Server and Client-Side Latency Detection

Visually detect node and edge latency distribution directly from the service map.

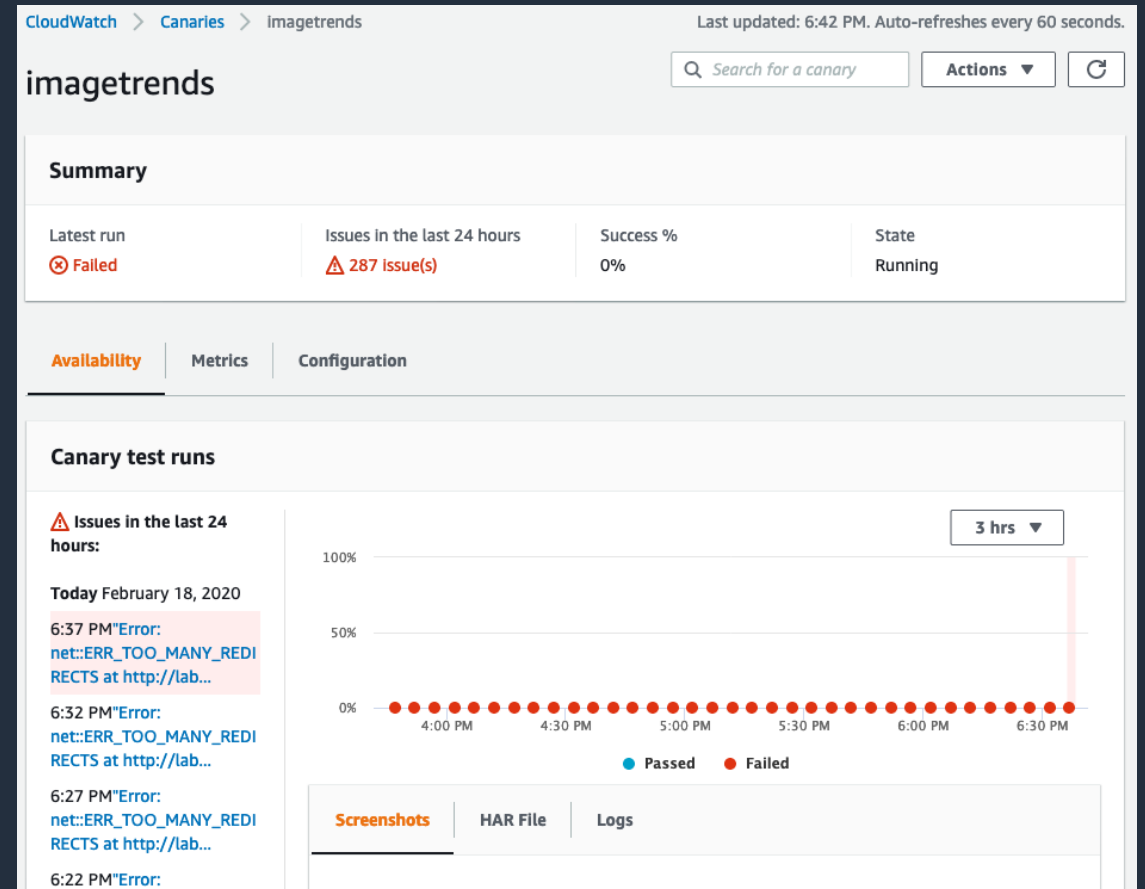
- Quickly isolate outliers, graph pattern and trends, drill into traces and filter by built-in keys and custom annotations to better understand performance issues impacting your application and end users.



# CloudWatch Synthetics

Runs tests on your endpoints every minute, 24x7, and alerts you as soon as your application endpoints don't behave as expected.

- View of your customers' experiences
- Configurable scripts
- Run once
- Run on a schedule
- Check availability and latency
- Store load time data
- Store screenshots



# Amazon VPC FlowLogs

# Amazon VPC Flow Logs

Stores logs in AWS CloudWatch Logs

- Can be enabled on
  - Amazon VPC, a subnet, or a network interface
  - Amazon VPC & subnet enables logging for all interfaces in the VPC/subnet
  - Each network interface has a unique log stream
- Flow logs **do not capture real-time** log streams for your network interfaces
- Filter desired result based on need
  - All, Reject, Accept
  - Troubleshooting or security related with alerting needs?
  - Think before enabling All on VPC, will you use it?

