Module 10
Monitoring and Analyzing the Behavior of the Application Network

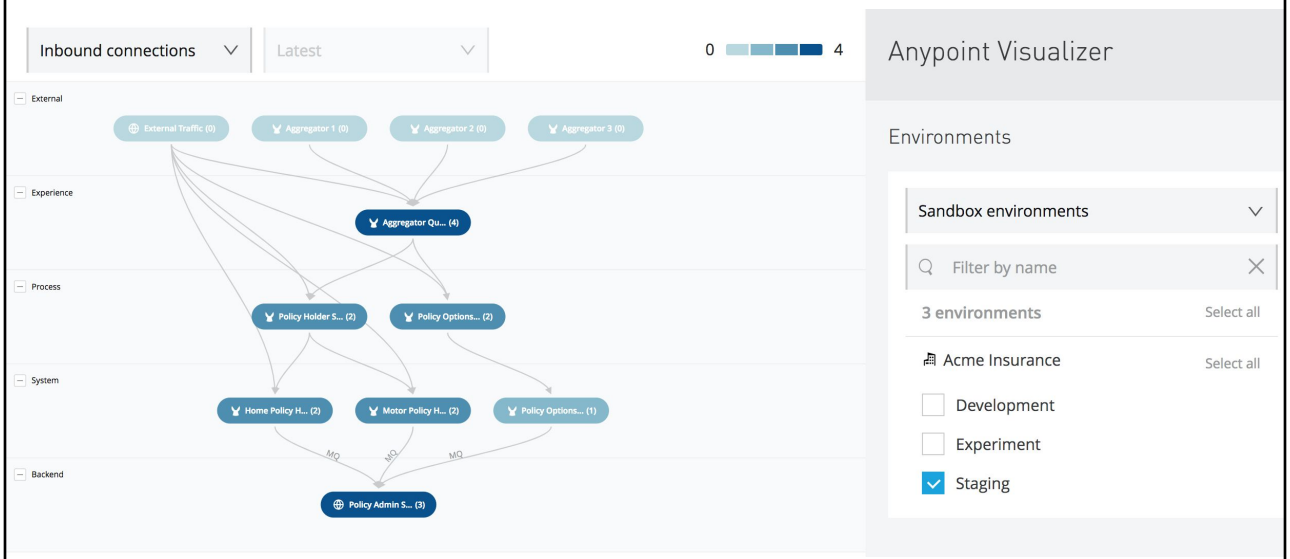
At the end of this module, you should be able to

- Automatically visualize an application network with **Visualizer**
- Describe **origins of data** for monitoring, analysis and alerting
- Describe the **metrics** collected on the level of API invocations
- Describe the available **grouping** of API metrics for analysis
- Make use of options for performing **API analytics** in/outside of Anypoint Platform
- Define **alerts** for API invocations in all tiers of API-led connectivity
- Use metrics and alerts for **API implementations** to augment those for API invocations
- Recognize **operations teams** as stakeholder in API-related assets

Visualize the application network with Anypoint Visualizer

Introducing Anypoint Visualizer

MuleSoft



Introducing Anypoint Visualizer

MuleSoft

- Visual **application network explorer**
- Integrated into MuleSoft-hosted Anypoint Platform control plane
- Shows automatically rendered graph of application network
- **Nodes: application components**
  - Special support for Mule apps deployed to CloudHub
  - All others categorized as "external"
  - Arbitrary layers: System, Process and Experience pre-defined
  - Colored by inbound connections, response time, throughput, failures, ...
- **Edges: request-response interactions** detected at runtime
  - Direction from originator to target
  - Includes all API invocations
  - Analyzes IPs and URLs
  - Data collection through Mule runtime and Connectors

Introducing Anypoint Visualizer

MuleSoft

- Nodes and edges **dynamically updated to reflect actual traffic**
- Just select one or more **environments** to show
- Assign arbitrary **labels**
- Currently **no concept of APIs** and API instances as in API Manager

Use-cases for Anypoint Visualizer

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- **Discover** baseline application architecture
- Identify duplicate interactions as **preparation for consolidation**
- **Architecture governance**
  - Identifying violations of API-led connectivity
- **Impact analysis** for proposed changes
- **Comparing environments**
- As substitute for proper **documentation**
- Visualizer shows traffic detected at runtime
  - Not suitable for detecting potential interactions

Anypoint Monitoring

A note about Anypoint Monitoring

MuleSoft

- This material uses **API Manager, Analytics, Runtime Manager**
- New product: **Anypoint Monitoring**
  - Older products and features **remain available**
- **Larger set of metrics** for API invocations, API implementations (Mule applications) and Mule runtimes
  - Inbound, outbound, performance, failures, JVM, infrastructure
- Averages, **percentiles**, …
- Built-in and custom **dashboards and charts**
- Graphs can **automatically refresh**
- Highly configurable **time-series graphs, histograms**, etc.

