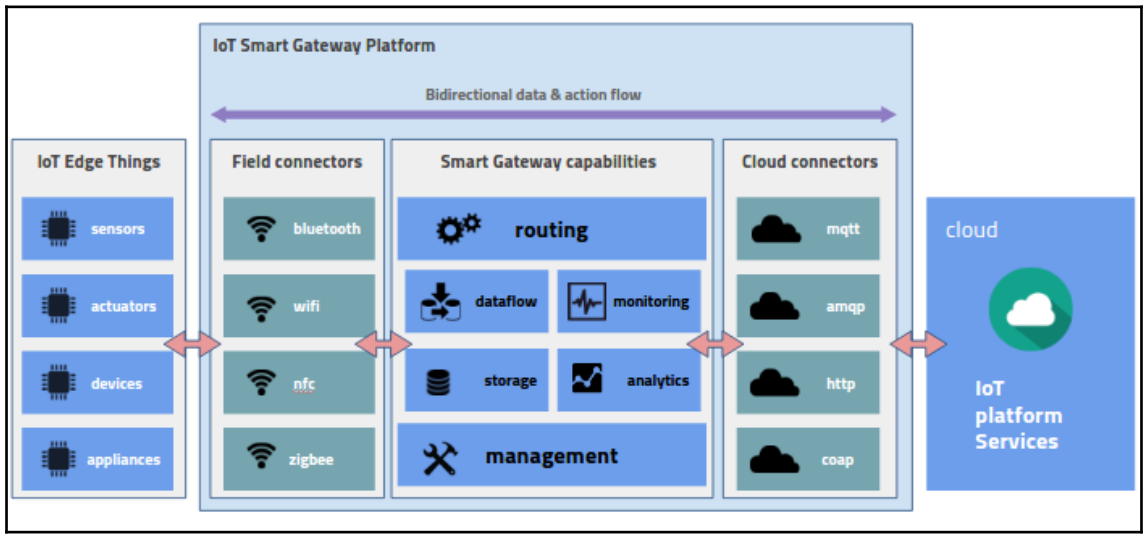
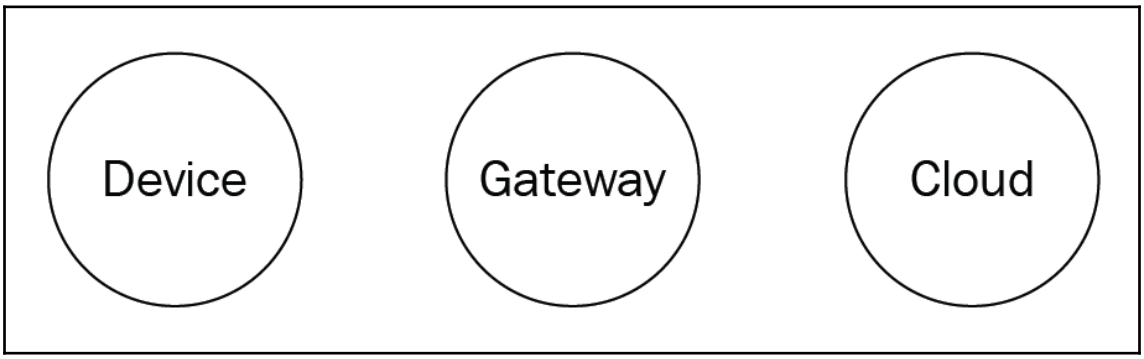
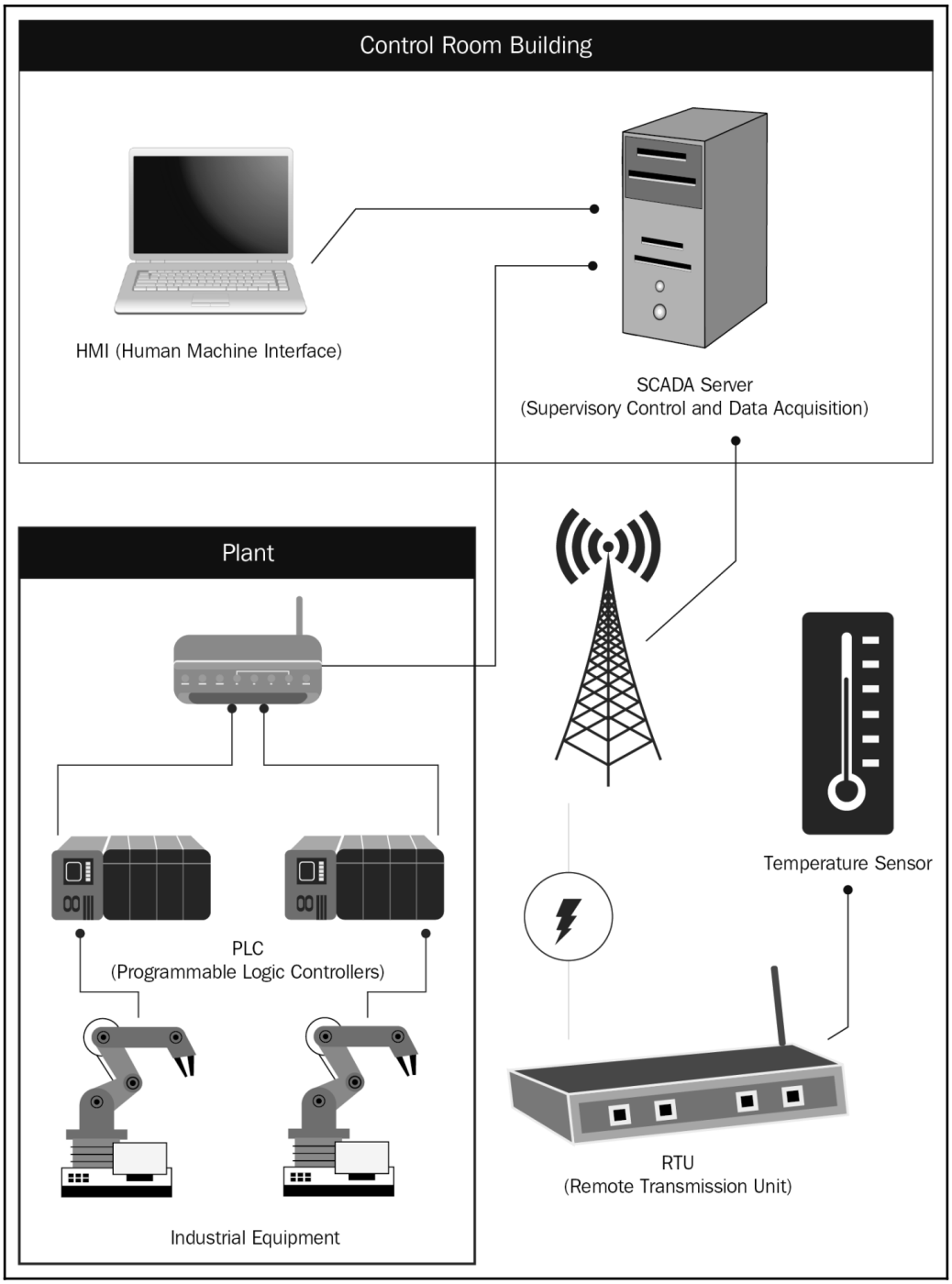
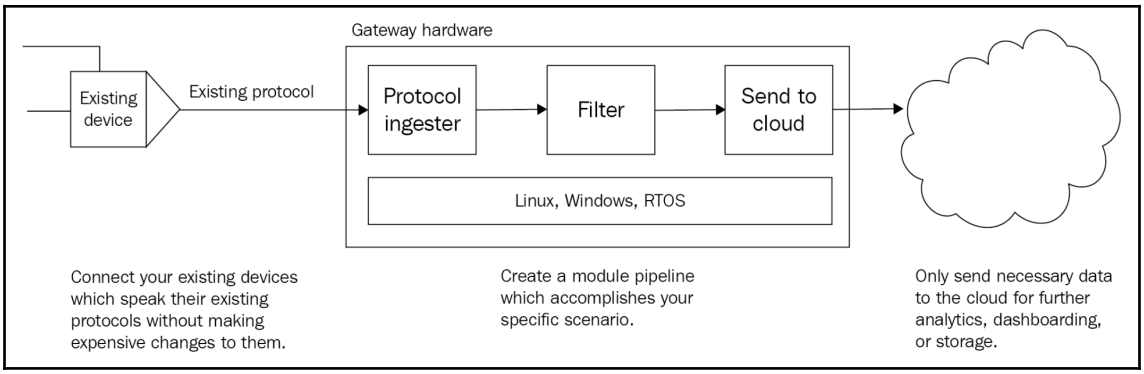
Chapter 1: IIoT Fundamentals and Components

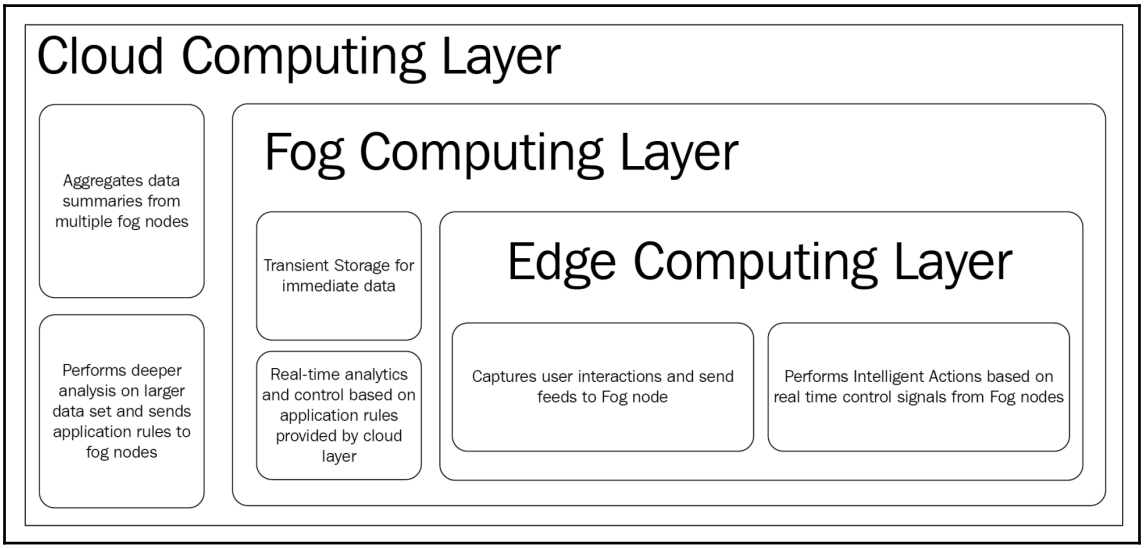


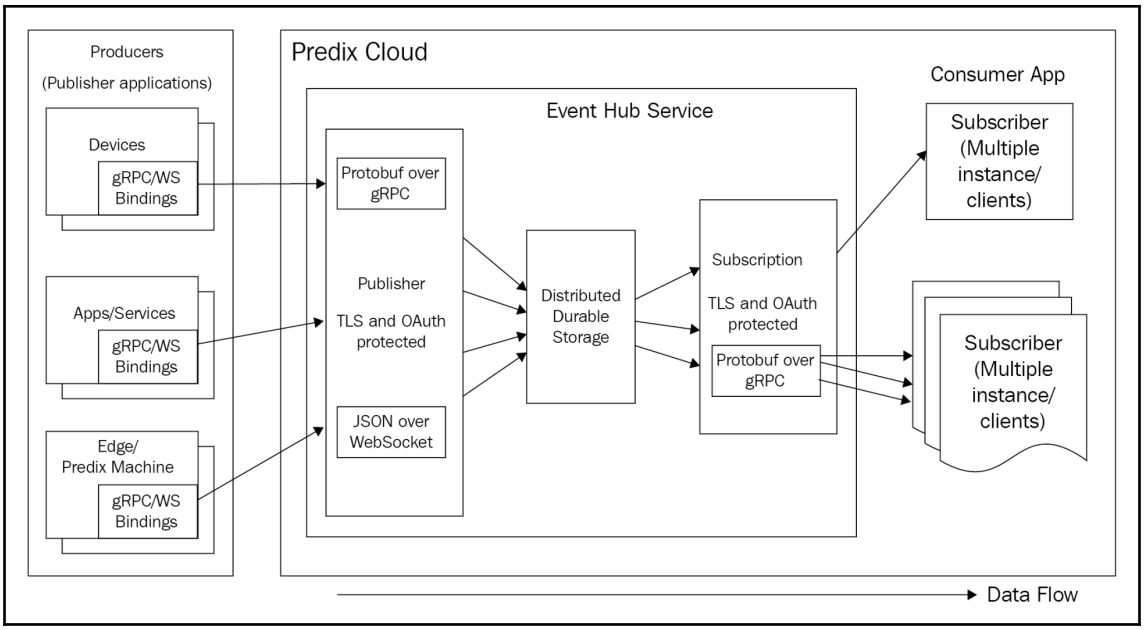
Chapter 2: IIoT Application Architecture and Design