# Amazon VPC Flow Logs

- Agentless
- Enable per ENI, per subnet, or per VPC
- Logged to AWS CloudWatch Logs
- Create CloudWatch metrics from log data
- Alarm on those metrics

Interface      Source IP      Source port      Protocol      Packets

AWS account

Event Data														
▶ 2 41747	eni-b30b9cd5	119.147.115.32	10.1.1.179	6000	22	6	1	40	1442975475	1442975535	REJECT	OK	Accept or reject	
▼ 2 41747	eni-b30b9cd5	169.54.233.117	10.1.1.179	21188	80	6	1	40	1442975535	1442975595	REJECT	OK		
▼ 2 41747	eni-b30b9cd5	212.7.209.6	10.1.1.179	3389	3389	6	1	40	1442975596	1442975655	REJECT	OK		
▼ 2 41747	eni-b30b9cd5	189.134.227.225	10.1.1.179	39664	23	6	2	120	1442975656	1442975716	REJECT	OK		
▼ 2 41747	eni-b30b9cd5	77.85.113.238	10.1.1.179	0	0	1	1	100	1442975656	1442975716	REJECT	OK		
▼ 2 41747	eni-b30b9cd5	10.1.1.179	198.60.73.8	512	123	17	1	76	1442975776	1442975836	ACCEPT	OK		

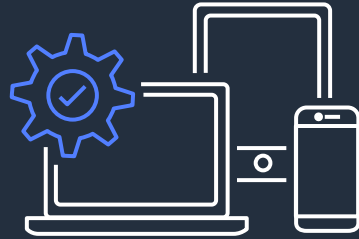
Destination IP      Destination port      Bytes      Start/end time

# Managed Open Source Tools for Observability

# Why AWS Managed OpenSource?



**Security  
First**



**Scale as-you-  
grow**



**Seamless  
integrations**



**Open Source  
Contribution**

# AWS Distro for OpenTelemetry

COLLECT DISTRIBUTED TRACES AND METRICS FOR APPLICATION MONITORING



- › **Send metrics and traces to multiple AWS monitoring solutions**
- › **Speed up performance troubleshooting and reduce mean time to resolution**
- › **Automatic trace collection**
- › **Collect metadata on application resources**
- › **Integrate with Amazon CloudWatch**



# Amazon Managed Grafana

SCALABLE, SECURE AND HIGHLY AVAILABLE DATA VISUALIZATION FOR YOUR OPERATIONAL METRICS



- › **Analyze, monitor, and alarm across multiple data sources; native AWS as well as third-party**
- › **Access to Grafana Enterprise data source via AWS marketplace directly from the console**
- › **Automatic scaling**
- › **Native integration with multiple AWS Services**
- › **Simple pay-as-you-go billing**

# Amazon Managed Service for Prometheus

HIGHLY AVAILABLE, SECURE, AND MANAGED MONITORING



- › **A serverless Prometheus-compatible monitoring service**
- › **Use the same open source Prometheus data model and query language**
- › **Fully managed, secure, and highly available using multi-AZ deployments**
- › **No up-front investments, pay for what you use**
- › **Improved scalability, availability, and security without having to manage the underlying infrastructure**

# Cost Monitoring

# Tags

Key (Attribute): 127  
Unicode characters

Value (Detail/Description):  
255 Unicode characters

Tags per resource: 50 tags

Key	Value
name	Jane_Doe
group	dev
costcenter	4004
use	image_svr

# Tag Key Examples

Cost  
Center

Business  
Unit

Dept./  
Group

Product /  
Application

Owner

Endpoint

Support  
Contact

Environ.