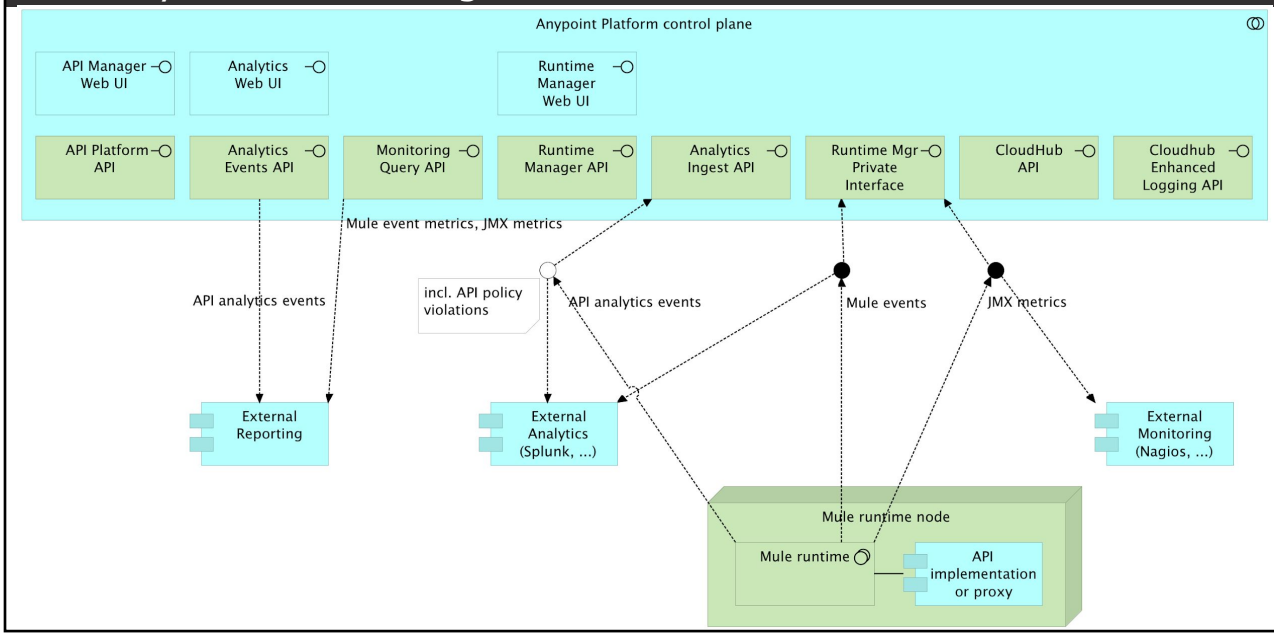
A note about Anypoint Monitoring

MuleSoft

- Visualization of **summary statistics** of a single metric
- Auto-color-coded **tables** summarizing time-series data
- Metrics for chart selected using (SQL-like) **query builder**
- **Alerts** based on metrics in charts
  - Augment API Manager and Runtime Manager alerts
- **Log and event aggregation and search** across Mule applications in the entire application network
- **Data storage and retention** depend on subscription level
- Can store data in **configurable regions**
  - Not in region of the Anypoint Platform control plane
  - Licensing-dependent
- Available in **all** Anypoint Platform **runtime planes**

Understanding monitoring data flow in Anypoint Platform

Data flows for Anypoint Platform monitoring, analytics and alerting



Using Anypoint Analytics to gain insight into API invocations

Metrics in Anypoint Analytics

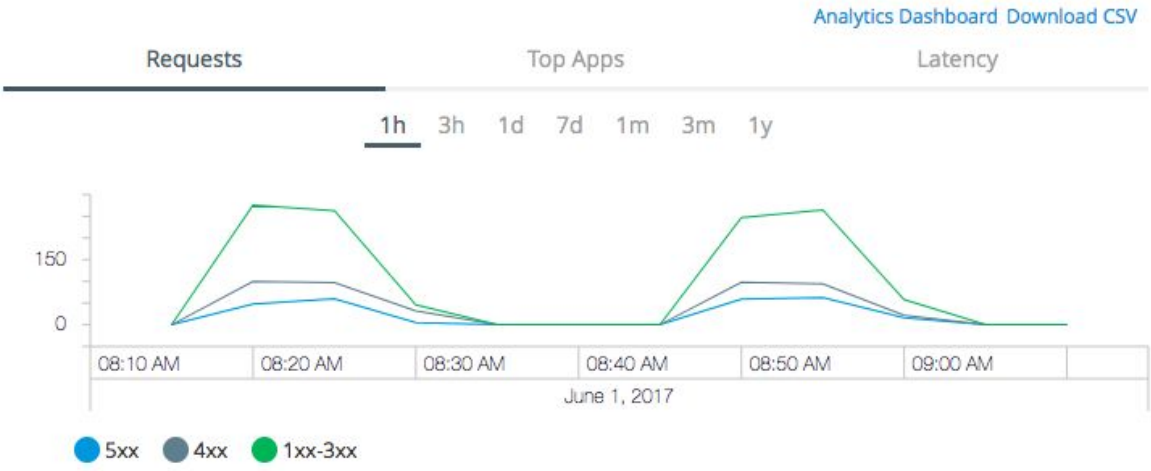
MuleSoft

- **Number** of API invocations (requests)
  - Successful: **[100, 400)**
  - Unsuccessful due to a client error: **[400, 500)**
  - Unsuccessful due to a server error: **[500, 600)**
- Mean **response time** (average latency)
- Request and response **payload size**
- Properties of the **API client**:
  - Client ID (if registered), geographical location, OS platform, ...
- Properties of the **API invocation**:
  - resource path, HTTP method, ...
- Metrics can be **grouped** and displayed along various dimensions:
  - for one/all API(s) and one/all API client(s)
  - custom