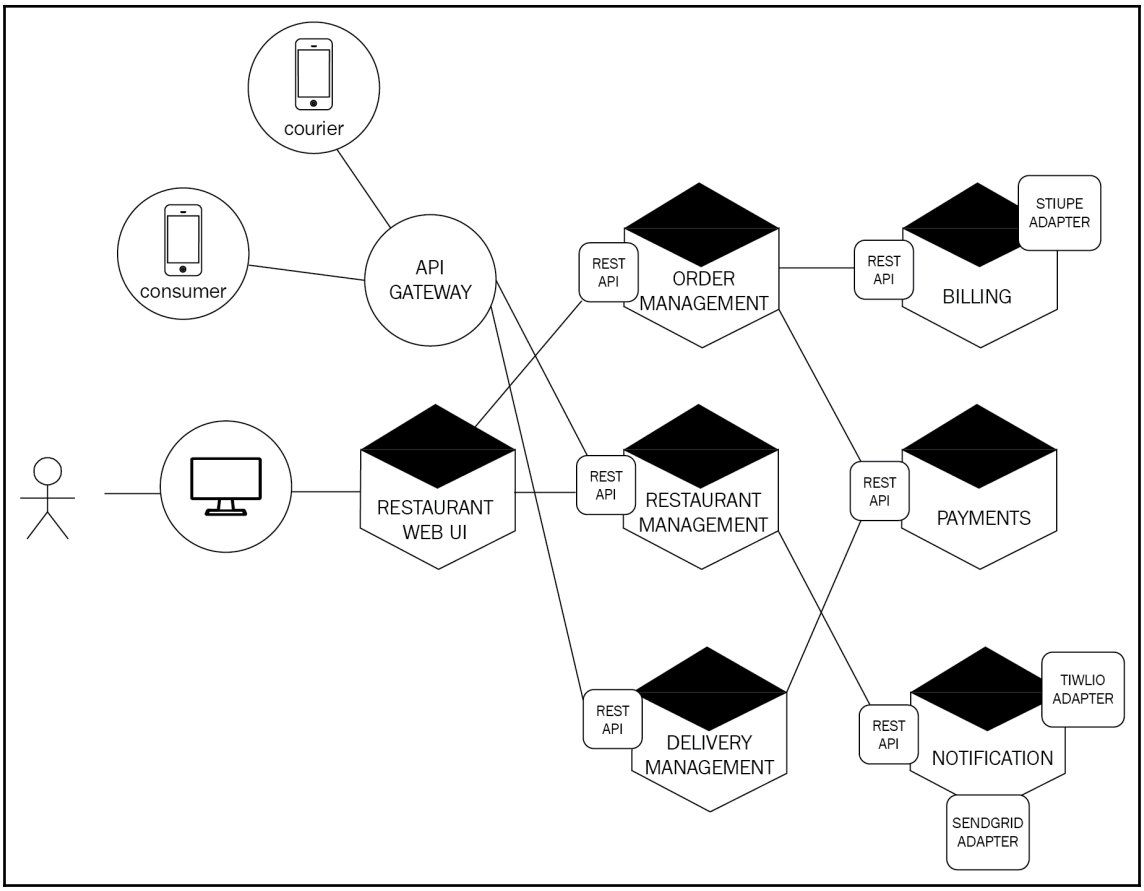


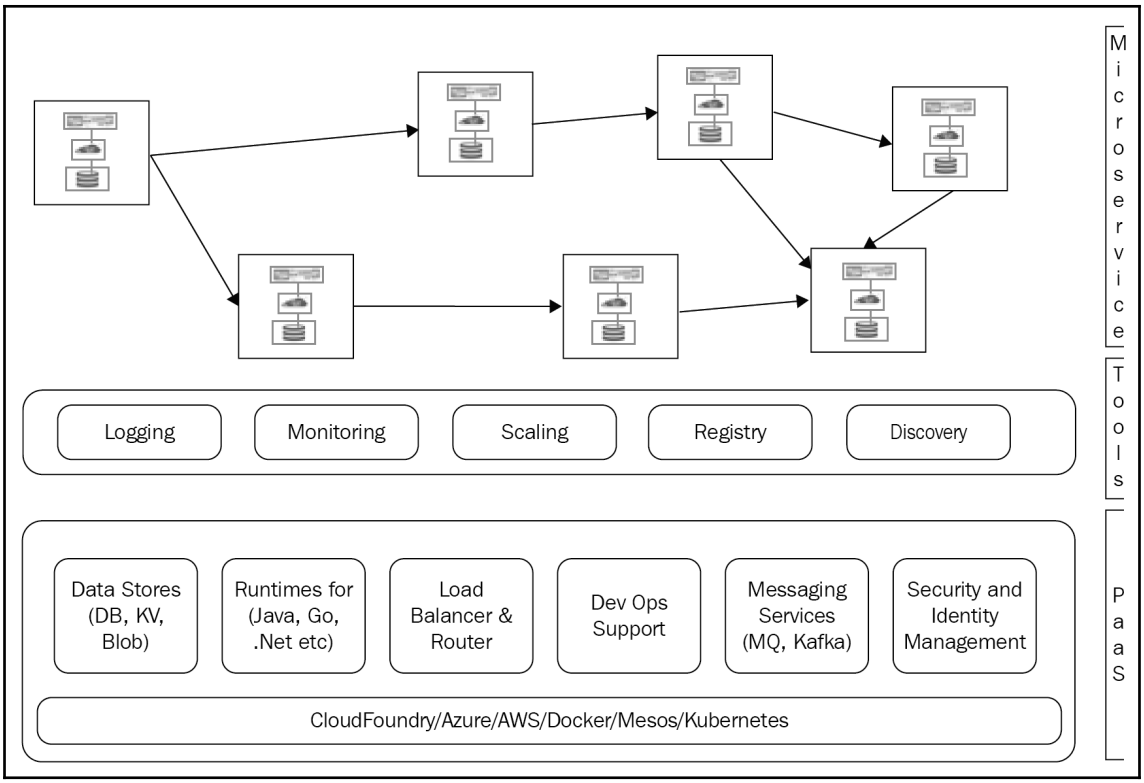

Control Room Building
HMI (Human Machine Interface)
SCADA Server
(Supervisory Control and Data Acquisition)
Plant
Temperature Sensor
PLC
(Programmable Logic Controllers)
RTU
(Remote Transmission Unit)
Industrial Equipment

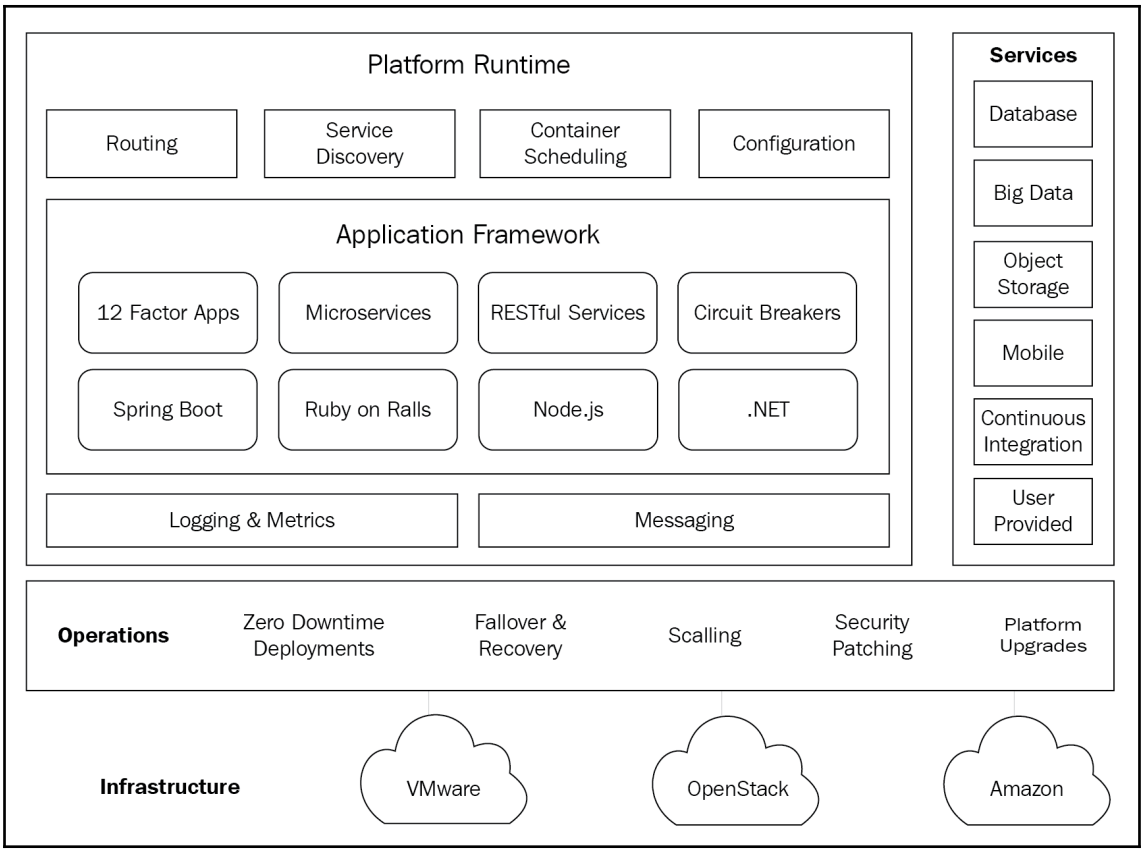

Gateway hardware
Existing device
Existing protocol
Protocol ingester
Filter
Send to cloud
Linux, Windows, RTOS
Connect your existing devices which speak their existing protocols without making expensive changes to them.
Create a module pipeline which accomplishes your specific scenario.
Only send necessary data to the cloud for further analytics, dashboarding, or storage.

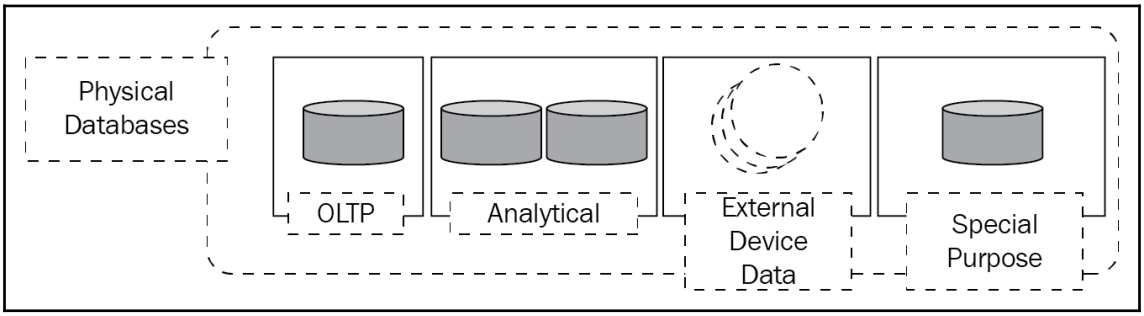

Cloud Computing Layer
Aggregates data summaries from multiple fog nodes
Performs deeper analysis on larger data set and sends application rules to fog nodes
Fog Computing Layer
Transient Storage for immediate data
Real-time analytics and control based on application rules provided by cloud layer
Edge Computing Layer
Captures user interactions and send feeds to Fog node
Performs Intelligent Actions based on real time control signals from Fog nodes

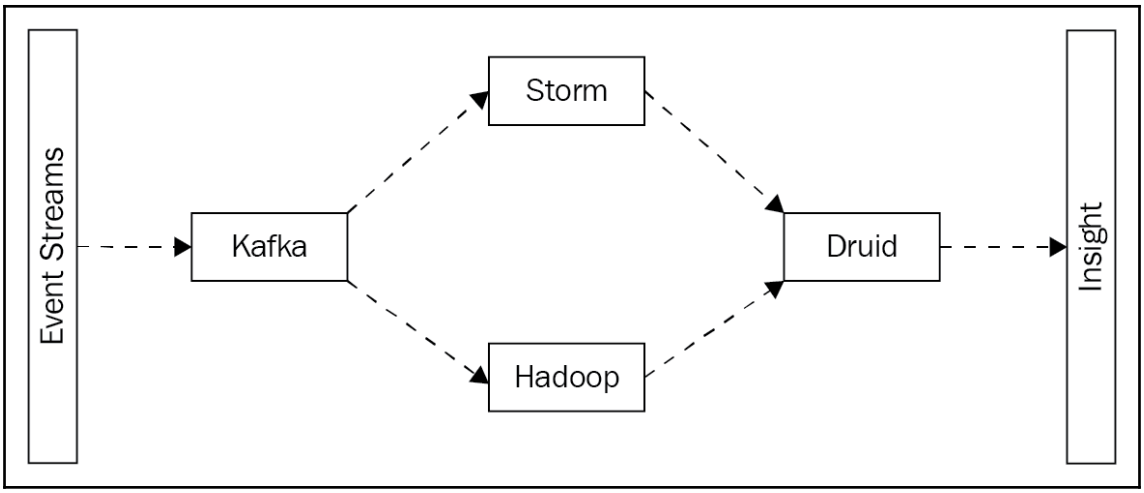

Producers
(Publisher applications)
Devices
gRPC/WS Bindings
Apps/Services
gRPC/WS Bindings
Edge/ Predix Machine
gRPC/WS Bindings
Predix Cloud
Event Hub Service
Protobuf over gRPC
Publisher
TLS and OAuth protected
JSON over WebSocket
Distributed Durable Storage
Subscription
TLS and OAuth protected
Protobuf over gRPC
Consumer App
Subscriber (Multiple instance/ clients)
Subscriber (Multiple instance/ clients)
Data Flow

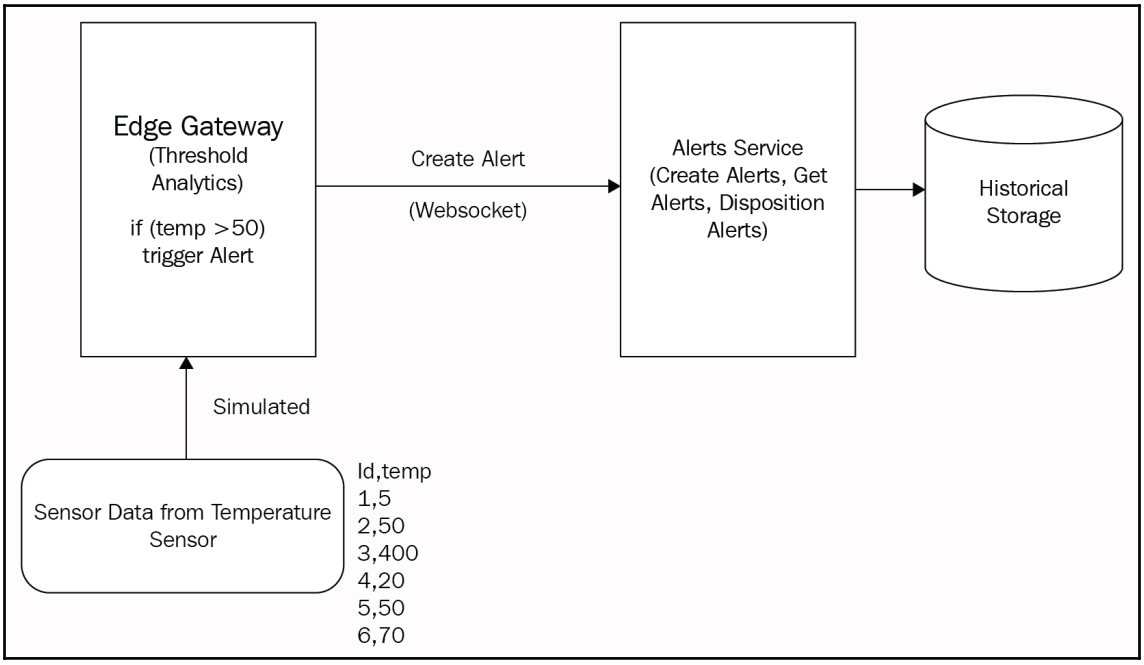

courier
consumer
API
GATEWAY
REST
API
ORDER
MANAGEMENT
REST
API
BILLING
STIUPE
ADAPTER
RESTAURANT
WEB UI
REST
API
RESTAURANT
MANAGEMENT
REST
API
PAYMENTS
REST
API
DELIVERY
MANAGEMENT
REST
API
NOTIFICATION
TIWLIO
ADAPTER
SENDGRID
ADAPTER