Backup

Tier

Shutdown  
Time

# AWS Cost Explorer

## • CONSOLE-BASED COST AND USAGE REPORTING



Filter/Group your data



Save your progress



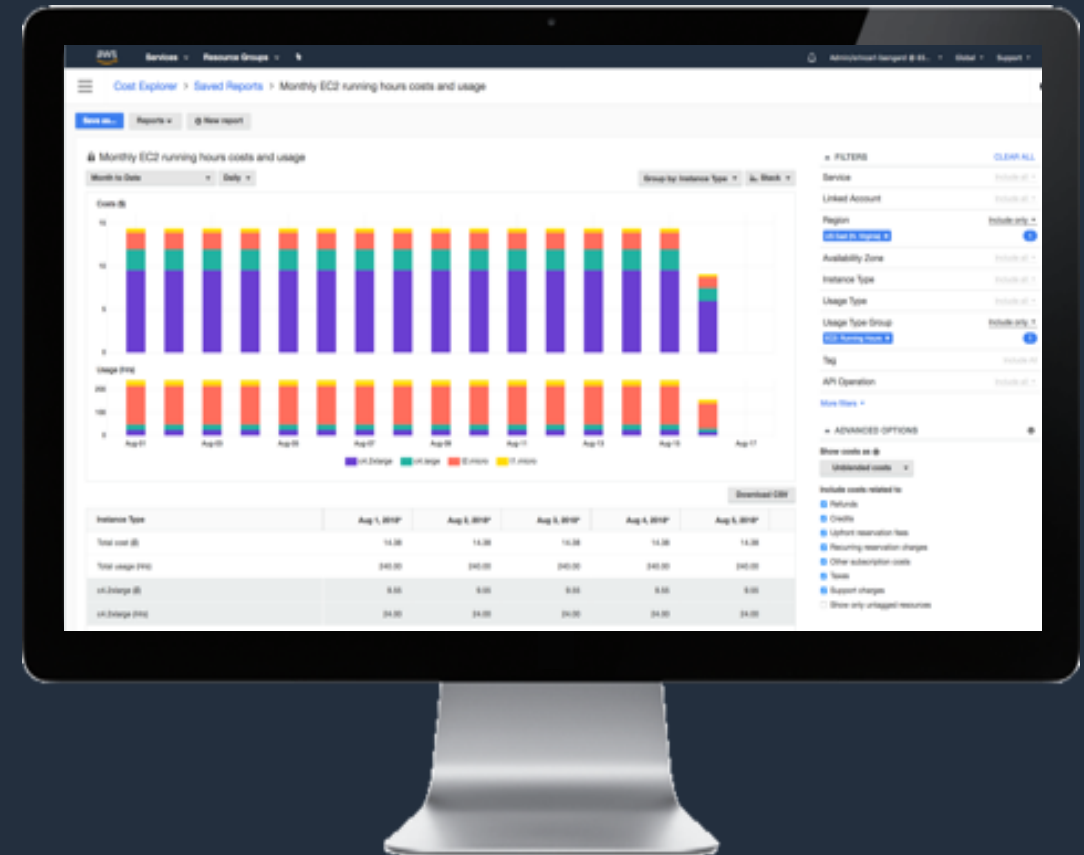
Set time interval and granularity



Forecast future costs and usage



Build custom applications

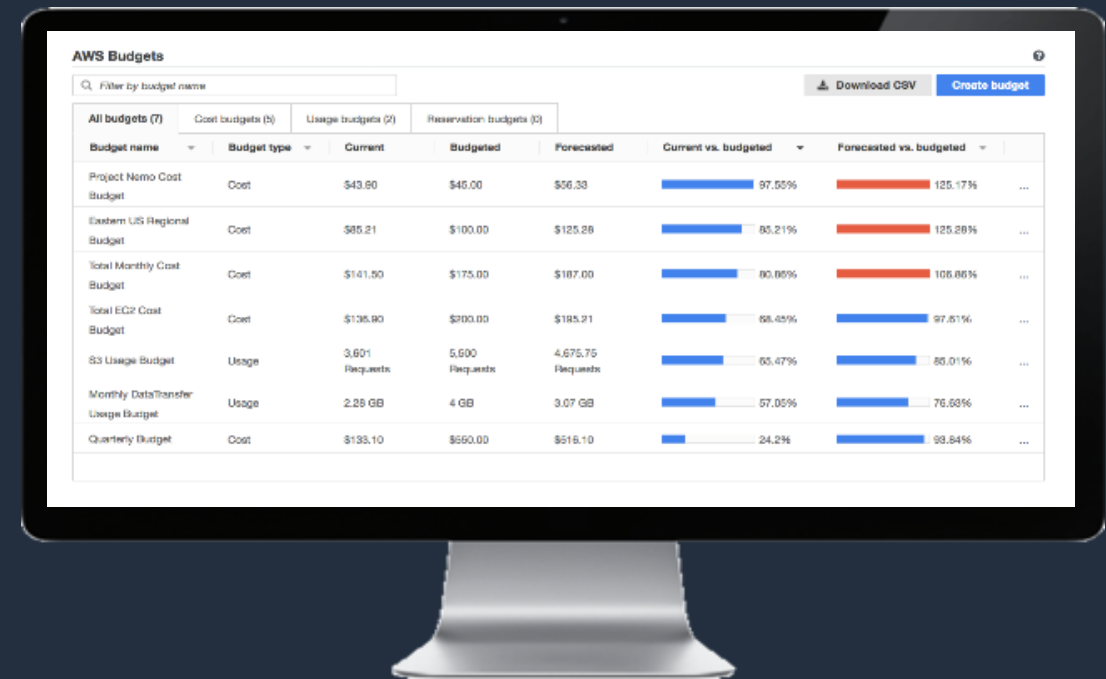


# AWS Budgets

AWS Budgets gives you the ability to set custom budgets that alert you when your cost or usage exceed (or are forecasted to exceed) your budgets amount.