Metrics in Anypoint Analytics

MuleSoft

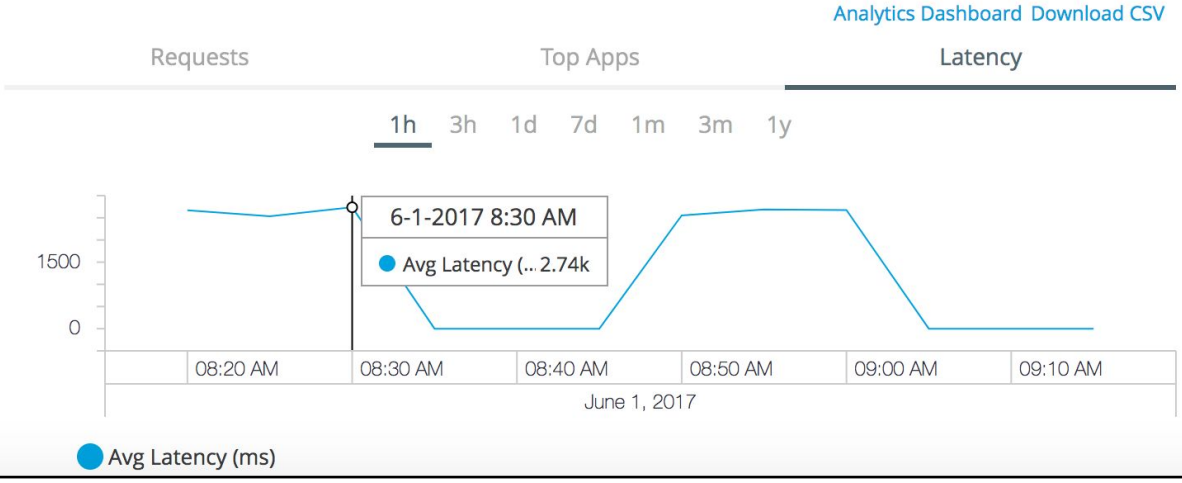
Number of API invocations (requests) over time for a given API and all its API clients, grouped by HTTP status code class



Metrics in Anypoint Analytics

MuleSoft

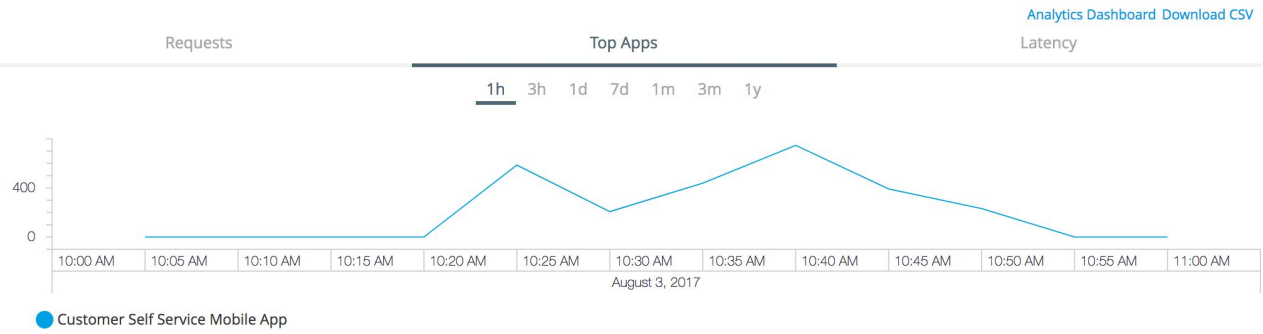
Mean response time (average latency) of API invocations over time for a given API and all its API clients and all HTTP status codes



Analyzing API invocations to the "Mobile Auto Claim Submission EAPI"

MuleSoft

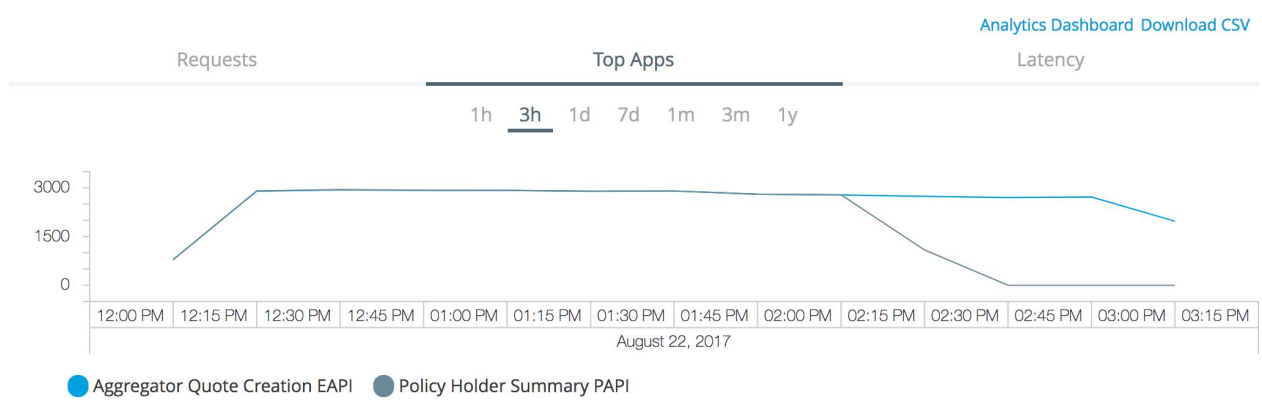
Number of API invocations (requests) over time to the "Mobile Auto Claim Submission EAPI", grouped by each of its top 5 API clients