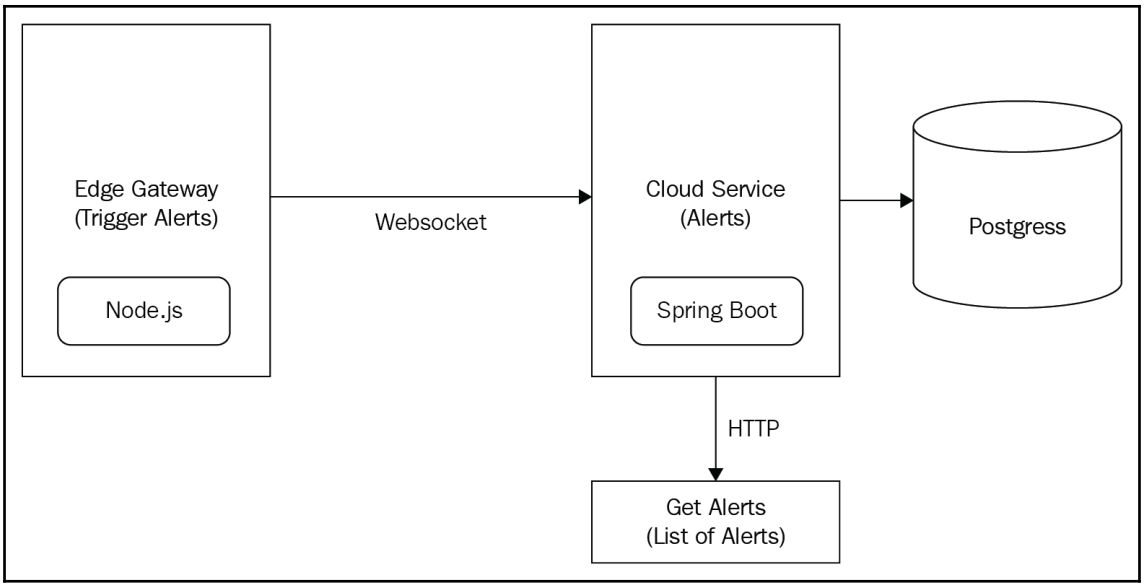

Microservice
Logging
Monitoring
Scaling
Registry
Discovery
Tools
Data Stores (DB, KV, Blob)
Runtimes for (Java, Go, .Net etc)
Load Balancer & Router
Dev Ops Support
Messaging Services (MQ, Kafka)
Security and Identity Management
CloudFoundry/Azure/AWS/Docker/Mesos/Kubernetes
PaaS

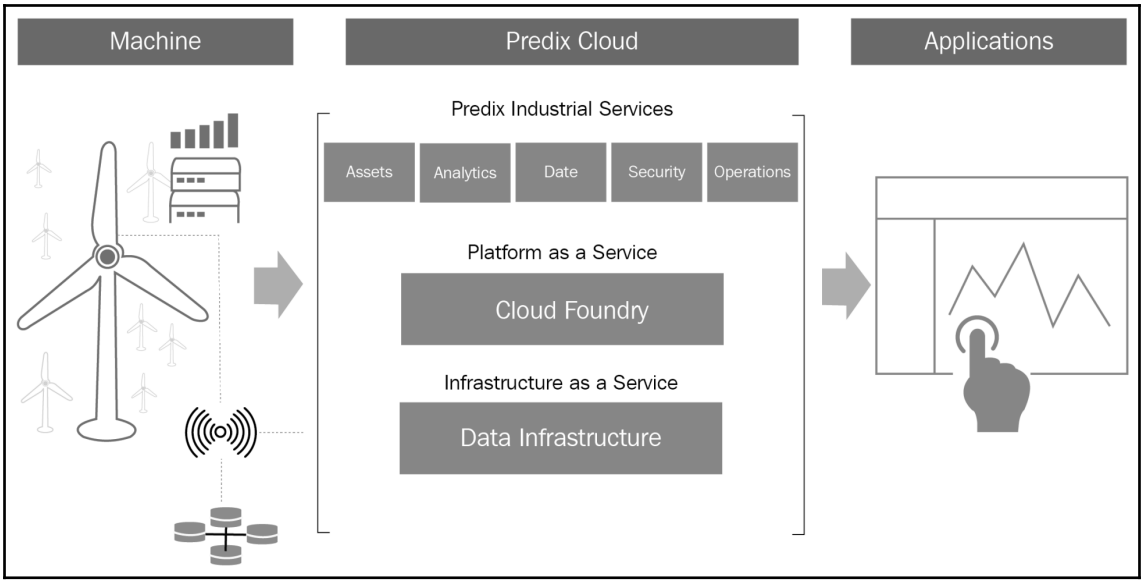

Platform Runtime
Routing
Service Discovery
Container Scheduling
Configuration
Application Framework
12 Factor Apps
Microservices
RESTful Services
Circuit Breakers
Spring Boot
Ruby on Ralls
Node.js
.NET
Logging & Metrics
Messaging
Services
Database
Big Data
Object Storage
Mobile
Continuous Integration
User Provided
Operations
Zero Downtime Deployments
Fallover & Recovery
Scalling
Security Patching
Platform Upgrades
Infrastructure
VMware
OpenStack
Amazon

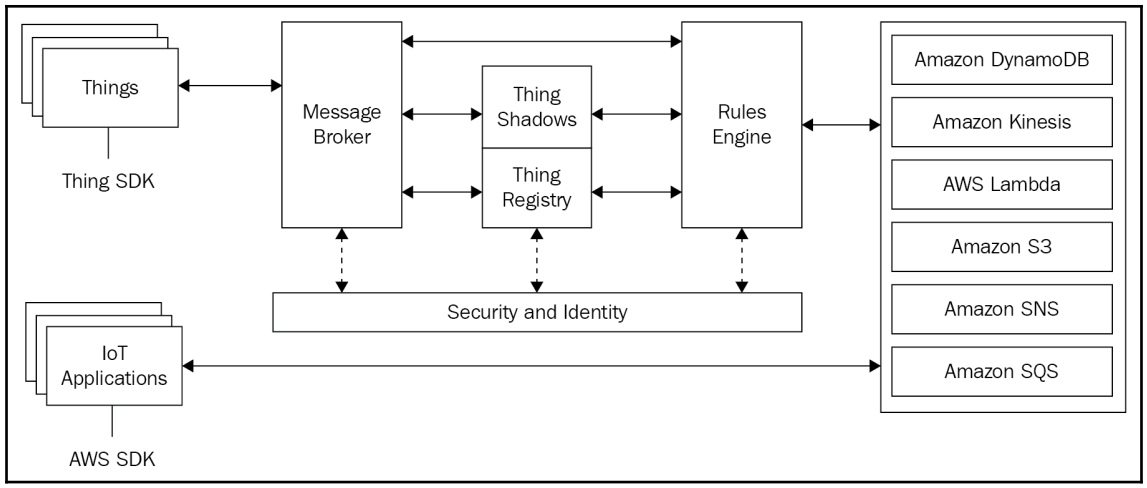

Physical Databases
OLTP
Analytical
External Device Data
Special Purpose

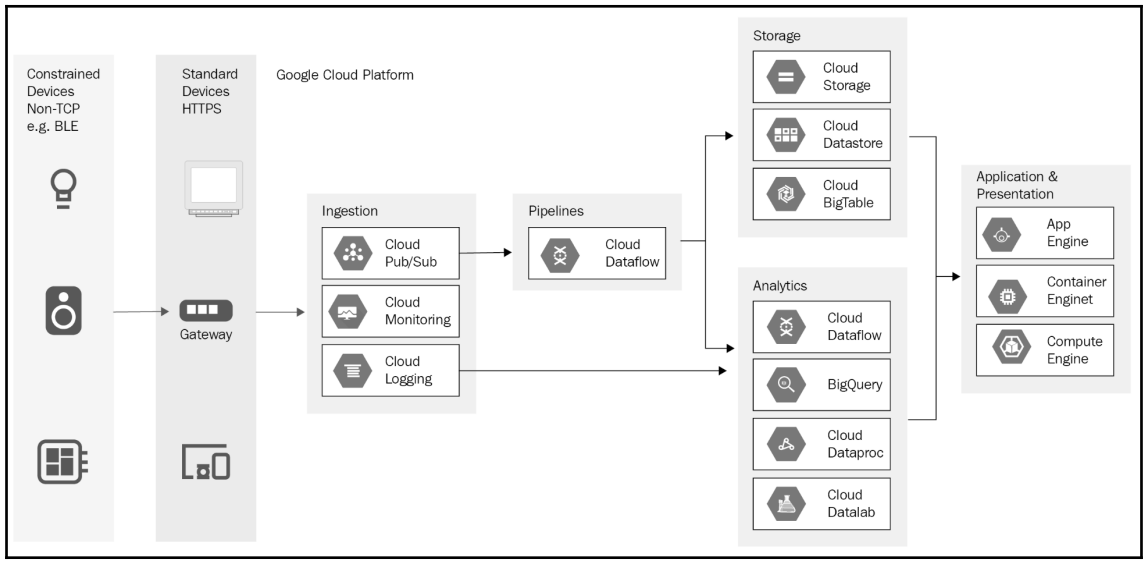

Event Streams
Kafka
Storm
Hadoop
Druid
Insight


Edge Gateway
(Threshold Analytics)
if (temp >50) trigger Alert
Create Alert
(Websocket)
Alerts Service
(Create Alerts, Get Alerts, Disposition Alerts)
Historical Storage
Simulated
Sensor Data from Temperature Sensor
Id,temp
1,5
2,50
3,400
4,20
5,50
6,70

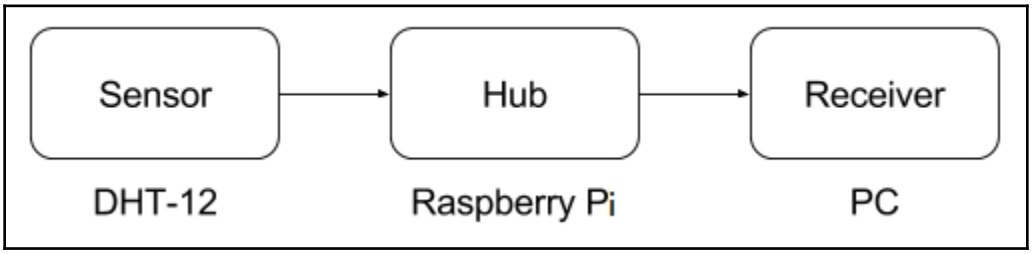

Edge Gateway
(Trigger Alerts)
Node.js
Websocket
Cloud Service
(Alerts)
Spring Boot
Postgress
HTTP
Get Alerts
(List of Alerts)


Machine
Predix Cloud
Applications
Predix Industrial Services
Assets
Analytics
Date
Security
Operations
Platform as a Service
Cloud Foundry
Infrastructure as a Service
Data Infrastructure


Things
Thing SDK
Message Broker
Thing Shadows
Thing Registry
Rules Engine
Amazon DynamoDB
Amazon Kinesis
AWS Lambda
Amazon S3
Amazon SNS
Amazon SQS
Security and Identity
IoT Applications
AWS SDK

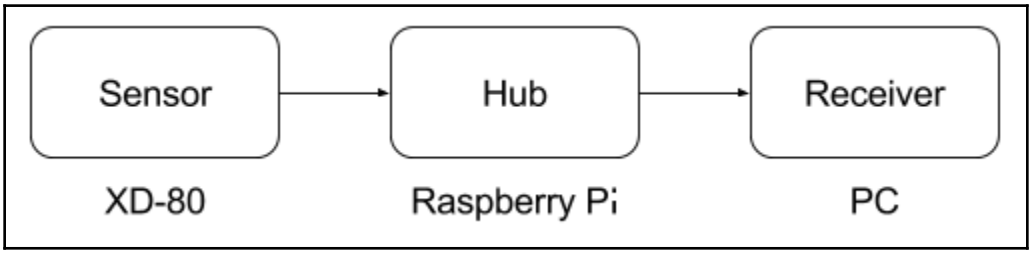

Constrained Devices Non-TCP e.g. BLE
Standard Devices HTTPS
Gateway
Google Cloud Platform
Ingestion
Cloud Pub/Sub
Cloud Monitoring
Cloud Logging
Pipelines
Cloud Dataflow
Storage
Cloud Storage
Cloud Datastore
Cloud BigTable
Analytics
Cloud Dataflow
BigQuery
Cloud Dataproc
Cloud Datalab
Application & Presentation
App Engine
Container Enginet
Compute Engine