## Benefits

- Customizable budgets
- Ongoing monitoring and alert notification
- Flexible Automation



# AWS Budgets Reports

- Set up daily, weekly, or monthly AWS Budgets Reports emails
- For stakeholders with limited or no access to AWS Cost Management dashboard

Dear AWS Customer,

You requested that we provide a daily update on the status of the following budgets.

Budget Name	Budget Type	Current	Budgeted	Forecasted	Current vs. Budgeted	Forecasted vs. Budgeted
<a href="#">DC.EC2.Product Budget</a>	Cost	\$0.00	\$5.00	-	0.00%	-
<a href="#">Monthly EC2 Budget</a>	Cost	\$148.46	\$75.00	\$501.90	197.94%	669.20%
<a href="#">Monthly budget for EC2</a>	Cost	\$166.83	\$84.43	\$562.54	197.60%	666.28%
<a href="#">DC.EC2.Usage</a>	Cost	\$0.00	\$100.00	-	0.00%	-
<a href="#">e.g., My Monthly EC2 Budget.17</a>	Cost	\$148.46	\$100.00	\$501.90	148.46%	501.90%
<a href="#">Monthly EC2 Budget</a>	Cost	\$190.80	\$200.00	\$643.99	95.40%	321.99%
<a href="#">Monthly EC2 Costs</a>	Cost	\$266.01	\$584.62	\$871.89	45.50%	149.14%
<a href="#">My Monthly EC2 Budget</a>	Cost	\$0.00	\$1,000.00	-	0.00%	-
<a href="#">EC2 Data Transfer</a>	Usage	0.12 GB	0.50 GB	0.42 GB	23.80%	84.40%
<a href="#">Daily EC2 Utilization</a>	RI Utilization	100.00%	100.00%	-	100.00%	-
<a href="#">Daily EC2 RI Coverage</a>	RI Coverage	20.90%	100.00%	-	20.90%	-
<a href="#">Daily EC2 Coverage</a>	RI Coverage	20.90%	100.00%	-	20.90%	-

[Go to AWS Budgets Report Dashboard](#)



# AWS Budgets | Alerting

## ▼ Alert #1

### Set alert threshold

#### Threshold

When should this alert be triggered?

80

% of budgeted amount

#### Trigger

How should this alert be triggered?

Actual

### Notification preferences - *Optional*

Select one or more notification preferences to receive alerts.

#### Email recipients

Specify the email recipients you want to notify when the threshold has exceeded.

*Separate email addresses using commas*

Maximum number of email recipients is 10.

► [Amazon SNS Alerts Info](#)

► [Amazon Chatbot Alerts](#)

## Budget Notification: Total Monthly Cost Budget is in Alarm State



no-reply-aws@amazon.com <no-reply-aws@amazon.com>

Tuesday, August 1, 2017 at 6:55 PM

To: ○ Carlson, Erin



AWS Budget Notification

08/02/2017

Dear AWS Customer,

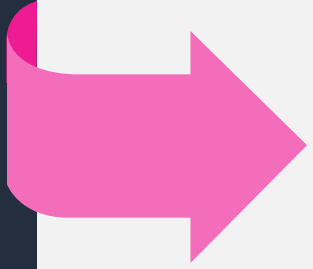
You requested that we notify you when your **Forecasted Cost** for your budget "*Total Monthly Cost Budget*" is **greater than \$150.00**. Your **Forecasted Cost** for this budget is now **\$199.28**. You can find further details below and by accessing your AWS Budgets dashboard.

Budget Name	Budget Type	Budgeted Value	Notification Threshold	Forecasted Value
Total Monthly Cost Budget	Forecasted	\$150.00	> \$150.00	\$199.28

[Go to AWS Budgets Dashboard](#)



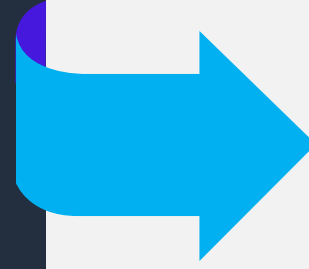
# AWS Cost Anomaly Detection



## What is it?

A **free** monitoring feature that leverages advanced Machine Learning technologies to identify anomalous spend and root causes.

- › With **three** steps, create a contextualized cost monitor and receive alerts when any anomalous spend is detected.