Analyzing API invocations to the "Policy Holder Search PAPI"

MuleSoft

Number of API invocations (requests) over time to the "Policy Holder Search PAPI", grouped by each of its top 5 API clients



Analyzing API invocations from the perspective of the Customer Self-Service Mobile App

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My applications | Customer Self-Service Mobile App

Reset Client Secret | Edit | Delete

- Show All (2)
- Mobile Auto Claim Subm... v3
- Mobile Policy Holder Su... v1

Application Description: Acme Insurance's iOS and Android mobile app for customer self-service
Application URL:
Redirect URIs:

Client ID: 44b3b9bc9805482bad2e381626aa3bec
Client Secret: ********** Show
Grant Types:

6,614	2ms	0.00%
Total Requests	Average Latency	Error %

Aug 3, 2017 - Aug 3, 2017

Total Requests — Download CSV

1400, 800, 200

08:00 AM, 08:15 AM, 08:30 AM, 08:45 AM, 09:00 AM, 09:15 AM, 09:30 AM, 09:45 AM, 10:00 AM, 10:15 AM, 10:30 AM, 10:45 AM

August 3, 2017

Average Latency — Download CSV

3.2, 2.6, 2, 1.4

08:00 AM, 08:15 AM, 08:30 AM, 08:45 AM, 09:00 AM, 09:15 AM, 09:30 AM, 09:45 AM, 10:00 AM, 10:15 AM, 10:30 AM, 10:45 AM

August 3, 2017

Requests By Status Code — Download CSV

6500, 5000, 3500, 2000, 500

200

Error Percentage — Download CSV

0.4, 0.2, -0.8

08:00 AM, 08:15 AM, 08:30 AM, 08:45 AM, 09:00 AM, 09:15 AM, 09:30 AM, 09:45 AM, 10:00 AM, 10:15 AM, 10:30 AM, 10:45 AM

August 3, 2017

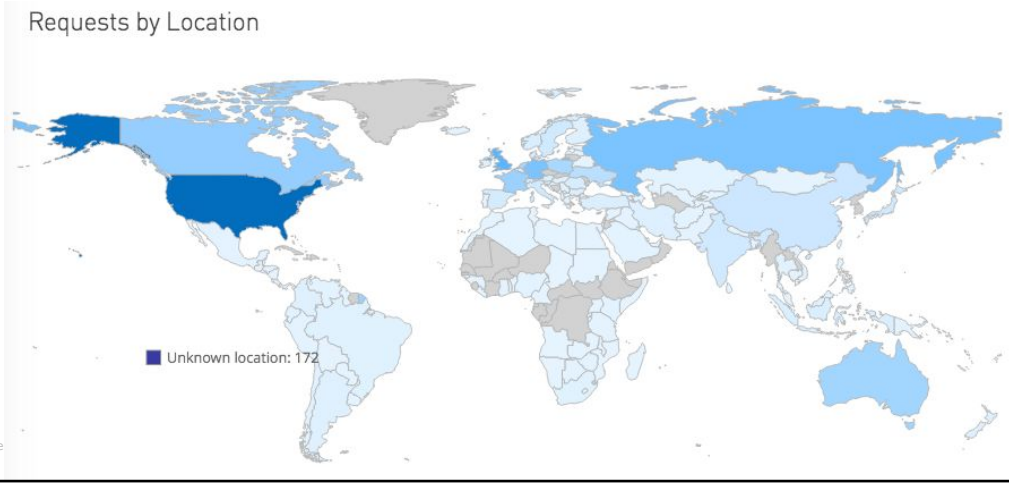
Analyzing API invocations across the application network

Introducing application network-wide API analytics

- **Anypoint Analytics** can perform standard and custom analyses across all API invocations in an application network:
  - **Interactive** exploration through drill-down
  - Definition of **custom charts and dashboards**
  - Definition of **custom reports**
  - Exporting all data underlying a graph to **CSV** files
  - Access to all data via Anypoint **Platform APIs**