Chapter 3: IIoT Edge Development

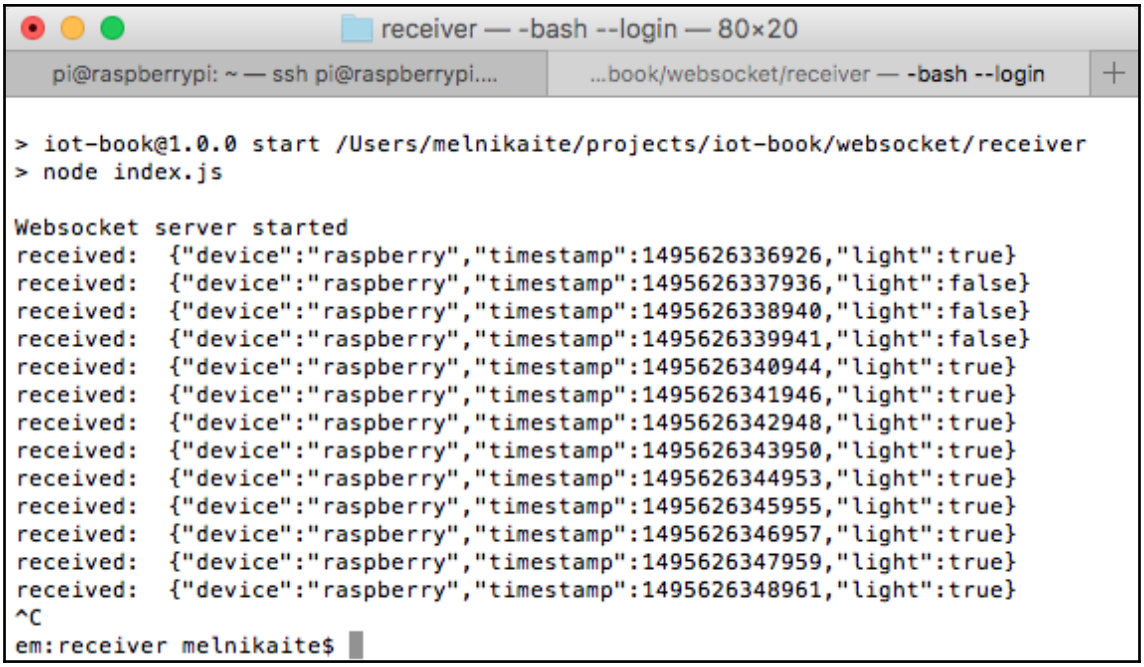


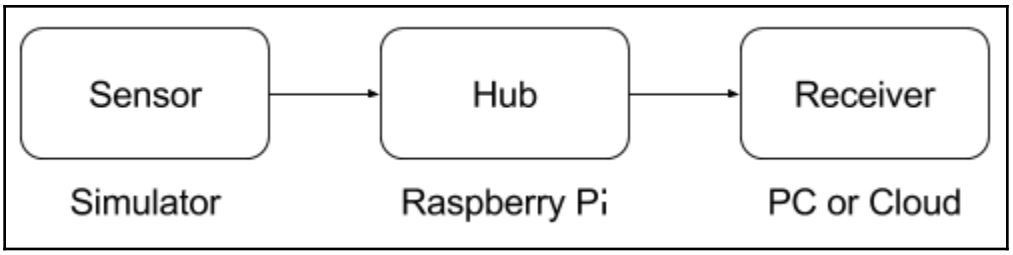

```
receiver — -bash --login — 83×19
pi@raspberrypi: ~/sensor/dht_12 — ssh pi@...   ×  ...ects/iot-book/http/receiver — -bash --login
em:receiver melnikaite$ npm start

> receiver@1.0.0 start /Users/melnikaite/projects/iot-book/http/receiver
> node index.js

{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '32.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '32.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '35.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '35.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '38.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '38.00', device: 'raspberry' }
{ temperature: '27.00', humidity: '38.00', device: 'raspberry' }
{ temperature: '27.00', humidity: '38.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '42.00', device: 'raspberry' }
```

```
melnikaite — pi@raspberrypi: ~/sensor/dht_12 — ssh pi@raspberrypi.altoros.corp...
pi@raspberrypi: ~/sensor/dht_12 — ssh pi@...   ...ects/iot-book/http/receiver — -bash --login
[pi@raspberrypi:~/sensor/dht_12 $ sudo node index.js
{ temperature: '0.00', humidity: '0.00', device: 'raspberry' }
Failed to send to http://172.16.32.193:8080
{ temperature: '0.00', humidity: '0.00', device: 'raspberry' }
Failed to send to http://172.16.32.193:8080
{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
Failed to send to http://172.16.32.193:8080
{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '31.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '32.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '32.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '35.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '35.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '38.00', device: 'raspberry' }
{ temperature: '26.00', humidity: '38.00', device: 'raspberry' }
{ temperature: '27.00', humidity: '38.00', device: 'raspberry' }
```



```
pi@raspberrypi:~ $ sudo node device4.1.js
light status: true
failed to send data to ws://172.16.32.193:8080
light status: true
failed to send data to ws://172.16.32.193:8080
light status: true
failed to send data to ws://172.16.32.193:8080
light status: true
light status: false
light status: false
light status: false
light status: true
light status: true
light status: true
light status: true
light status: true
light status: true
light status: true
light status: true
light status: true
```





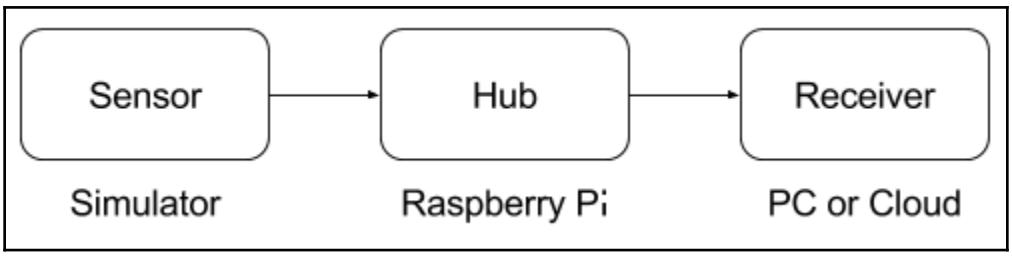
hub — -bash --login — 80×20

node ◂ npm…ite/.rvm/bin | …us/hub — -bash --login | node ◂ npm…aite/.rvm/bin …

```
em:hub melnikaite$ npm start

> hub@1.0.0 start /Users/melnikaite/projects/iot-book/modbus/hub
> node index.js

onConnect
321
onDestroy
em:hub melnikaite$
```

```
sensor — node ◂ npm MANPATH=/Users/melnikaite/.nvm/versions/node/v6.9.4...
node ◂ npm...ite/.rvm/bin | ...us/hub — -bash --login | node ◂ npm...aite/.rvm/bin ...
em:sensor melnikaite$ npm start

> sensor@1.0.0 start /Users/melnikaite/projects/iot-book/modbus/sensor
> node index.js

{ nb_bits: 2,
  nb_input_bits: 0,
  nb_input_registers: 0,
  nb_registers: 5,
  tab_bits: [ 0, 1 ],
  tab_input_bits: [],
  tab_input_registers: [],
  tab_registers: [ 0, 0, 321, 0, 0 ] }
onQuery
[ false, true ]
onQuery
[ false, false ]
onQuery
[ false, false ]
```

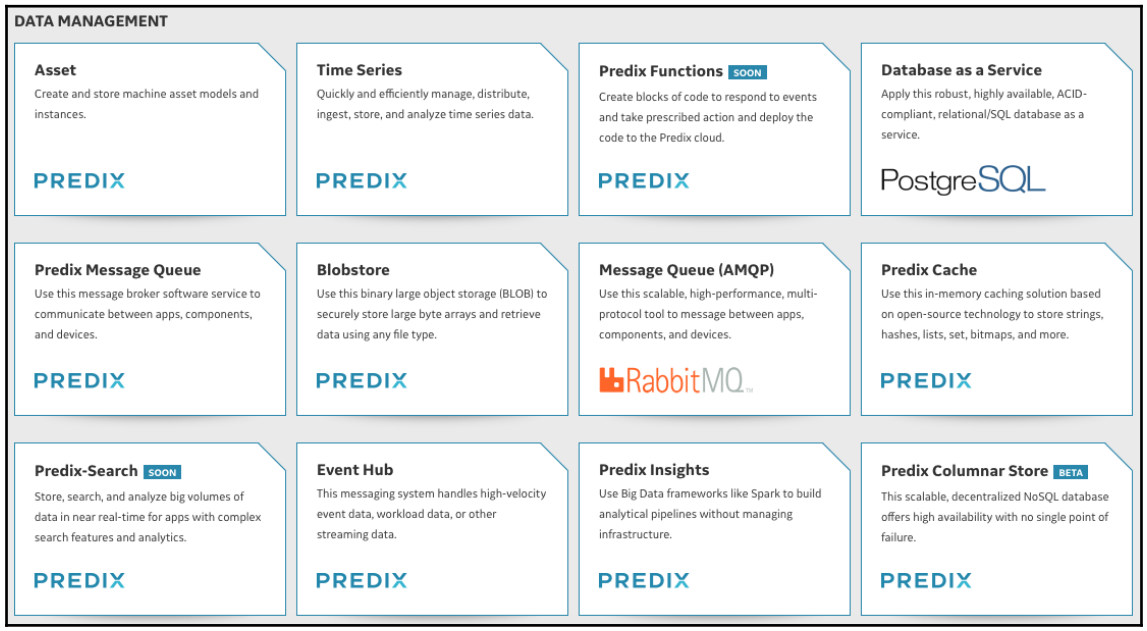
```
receiver — node ◂ npm MANPATH=/Users/melnikaite/.nvm/versions/node/v6.9....
node ◂ npm...ite/.rvm/bin | ...us/hub — -bash --login | node ◂ npm...aite/.rvm/bin
em:receiver melnikaite$ npm start

> receiver@1.0.0 start /Users/melnikaite/projects/iot-book/modbus/receiver
> node index.js

{ device: 'sensor1', timestamp: '1495713113784', reg2: '321' }
```



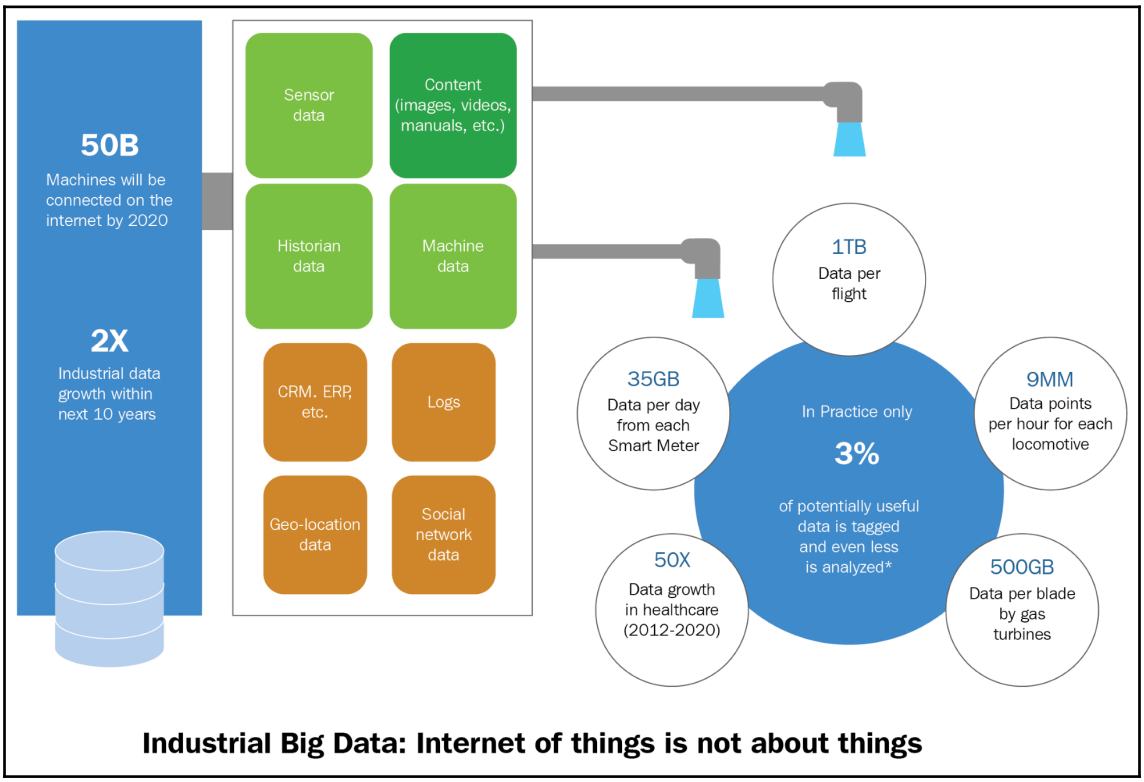
```
em:sensor $ npm start

> sensor@1.0.0 start /Users/[redacted]/projects/iot-book/opcua/sensor
> node index.js

Endpoint:  opc.tcp://[redacted]:4334/UA/resourcePath
```

```
em:receiver $ npm start

> receiver@1.0.0 start /Users/[redacted]/projects/iot-book/opcua/receiver
> node index.js

{ device: 'sensor1',
  timestamp: '1533900869892',
  Variable1: '100' }
{ device: 'sensor1',
  timestamp: '1533900870389',
  Variable1: '37' }
{ device: 'sensor1',
  timestamp: '1533900870891',
  Variable1: '55' }
{ device: 'sensor1',
  timestamp: '1533900870891',
  Variable1: '76' }
{ device: 'sensor1',
  timestamp: '1533900871894',
  Variable1: '97' }
{ device: 'sensor1',
  timestamp: '1533900872396',
  Variable1: '92' }
{ device: 'sensor1',
  timestamp: '1533900872396',
  Variable1: '85' }
{ device: 'sensor1',
  timestamp: '1533900873401',
  Variable1: '60' }
{ device: 'sensor1',
  timestamp: '1533900873401',
  Variable1: '17' }
```

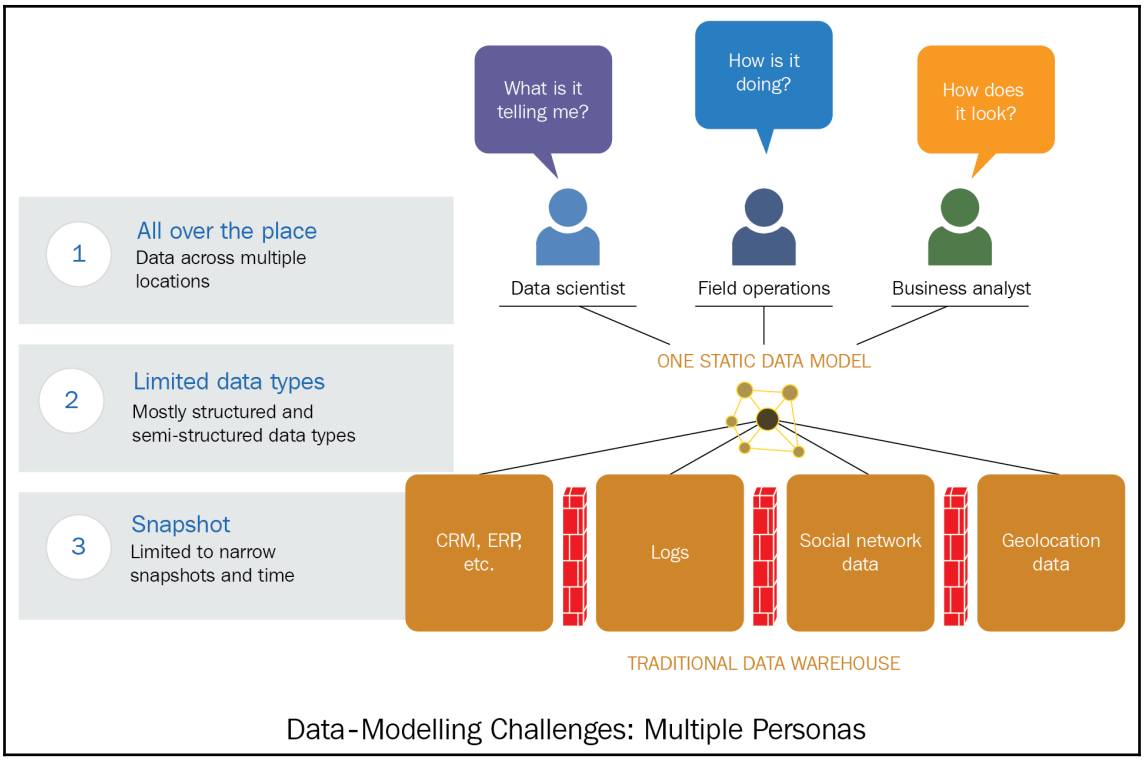
```
[em:hub [redacted]$ npm start

> hub@1.0.0 start /Users/[redacted]/projects/iot-book/opcua/hub
> node index.js

Connection successful
Variable1 =  24
subscription id:  398664
Variable1 =  100
Variable1 =  37
Variable1 =  55
Variable1 =  76
Variable1 =  97
Variable1 =  92
Variable1 =  85
Variable1 =  60
Variable1 =  17
Successfully finished
em:hub [redacted]$
```