## How does it work?

Based on selected spend segments, Cost Anomaly Detection **automatically determines patterns** each day by adjusting for organic growth and seasonal trends. It triggers an alert when spend seems abnormal

# AWS Cost Anomaly Detection

- SAVE TIME MONITORING SPEND AND FOCUS ON DRIVING INNOVATION

## Easy start

Simple setup to evaluate spend anomalies for all AWS services individually, member accounts, cost allocation tags, or AWS Cost Categories.

## Automated root cause

Receive automated root cause analysis, pin-pointing potential cost drivers, such as usage type, specific AWS service, Region, and Member Account(s).

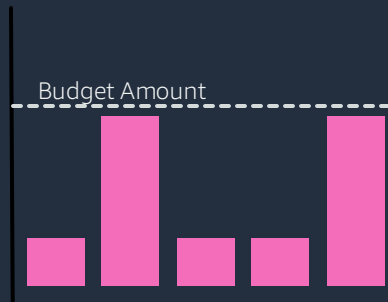
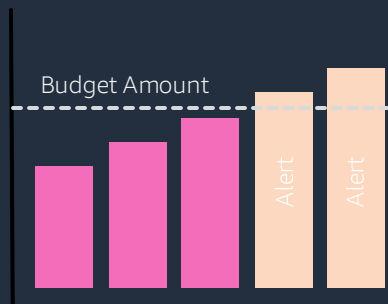
## Minimize surprise bills

Stay informed with automated detection alerts, via email or SNS topic at the frequency of your choice (individual alerts or daily or weekly summary).

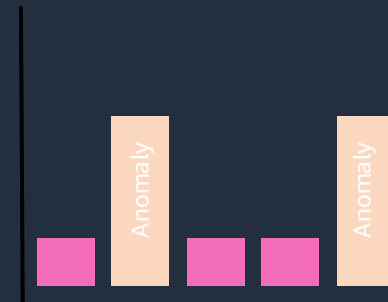
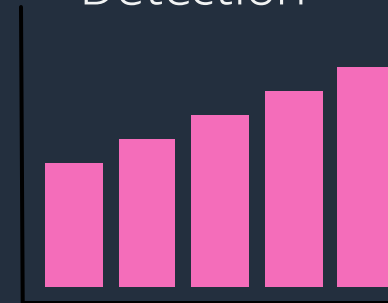
# Not all alerts tell the same story

- **LEVERAGE AWS BUDGETS AND AWS COST ANOMALY DETECTION TO AVOID SURPRISES**

AWS Budgets



AWS Cost Anomaly Detection



# Cost Management Competency Partners



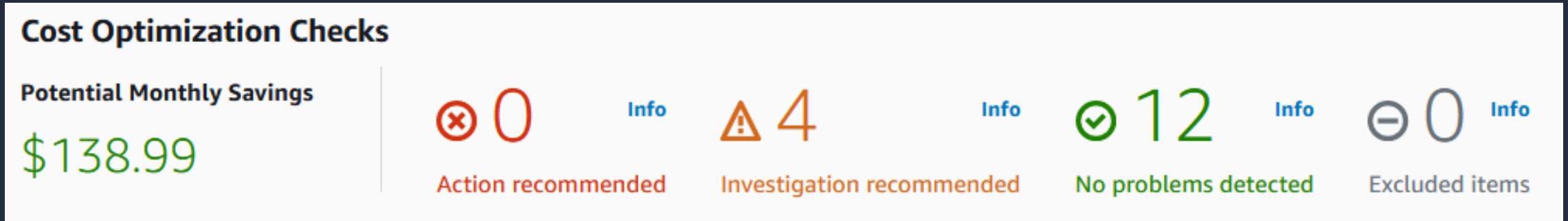
<https://aws.amazon.com/products/management-tools/partner-solutions/>

# AWS Trusted Advisor



- A tool that provides guidance following AWS best practices
- All customers have access to Core checks
- Enterprise Support and Business Support customers have access to the full set of checks including Cost Optimization

# AWS Trusted Advisor Cost Optimization Checks



- Underutilized resources
- Idle resources
- RI Recommendations

# Summary

- Maximize the value of cloud by moving at **speed combined with cost control and efficiency**; control and efficiency starts with **cost visibility**
- Use **AWS Cost Explorer** to create cost and usage visibility
- Use **AWS Budgets** to alert you when cost, usage, Reserved Instance, and Savings Plans coverage and utilization deviate from plan
- Use **AWS Cost Anomaly Detection** to detect and address anomalous spend by leveraging root cause analysis
- Build **DIY reporting** or procure third-party, **AWS partner tools**





# Thank you!