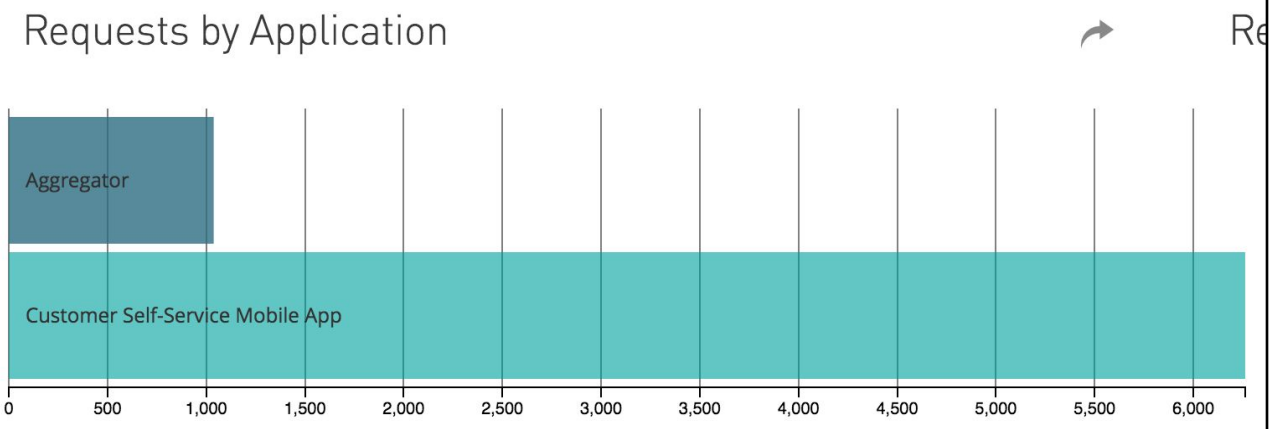
API invocation analysis by geography

Number of API invocations from all API clients to all Experience APIs, grouped by geography



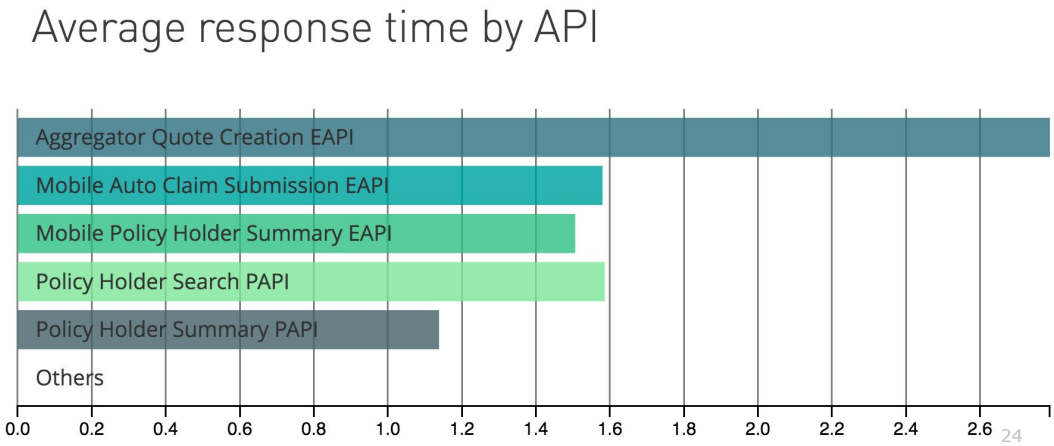
API invocation analysis by API client

Number of API invocations to all Experience APIs, grouped by API clients, over the last hour



API invocation analysis by response time

Custom chart showing **average (mean) response time** per API invocation in milliseconds for the top 5 slowest APIs, for the last 90 days

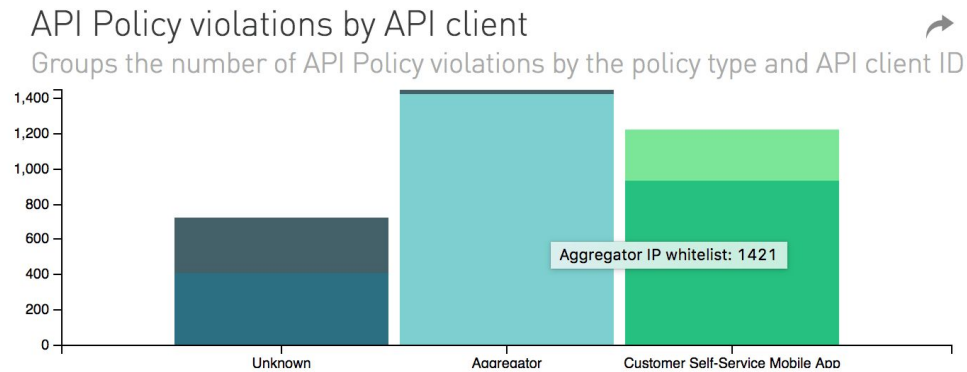


API governance analysis

MuleSoft

Custom chart showing **number of policy violations**, grouped by API policy and API client, over the last 90 days