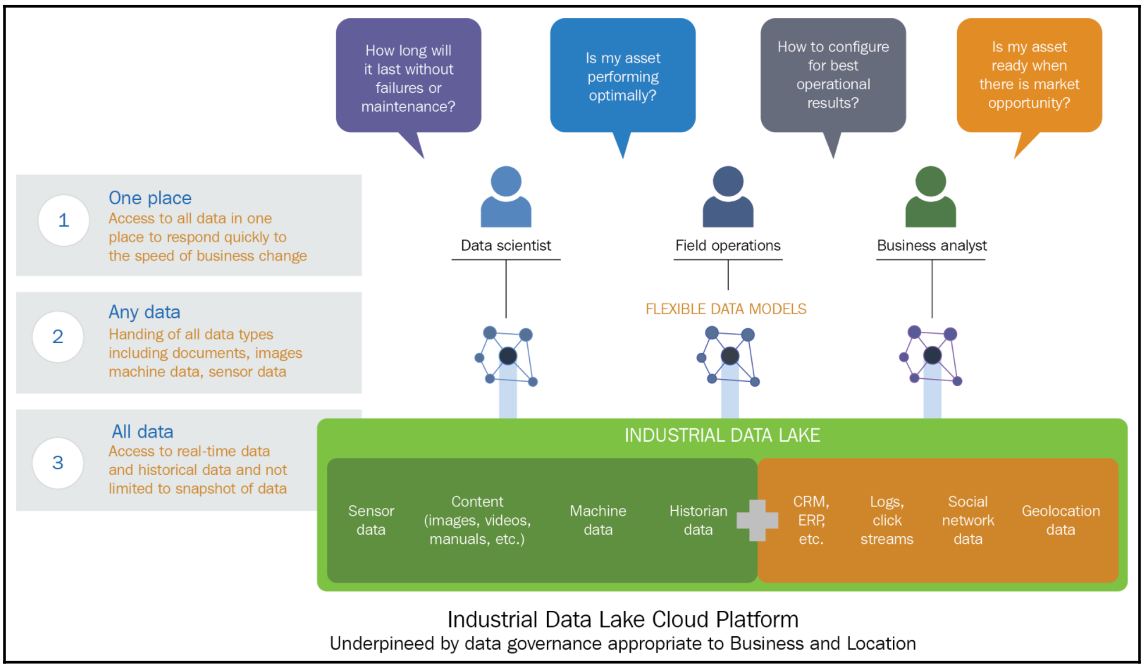
Chapter 4: Data for IIoT



Industrial Big Data: Internet of things is not about things

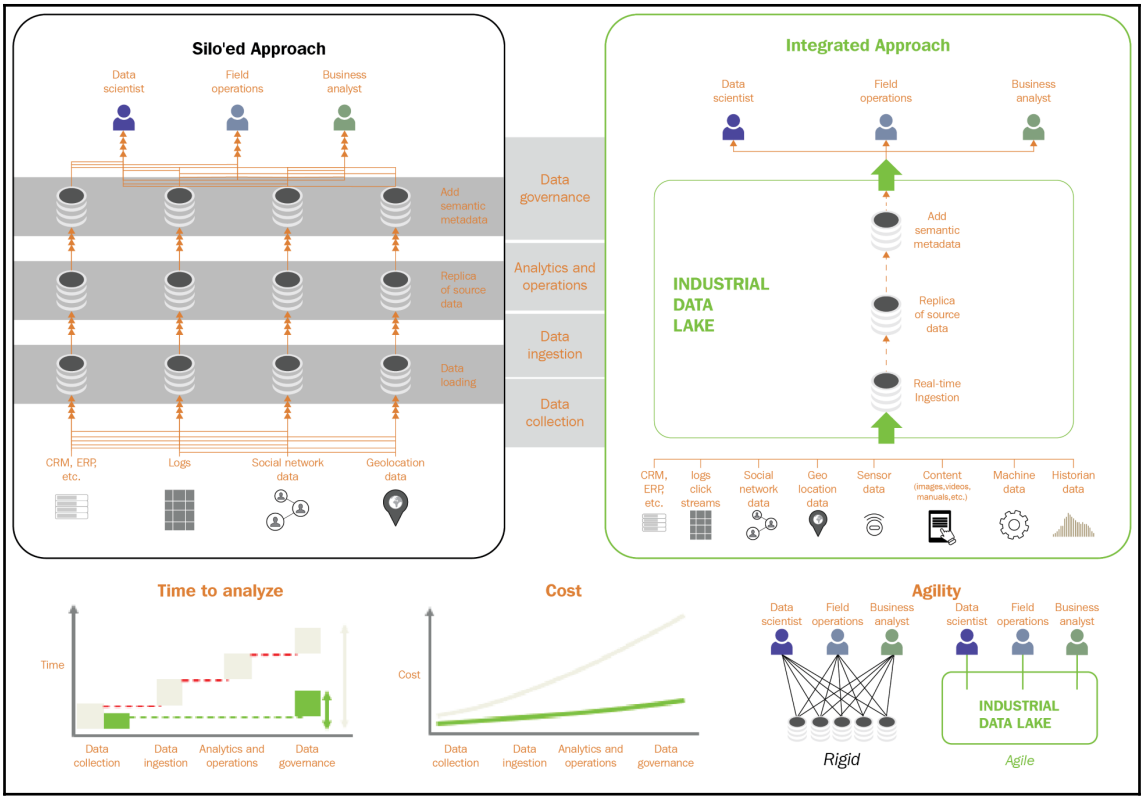


Data-Modelling Challenges: Multiple Personas



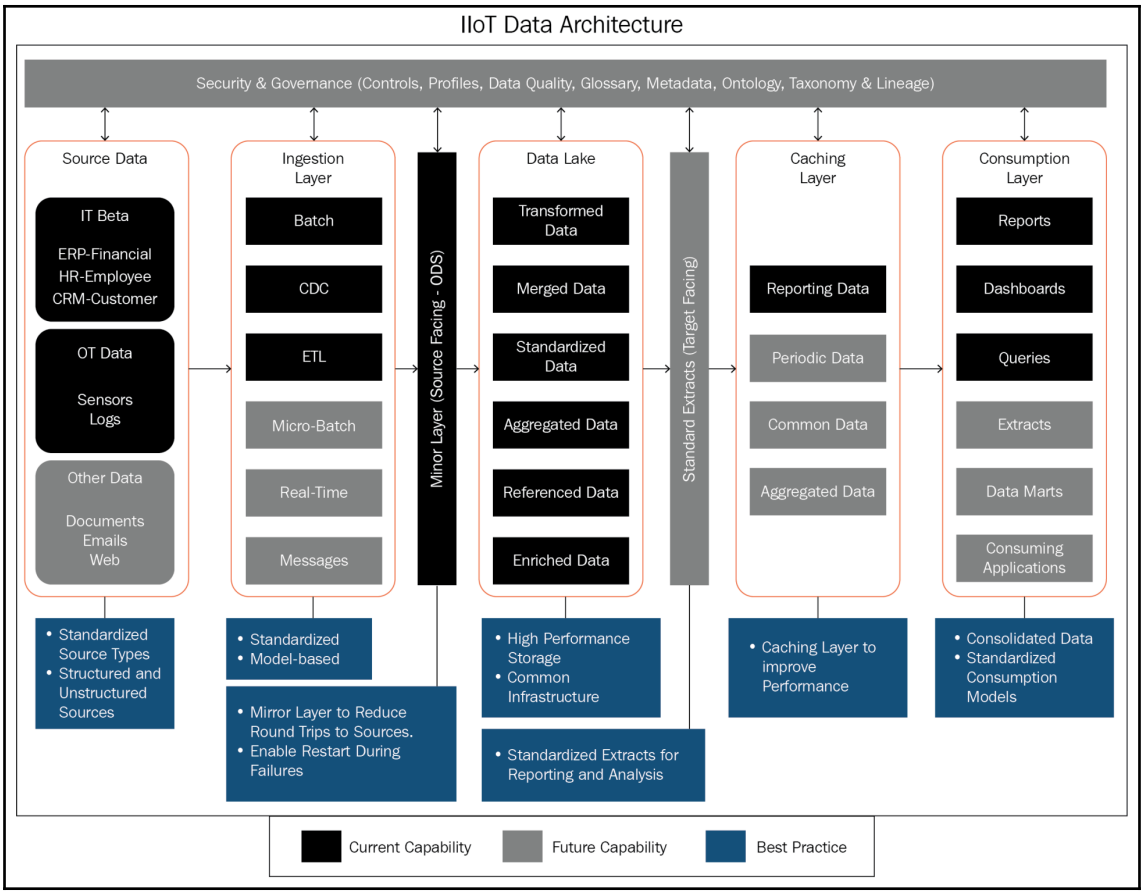
Industrial Data Lake Cloud Platform

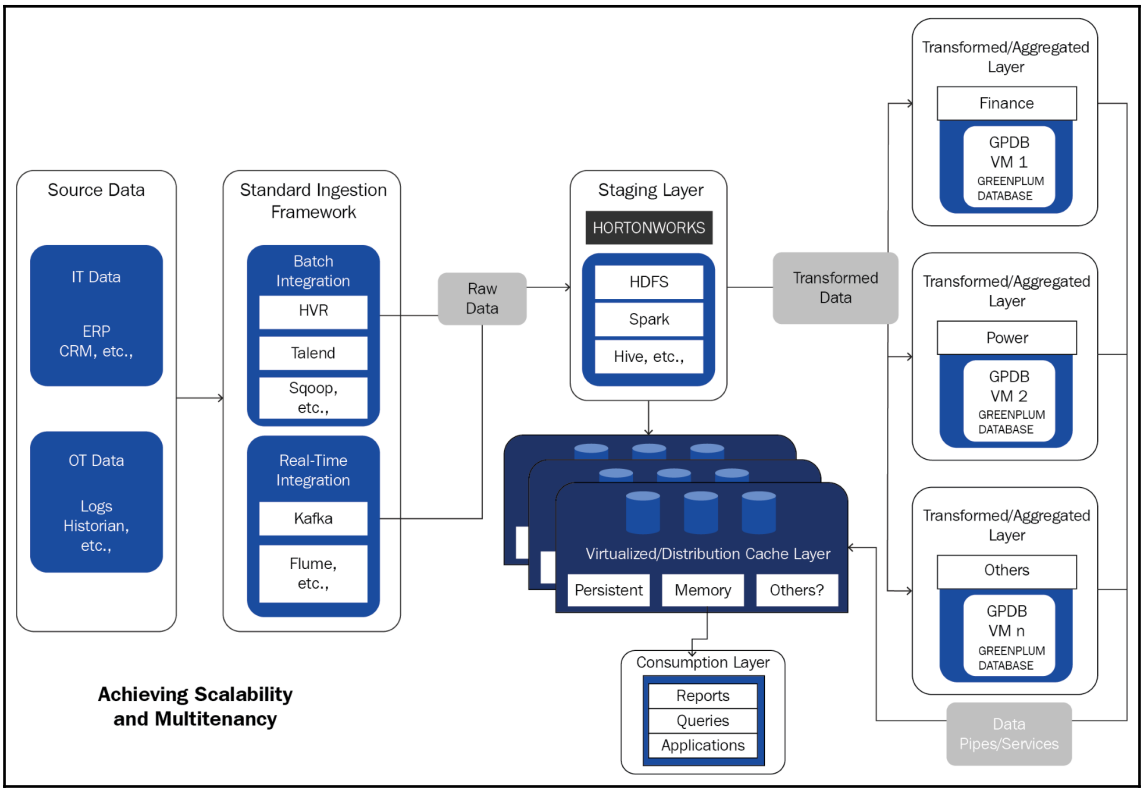
Underpineed by data governance appropriate to Business and Location

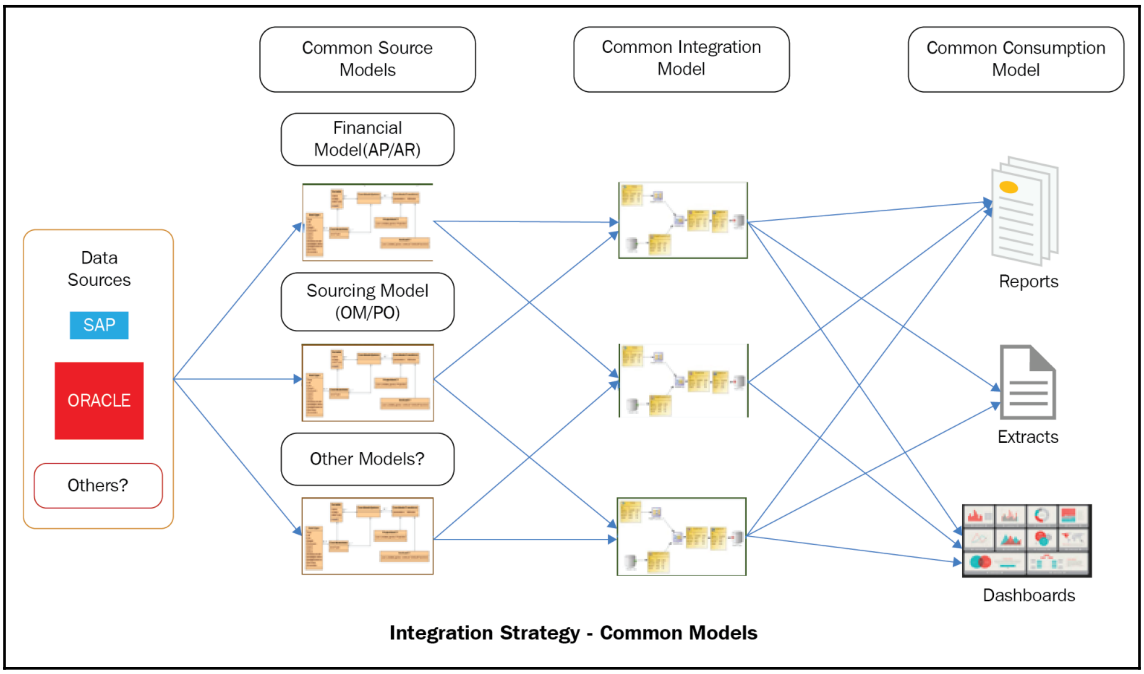


Integration and visualization	Structured Data	Batch / CDC-based replication	Simple transformation w/ mastering	Reporting tools
Advanced Analytics	Structured + Unstructured	Batch / CDC-based replication	Machine Learning Predictive Modeling	Reporting tools and self discovery tools
Search + API	Structured + Unstructured	Batch / CDC-based replication	Machine Learning Predictive Modeling	Search & API access to visualization
Real-time analytics	Structured + Unstructured	Real-time ingestion	Simple real-time processing	API based real-time access