Date Range: 1 Day

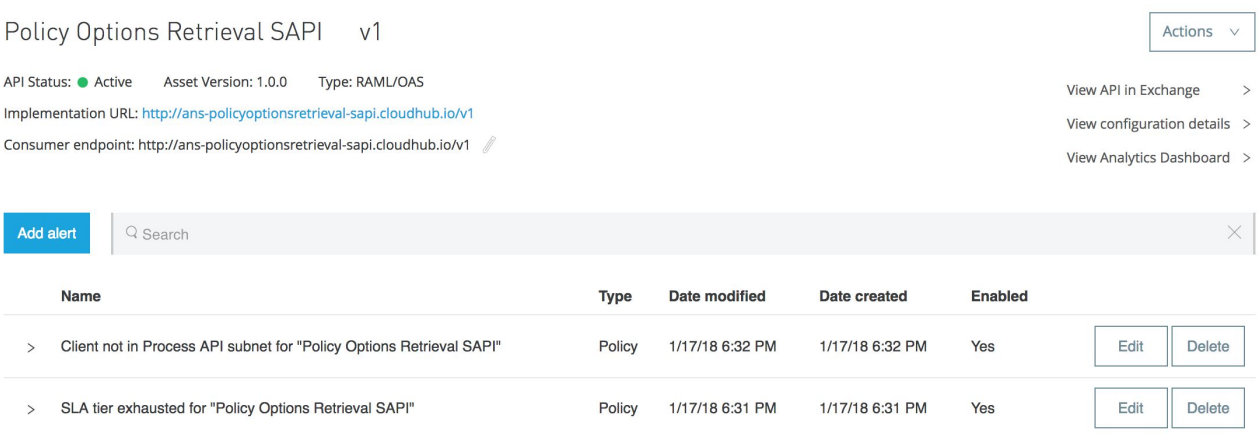


Defining alerts for exceptional occurrences in an application network

Introducing alerts at the level of API invocations

- **Alerts based on these metrics** of API invocations:
  - Number of **violations** of a given policy
  - Request count (**number of API invocations**)
  - **Response code** in given set of HTTP response status codes
  - **Response time** exceeding given threshold in milliseconds
- Alert is triggered **when** the metric
  - Falls above/below a **threshold**
  - For a given number of **time periods** of a given duration
- **C4E guideline**: alerts should at least cover:
  - All **violations of API policies**
  - All **violations of QoS guarantees** not explicitly captured in API policies

Defining alerts for "Policy Options Retrieval SAPI"



Defining alerts for "Policy Options Retrieval SAPI"

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- **SLA tier exhausted**:
  - Violation of **SLA-based Rate Limiting**, severity **Info**, > 60 violations for at least 3 consecutive 10-minute periods
  - Alerts when approx. **10%** of 1-second intervals are **above limit defined by SLA tier**
  - Also alerts on **invalid client ID/secret** supplied
- **Client not in Process API subnet**:
  - Violation of **IP whitelist**, severity **Critical**, > 1 violation for at least 3 consecutive 1-minute periods
- Could add alert for violations of **Spike Control**

Defining alerts for "Policy Holder Search PAPI"

MuleSoft

Policy Holder Search PAPI v1

Actions

API Status: Active Asset Version: 1.0.3 Type: RAML/OAS

Implementation URL: http://ans-policyholdersearch-papi.cloudhub.io/v1

Consumer endpoint: http://ans-policyholdersearch-papi.cloudhub.io/v1

View API in Exchange >

View configuration details >

View Analytics Dashboard >

Add alert

Search

	Name	Type	Date modified	Date created	Enabled		
>	Client not in Experience API or Process API subnet for "Policy Holder Search PAPI"	Policy	1/17/18 6:39 PM	1/17/18 6:39 PM	Yes	Edit	Delete
>	Response time QoS guarantee violated by "Policy Holder Search PAPI"	Response Time	1/17/18 6:40 PM	1/17/18 6:40 PM	Yes	Edit	Delete
>	Throughput QoS guarantee exhausted for "Policy Holder Search PAPI"	Policy	1/17/18 6:38 PM	1/17/18 6:38 PM	Yes	Edit	Delete

Defining alerts for "Policy Holder Search PAPI"

MuleSoft

- **Throughput QoS guarantee exhausted**:
  - Violation of **Spike Control**, severity **Info**, > 60 violations for at least 3 consecutive 10-minute periods
  - Alerts when approx. **10%** of 1-second intervals are **above limit**
- **Client not in Experience API or Process API subnet**:
  - Violation of **IP whitelist**, severity **Critical**, > 1 violation for at least 3 consecutive 1-minute periods

Defining alerts for "Policy Holder Search PAPI"

MuleSoft

- **Response time QoS guarantee violated**:
  - Severity **Warning**, > 6600 requests whose response time > 100 ms for at least 3 consecutive 10-minute periods
  - Alerts when approx. **1%** of API invocations (1% of 1100*60*10 = 6600) are **above limit** of 100 ms (twice the target median of 50 ms)
  - Note that **exact QoS guarantee** cannot be expressed in alert
    - median = 50 ms, maximum = 150 ms
- Should add alert for violations of **Client ID enforcement**

Defining alerts for "Aggregator Quote Creation EAPI"

MuleSoft

Aggregator Quote Creation EAPI v1

Actions

API Status: Active Asset Version: 1.0.1 Type: RAML/OAS

Implementation URL: http://ans-aggregatorquotecreation-eapi.cloudhub.io/v1

Consumer endpoint: http://ans-aggregatorquotecreation-eapi.cloudhub.io/v1

View API in Exchange >

View configuration details >

View Analytics Dashboard >

Add alert

Search

	Name	Type	Date modified	Date created	Enabled		
>	Response time QoS guarantee violated by "Aggregator Quote Creation EAPI"	Response Time	1/17/18 3:17 PM	1/17/18 3:17 PM	Yes	Edit	Delete
>	SLA tier exhausted for "Aggregator Quote Creation EAPI"	Policy	1/17/18 3:10 PM	1/17/18 3:10 PM	Yes	Edit	Delete
>	TLS mutual auth circumvented for "Aggregator Quote Creation EAPI"	Policy	1/17/18 3:11 PM	1/17/18 3:11 PM	Yes	Edit	Delete
>	XML attack on "Aggregator Quote Creation EAPI"	Policy	1/17/18 3:15 PM	1/17/18 3:15 PM	Yes	Edit	Delete