Use Case Pattern Summary


IIoT Data Architecture
Security & Governance (Controls, Profiles, Data Quality, Glossary, Metadata, Ontology, Taxonomy & Lineage)
Source Data
IT Beta
ERP-Financial
HR-Employee
CRM-Customer
OT Data
Sensors
Logs
Other Data
Documents
Emails
Web
Ingestion Layer
Batch
CDC
ETL
Micro-Batch
Real-Time
Messages
Minor Layer (Source Facing - ODS)
Data Lake
Transformed Data
Merged Data
Standardized Data
Aggregated Data
Referenced Data
Enriched Data
Standard Extracts (Target Facing)
Caching Layer
Reporting Data
Periodic Data
Common Data
Aggregated Data
Consumption Layer
Reports
Dashboards
Queries
Extracts
Data Marts
Consuming Applications
• Standardized Source Types
• Structured and Unstructured Sources
• Standardized
• Model-based
• Mirror Layer to Reduce Round Trips to Sources.
• Enable Restart During Failures
• High Performance Storage
• Common Infrastructure
• Standardized Extracts for Reporting and Analysis
• Caching Layer to improve Performance
• Consolidated Data
• Standardized Consumption Models
Current Capability
Future Capability
Best Practice


Source Data
IT Data
ERP
CRM, etc.,
OT Data
Logs
Historian,
etc.,
Standard Ingestion Framework
Batch Integration
HVR
Talend
Sqoop, etc.,
Real-Time Integration
Kafka
Flume, etc.,
Raw Data
Staging Layer
HORTONWORKS
HDFS
Spark
Hive, etc.,
Transformed Data
Virtualized/Distribution Cache Layer
Persistent
Memory
Others?
Consumption Layer
Reports
Queries
Applications
Transformed/Aggregated Layer
Finance
GPDB VM 1
GREENPLUM DATABASE
Transformed/Aggregated Layer
Power
GPDB VM 2
GREENPLUM DATABASE
Transformed/Aggregated Layer
Others
GPDB VM n
GREENPLUM DATABASE
Data Pipes/Services
Achieving Scalability and Multitenancy



Integration Strategy - Common Models

Batch Data Integration	Real-Time data Integration	Big data Integration	Data Virtualization
Large data sets	Small amounts of data transfer	Very Large data sets	Across data stores and data sets
Point to point	Point to point	Not Point to point	Not Point to point
Groups of data	Single business transactions	Processing to the data	No intermediate persistent store
Asynchronous - sent periodically	Synchronous	Only smaller sets of results get integrated	In memory integration
Tightly coupled	Tightly coupled	Loosely coupled	Loosely coupled
Careful orchestration of changes required	Logical design solutions to reduce P2P limitations	Master data/keys in structured and metadata tags in un-structured	Truly cross data platform and store integration in-memory

Data Integration Types

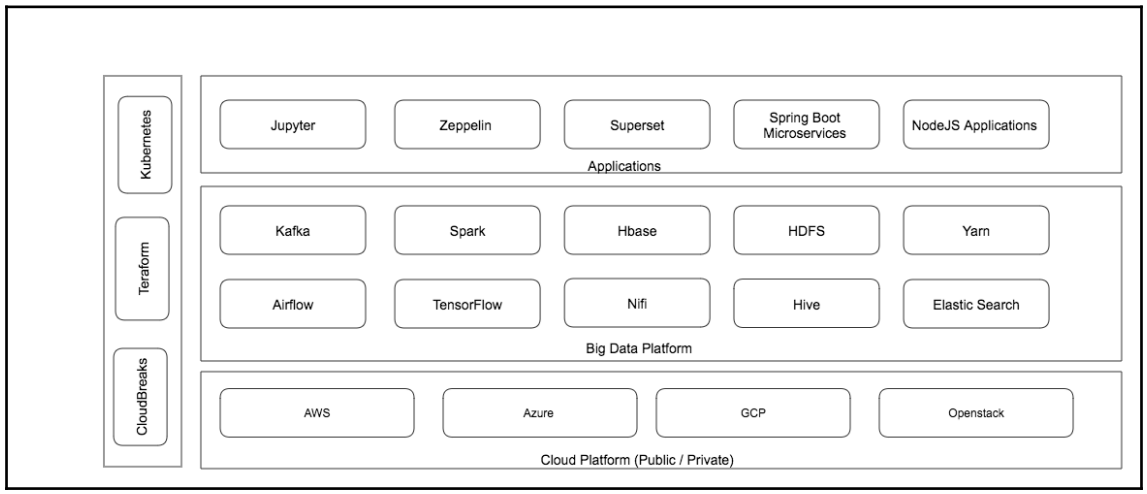
Hub and Spoke	Request and Reply	Pub and Sub	Two-Phase Commits
Used for real-time data integration	Point to point or through hub	Pub and sub information	All effected systems update together or fail
One interface created for each additional system	Synchronous or asynchronous	Requires orchestration system	Leveraged for transactional systems
All data transformed into canonical model	Need not have a common model	Requires tracking of requests	
Canonical model definition requires careful design	Get information or acknowledgement back		

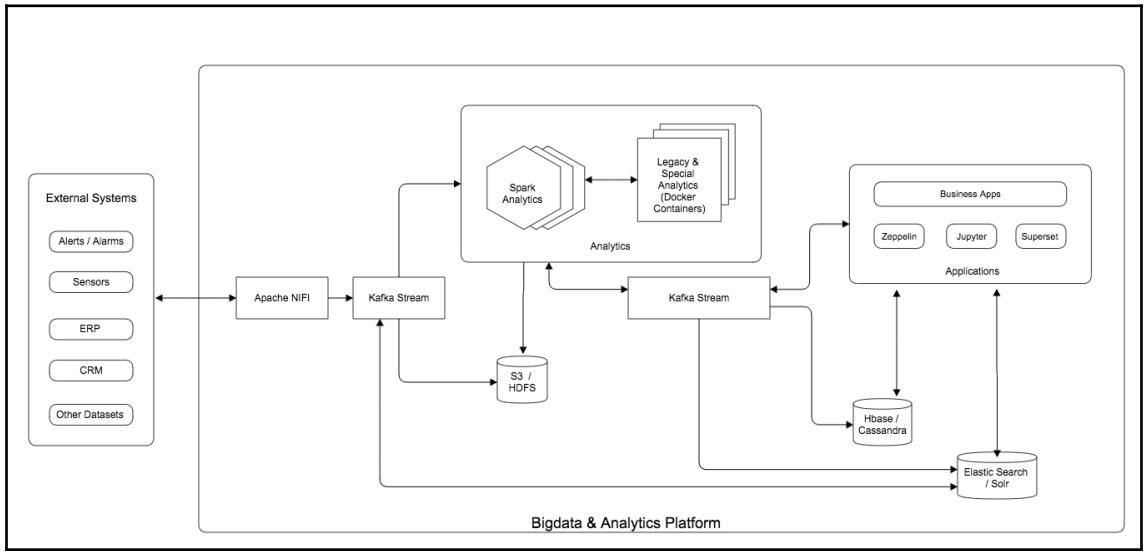
Data Integration Types

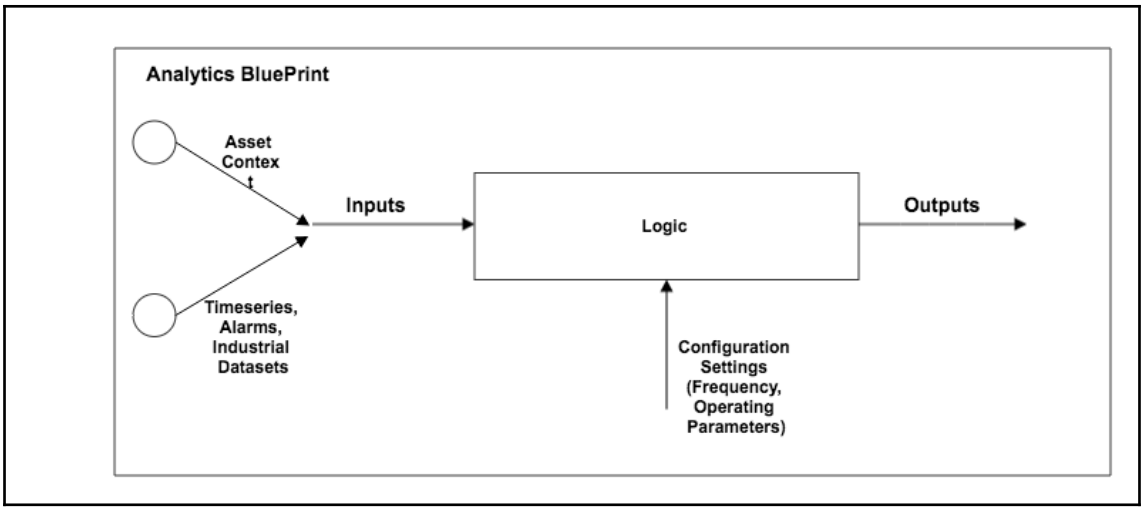
Data Policy Management	Data Profile Management	Data Quality Management	Business Glossary Management	Metadata Management	Data Security Management	Data Compliance Management	Audit and Log Management
Governance Council, Data Owners	Business Analyst	Data Quality Analyst	Data Steward	Data Steward	Security Steward	Compliance Steward	Operational Steward
• **Data Ownership** • Business Owner • External Owners • **Data Usage** • Contracts • Restrictions • **Data Usage** • Contracts • Restrictions • **Data Retention** • Duration • Regulations • **Data Archival** • Offline/Online • **Data Backup and Restoration** • Business Continuity • Point in Time • **Data Deletion** • Physical • Logical • Disposal	• **Data Analysis** • Metadata Based • Content Based • **Data Sampling** • Percentage • Every nth Record • **Data Quality Assessment** • %Good • %Valid	• **Data Standards** • Names • Address • Formats • **Data Validity** • Data Types • Ranges • References • **Match** • Exact • Fuzzy • Probabilistic • Deterministic • **Merge** • Deduped • **Survive** • Best Match • Cleansed Data	• **Business Terms** • Profitability • Cost of Goods Sold • **Business Models** • Reporting • Analytics • Forecasting • **Business Processes** • Order to Cash • Procure to Pay	• **Data Dictionary** • Sources • Targets • Repositories • Processes • Business Glossary Linkage • Reports • Extracts • **Data Models** • Architecture • Conceptual • Logical • Physical • **Impact Analysis** • Where Used • Changes • **Data Lineage** • Upstream • Downstream	• **Access Management** • Database and Table • Row and Column • Cell • **Data Classification** • Public • Internal • Sensitive • Restricted • **Data Masking** • Credit Cards • SSN, DOB • **Data Encryption** • At Rest • In Motion • **Data Substitution** • Dev/QA Environments	• **Data Privacy** • PII • PHI • **Compliance Controls** • HIPAA • SOX • PCI • **Data Sharing** • Contracts • Regulations • Restrictions	• **Access Logs** • Database Logs • Application Logs • **Security Logs** • User Logs • System Logs • **Log Analytics** • Patterns • Behaviour • Usage
Policy Management Framework	Profiling Framework	Data Quality Framework	Metadata Framework	Metadata Framework	Security Controls Framework	Compliance Controls Framework	Logging and Auditing Framework

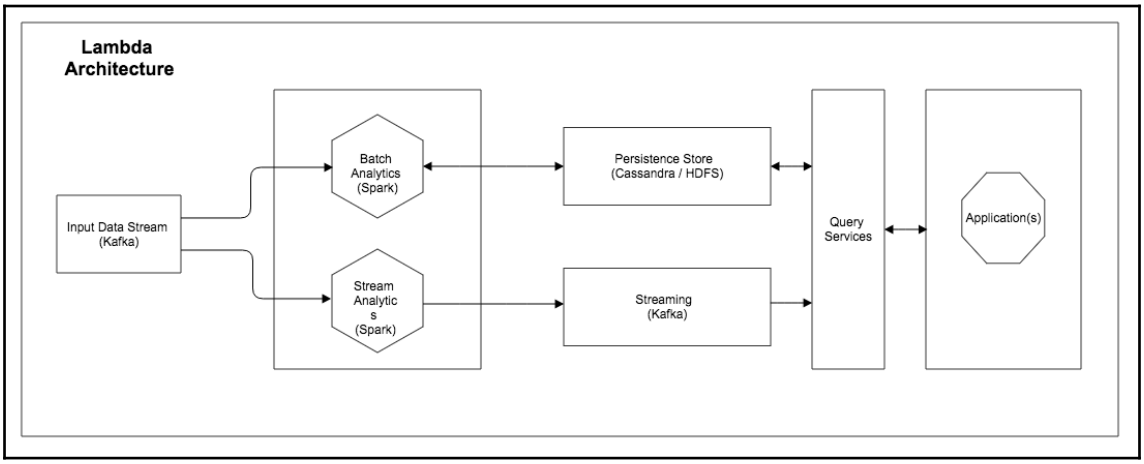
Data Governance - CTQs and Priorities

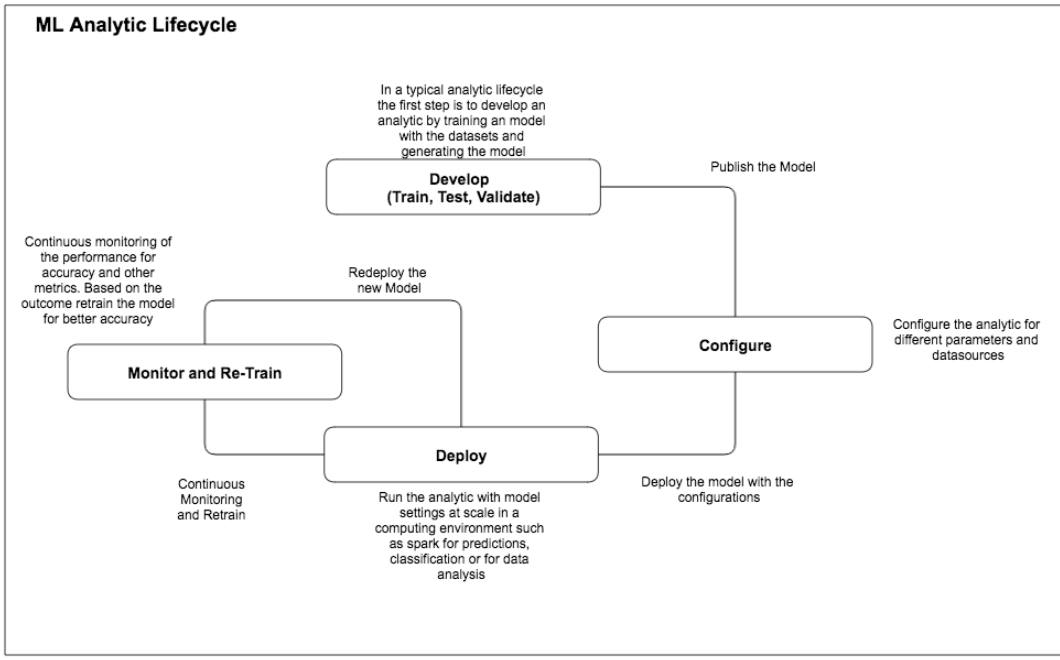
Chapter 5: Advanced Analytics for the IIoT