Defining alerts for "Aggregator Quote Creation EAPI"

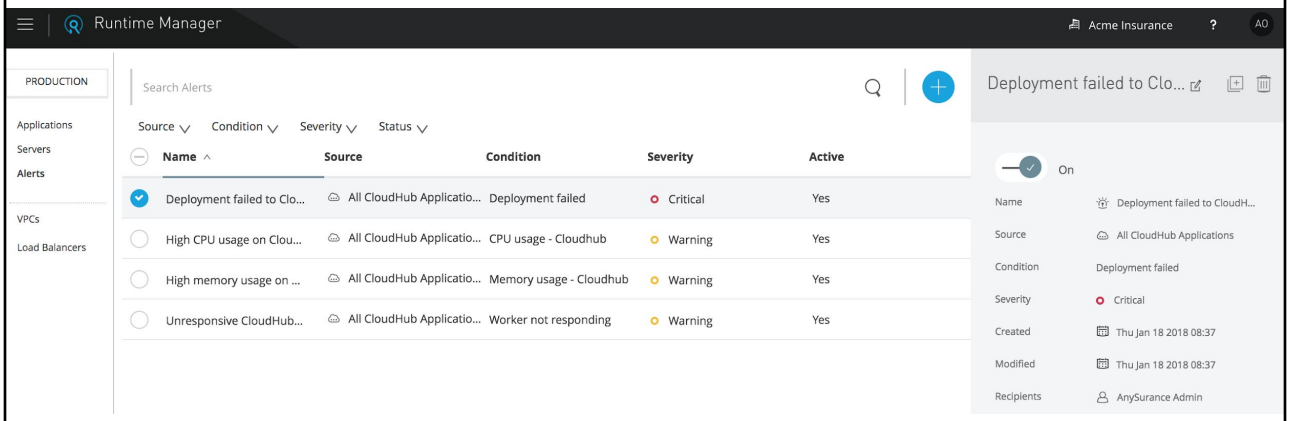
MuleSoft

- **SLA tier exhausted**:
  - Violation of **SLA-based Rate Limiting**, severity **Info**, > 60 violations for at least 3 consecutive 10-minute periods
  - Alerts when approx. **10%** of 1-second intervals are **above limit defined by SLA tier**
- **TLS mutual auth circumvented**:
  - Violation of **IP whitelist**, severity **Critical**, > 1 violation for at least 3 consecutive 1-minute periods

Defining alerts for "Aggregator Quote Creation EAPI"

- **XML attack**:
  - Violation of **XML threat protection**, severity **Warning**, > 30000 violations for at least 3 consecutive 10-minute periods
  - Alerts when approx. **5%** of requests (5% of 1000*60*10 = 30000) are identified as XML threats
- **Response time QoS guarantee violated**:
  - Severity **Warning**, > 6000 requests whose response time > 400 ms for at least 3 consecutive 10-minute periods
  - Alerts when approx. **1%** of API invocations (1% of 1000*60*10 = 6000) are **above limit** of 400 ms (twice the target median of 200 ms)
  - Note that **exact QoS guarantee** cannot be expressed in alert
    - median = 200 ms, maximum = 500 ms

Alerts on API implementations augment alerts for API invocations



Alerts on API implementations augment alerts for API invocations

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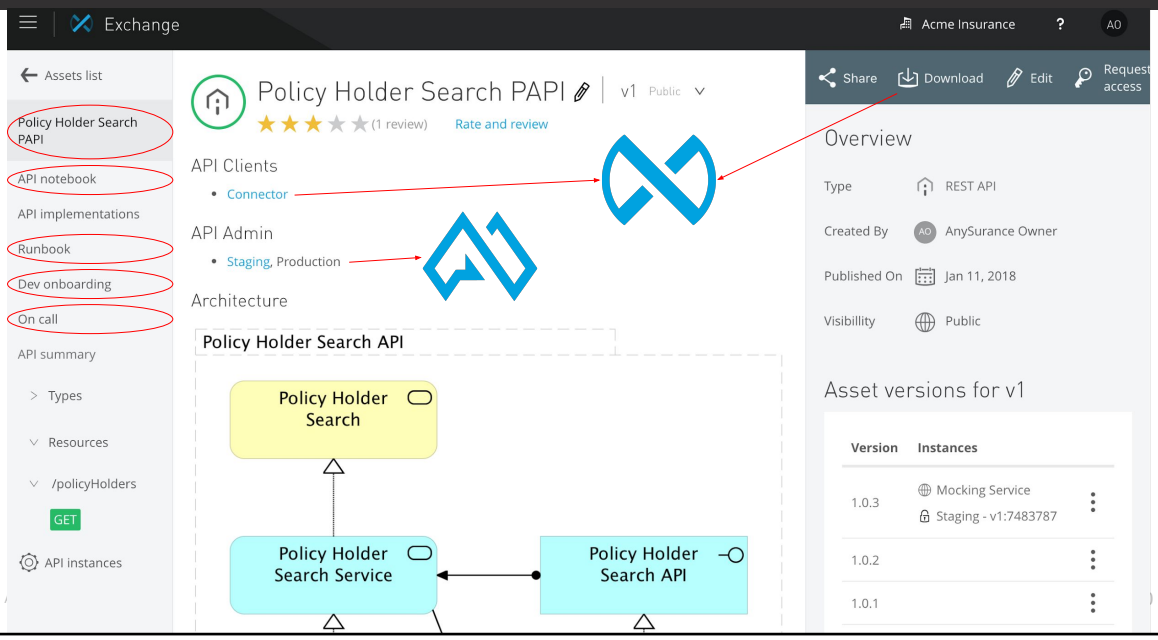
- Alerts for **API invocations and API implementations** complement each other
- If API implementation **crashes** but no API client invokes that API then no alert on the level of API invocations will be raised
  - But remember **auto-restart**
- Consistently high **CPU usage**
- **Deployment failures** in production and staging environments