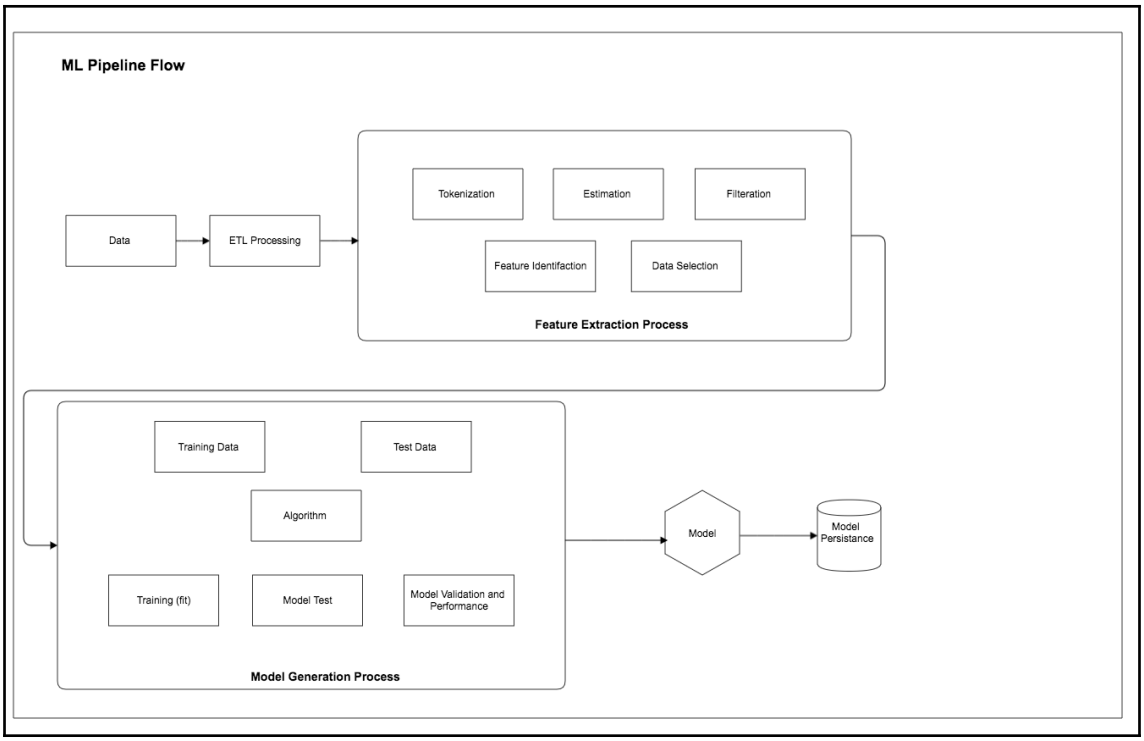


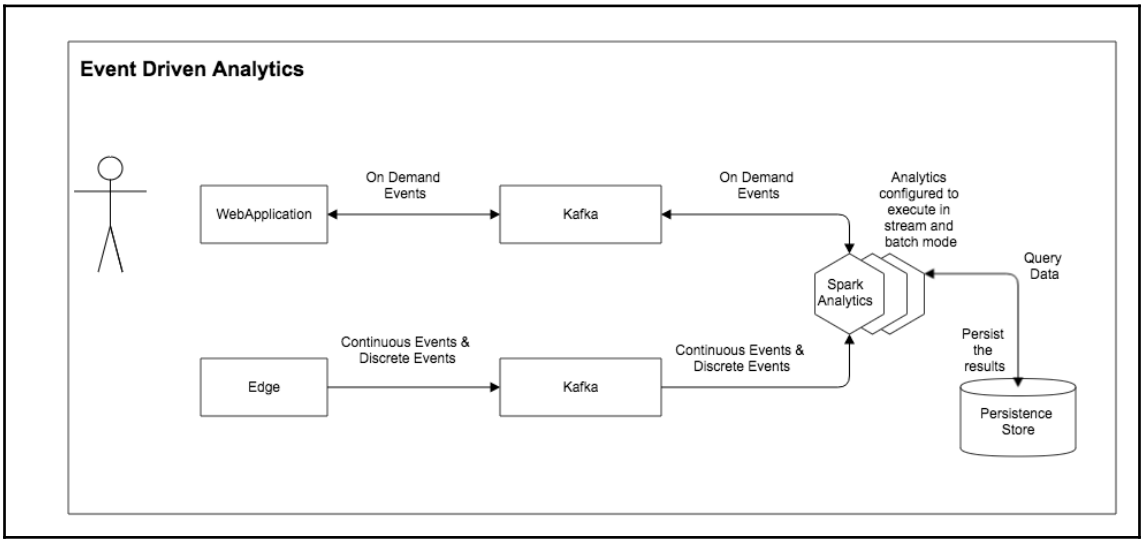


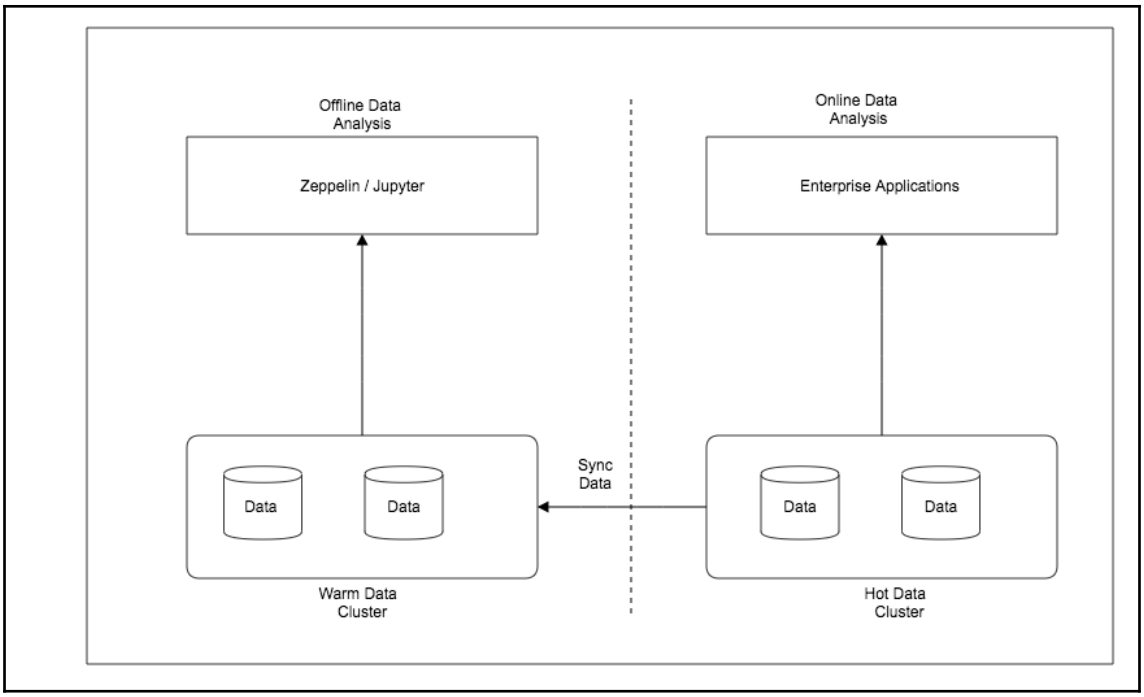

Analytics BluePrint
Asset Contex t
Timeseries, Alarms, Industrial Datasets
Inputs
Logic
Outputs
Configuration Settings (Frequency, Operating Parameters)

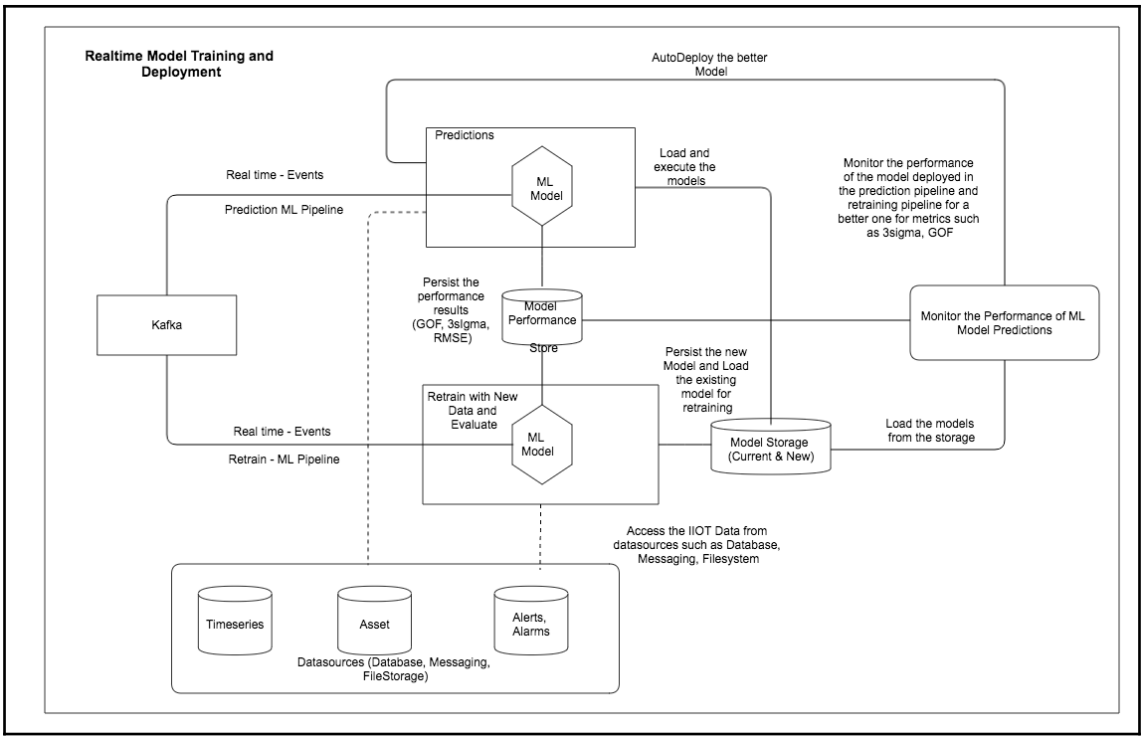

Lambda Architecture
Input Data Stream (Kafka)
Batch Analytics (Spark)
Stream Analytic s (Spark)
Persistence Store (Cassandra / HDFS)
Streaming (Kafka)
Query Services
Application(s)

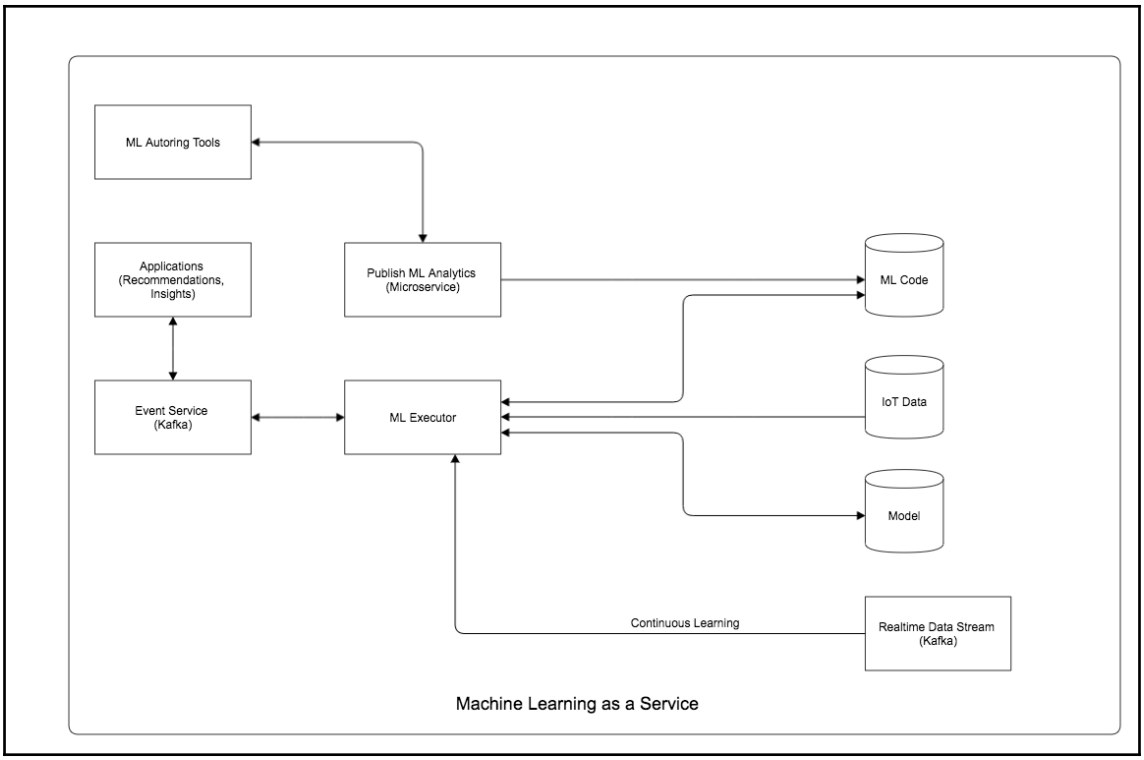

ML Analytic Lifecycle
In a typical analytic lifecycle the first step is to develop an analytic by training an model with the datasets and generating the model
Develop (Train, Test, Validate)
Publish the Model
Configure
Configure the analytic for different parameters and datasources
Deploy
Deploy the model with the configurations
Run the analytic with model settings at scale in a computing environment such as spark for predictions, classification or for data analysis
Monitor and Re-Train
Redeploy the new Model
Continuous monitoring of the performance for accuracy and other metrics. Based on the outcome retrain the model for better accuracy
Continuous Monitoring and Retrain