Organizing discoverable documentation for operations

Operations teams as a stakeholder in APIs

- **Development teams** may also operate the APIs and API implementations they implement
  - Thereby become **operations teams**
- Operations teams **need**
  - **Dashboards and alerts**
    - **Runtime Manager**, **API Manager**, Anypoint **Analytics**
  - Custom-written **documentation**:
    - **Runbooks**: how to address **alerts**
    - **On-call registers**: **who** to contact
- Should be discoverable through **Exchange**

Exchange entry is portal to API's documentation and assets



Matching API Manager API administration entry

MuleSoft

API Manager | Acme Insurance | ? | MA

API Administration (Staging) | Policy Holder Search PAPI (v1) - Settings

STAGING

← API Administration

- Alerts
- Contracts
- Policies
- SLA Tiers
- **Settings**

Policy Holder Search PAPI v1

Actions

API Status: ● Active Asset Version: 1.0.3 Type: RAML/OAS

Implementation URL: http://ans-policyholdersearch-papi.cloudhub.io/v1

Consumer endpoint: http://ans-policyholdersearch-papi.cloudhub.io/v1

API Instance ⓘ

ID: 7483787

Label: ⊕ Add a label

Autodiscovery ⓘ

API ID: 7483787

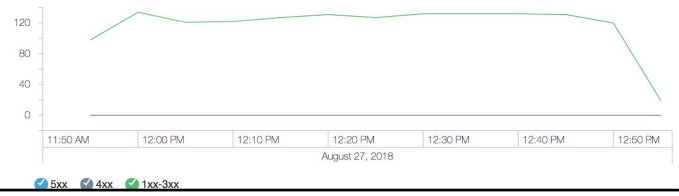
- View API in Exchange >
- View configuration details >
- View Analytics Dashboard >

Download CSV

Requests | Top Apps | Latency

Include Policy Violations

1h 3h 1d 7d 1m 3m 1y



Exchange entry section for API implementations

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Exchange

← Assets list

- Policy Holder Search PAPI
- API notebook
- API implementations
- Runbook
- Dev onboarding
- On call
- API summary

Policy Holder Search PAPI | v1 Public

★★★☆☆ (1 review) Rate and review

API implementations

Default

- Dependencies:
  - Motor Policy Holder Search SAPI
  - Home Policy Holder Search SAPI
- Deployments: Staging, Production
- Source code
- CI/CD job

Runtime Manager dashboard for matching CloudHub deployment of API implementation

MuleSoft

Runtime Manager

Acme Insurance

STAGING

Applications

Dashboard

Insight

Logs

Application Data

Queues

Schedules

Settings

ans-policyholdersearch-papi

Domain: ans-policyholdersearch-papi.cloudhub.io · Last Updated 2018-01-11 5:12:16PM · 1 micro worker, using 3.9.0

Mule messages

Last hour | Last 24hs | Last week

3000
2500
2000
1500
1000
500
0

09:26:38 09:36:38 09:46:38 09:56:38 10:06:38 10:16:38

CPU

Worker 18.218.156.99

100%
50%
0%

09:26:00 09:36:00 09:46:00 09:56:00 10:06:00 10:16:00

Memory

Summary

Summary

MuleSoft

- **Data** used in monitoring, analysis and alerting flows from Mule runtimes to external monitoring/analytics systems and/or Anypoint Platform
  - **Available via APIs** for external reporting
- Anypoint Platform collects numerous **metrics** for API invocations:
  - Response time, payload size, client location, ...
- Metrics can be **grouped** by API, API client or any of the other metrics
- Analyses targeted specifically at **API consumers** and clients

Summary

MuleSoft

- Anypoint **Analytics** supports
  - Interactive analyses, custom charts and reports
  - Data download in CSV files and/or retrieval through Anypoint Platform APIs
- **Alerts** defined based on API invocation metrics:
  - Request count and time, response status code
  - Number of API policy violations
- Metrics and alerts for **API implementations** defined in Runtime Manager augment API invocations metrics and alerts
- **Operations teams** are important stakeholder in API-related assets: structure and link assets to support them