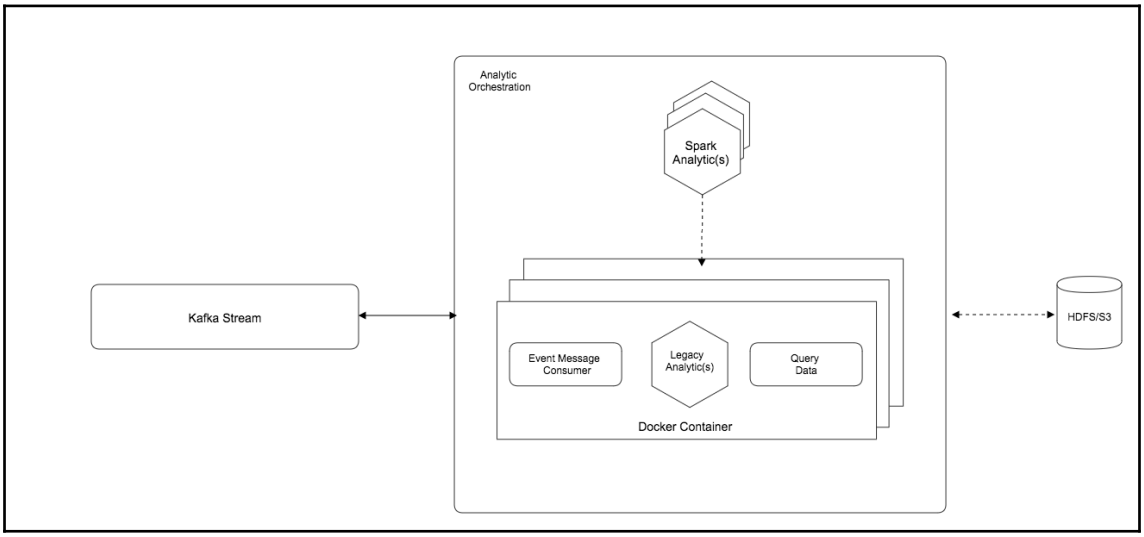

ML Pipeline Flow
Data
ETL Processing
Tokenization
Estimation
Filteration
Feature Identifaction
Data Selection
Feature Extraction Process
Training Data
Test Data
Algorithm
Training (fit)
Model Test
Model Validation and Performance
Model Generation Process
Model
Model Persistance

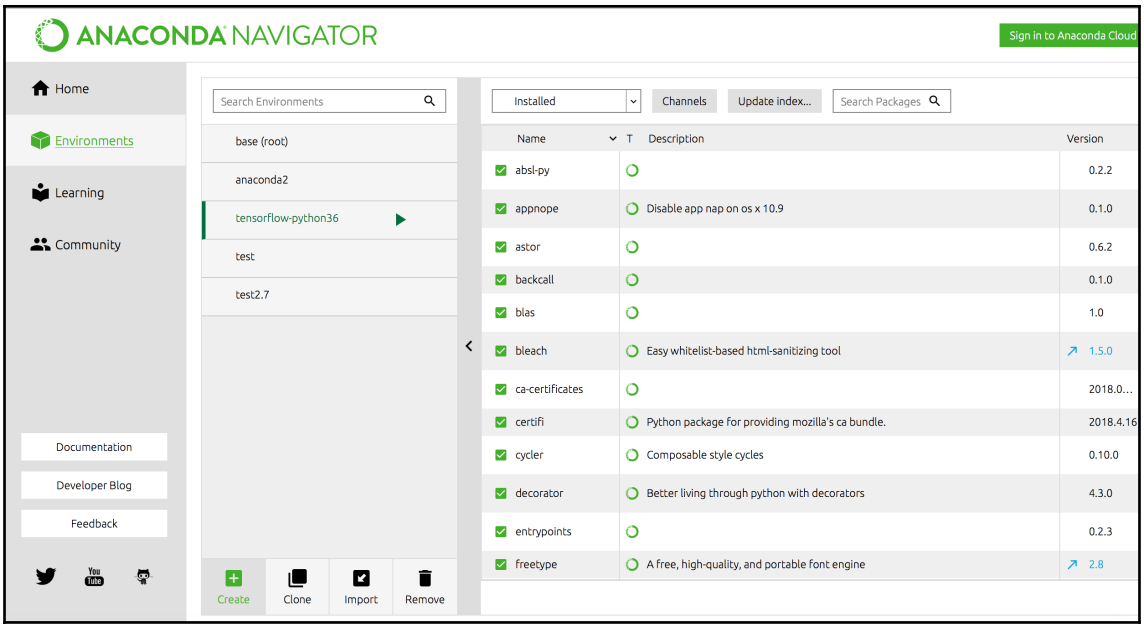

Event Driven Analytics
WebApplication
On Demand Events
Kafka
On Demand Events
Analytics configured to execute in stream and batch mode
Spark Analytics
Query Data
Edge
Continuous Events & Discrete Events
Kafka
Continuous Events & Discrete Events
Persist the results
Persistence Store


Offline Data
Analysis
Zeppelin / Jupyter
Online Data
Analysis
Enterprise Applications
Data
Data
Sync
Data
Data
Data
Warm Data
Cluster
Hot Data
Cluster


Realtime Model Training and Deployment
AutoDeploy the better Model
Predictions
ML Model
Load and execute the models
Monitor the performance of the model deployed in the prediction pipeline and retraining pipeline for a better one for metrics such as 3sigma, GOF
Real time - Events
Prediction ML Pipeline
Kafka
Persist the performance results (GOF, 3sIgma, RMSE)
Model Performance Store
Monitor the Performance of ML Model Predictions
Persist the new Model and Load the existing model for retraining
Retrain with New Data and Evaluate
ML Model
Model Storage (Current & New)
Load the models from the storage
Real time - Events
Retrain - ML Pipeline
Access the IIOT Data from datasources such as Database, Messaging, Filesystem
Timeseries
Asset
Alerts, Alarms
Datasources (Database, Messaging, FileStorage)


ML Autoring Tools
Applications
(Recommendations,
Insights)
Publish ML Analytics
(Microservice)
ML Code
Event Service
(Kafka)
ML Executor
IoT Data
Model
Continuous Learning
Realtime Data Stream
(Kafka)
Machine Learning as a Service


Analytic
Orchestration
Spark
Analytic(s)
Kafka Stream
Event Message
Consumer
Legacy
Analytic(s)
Query
Data
Docker Container
HDFS/S3


ANACONDA NAVIGATOR
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Home
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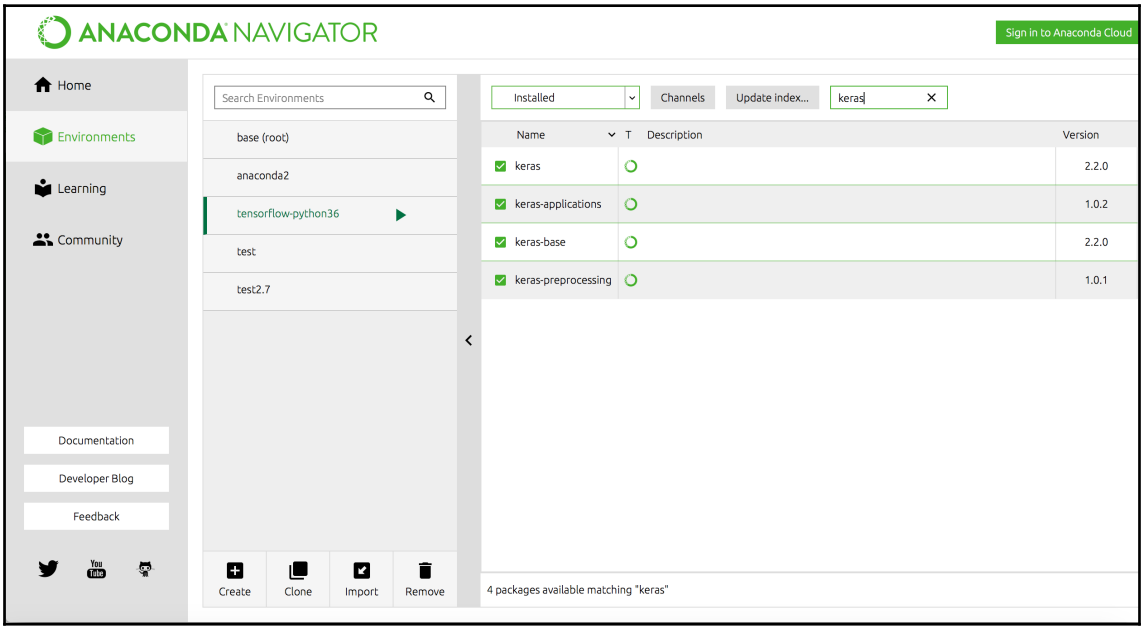
Community
Documentation
Developer Blog
Feedback
Search Environments
base (root)
anaconda2
tensorflow-python36
test
test2.7
Create
Clone
Import
Remove
Installed
Channels
Update index...
Search Packages
Name
T
Description
Version
absl-py 0.2.2
appnope Disable app nap on os x 10.9 0.1.0
astor 0.6.2
backcall 0.1.0
blas 1.0
bleach Easy whitelist-based html-sanitizing tool 1.5.0
ca-certificates 2018.0...
certifi Python package for providing mozilla's ca bundle. 2018.4.16
cycler Composable style cycles 0.10.0
decorator Better living through python with decorators 4.3.0
entrypoints 0.2.3
freetype A free, high-quality, and portable font engine 2.8


ANACONDA NAVIGATOR
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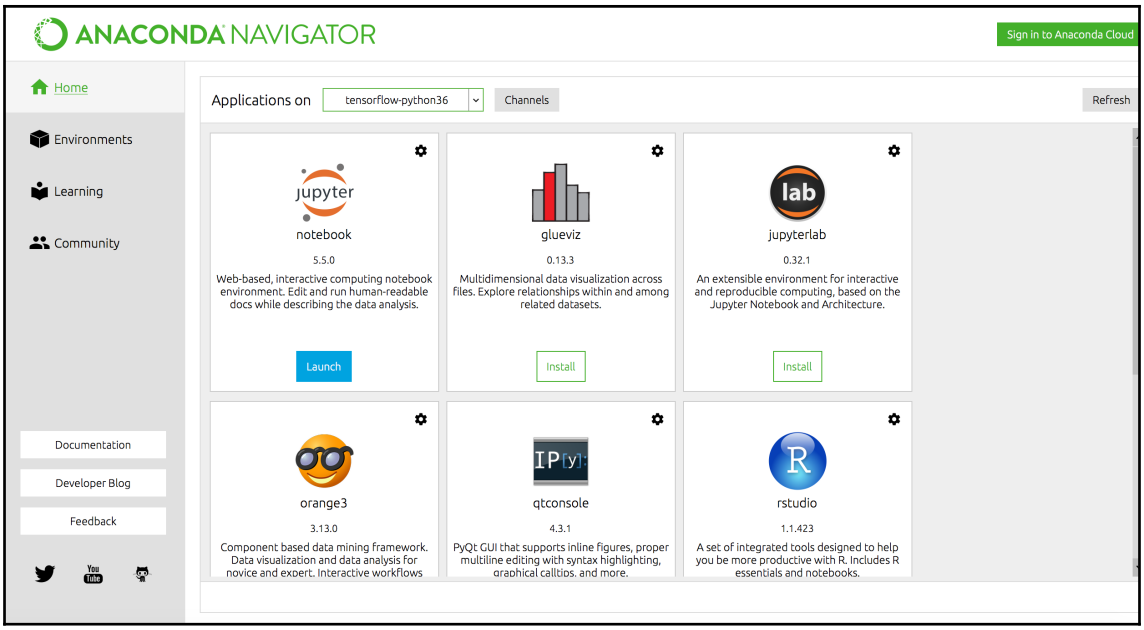
Search Environments
base (root)
anaconda2
tensorflow-python36
test
test2.7
Create
Clone
Import
Remove
Installed
Channels
Update index...
keras
Name
T
Description
Version
keras 2.2.0
keras-applications 1.0.2
keras-base 2.2.0
keras-preprocessing 1.0.1
4 packages available matching "keras"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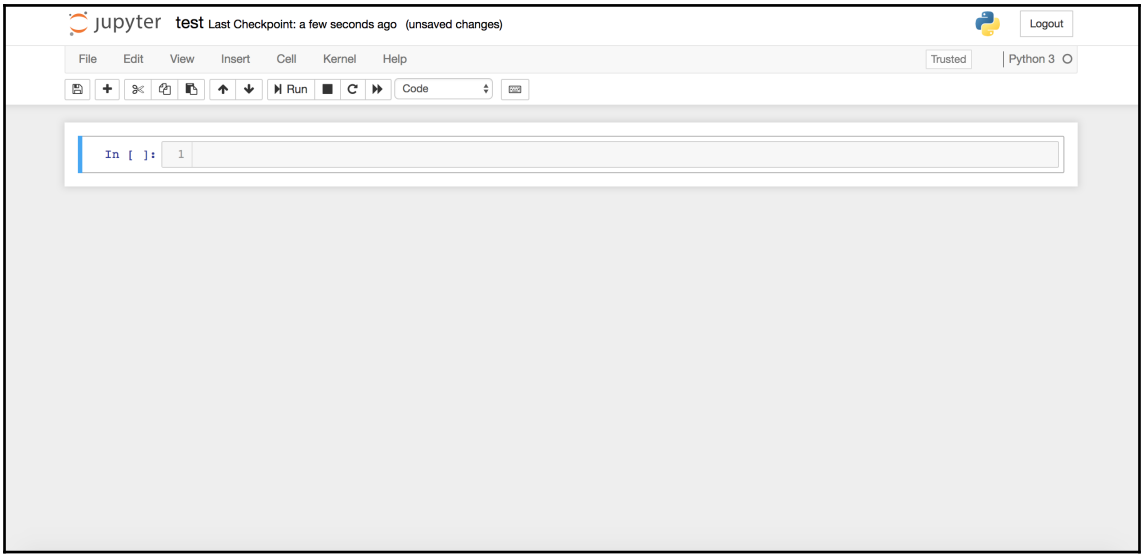
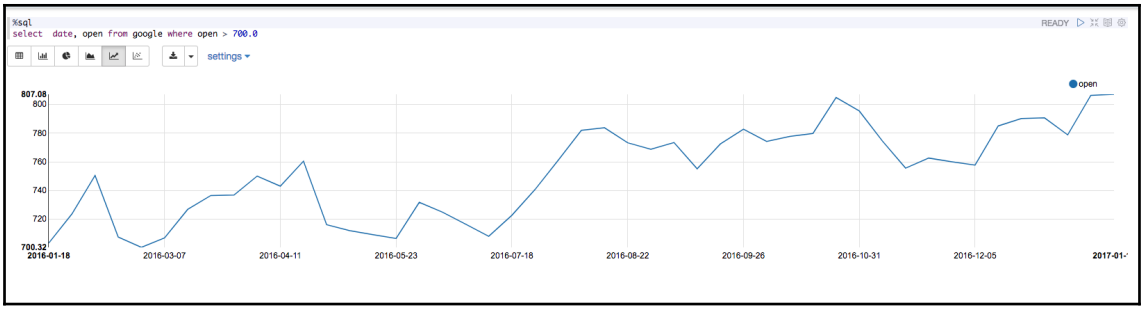
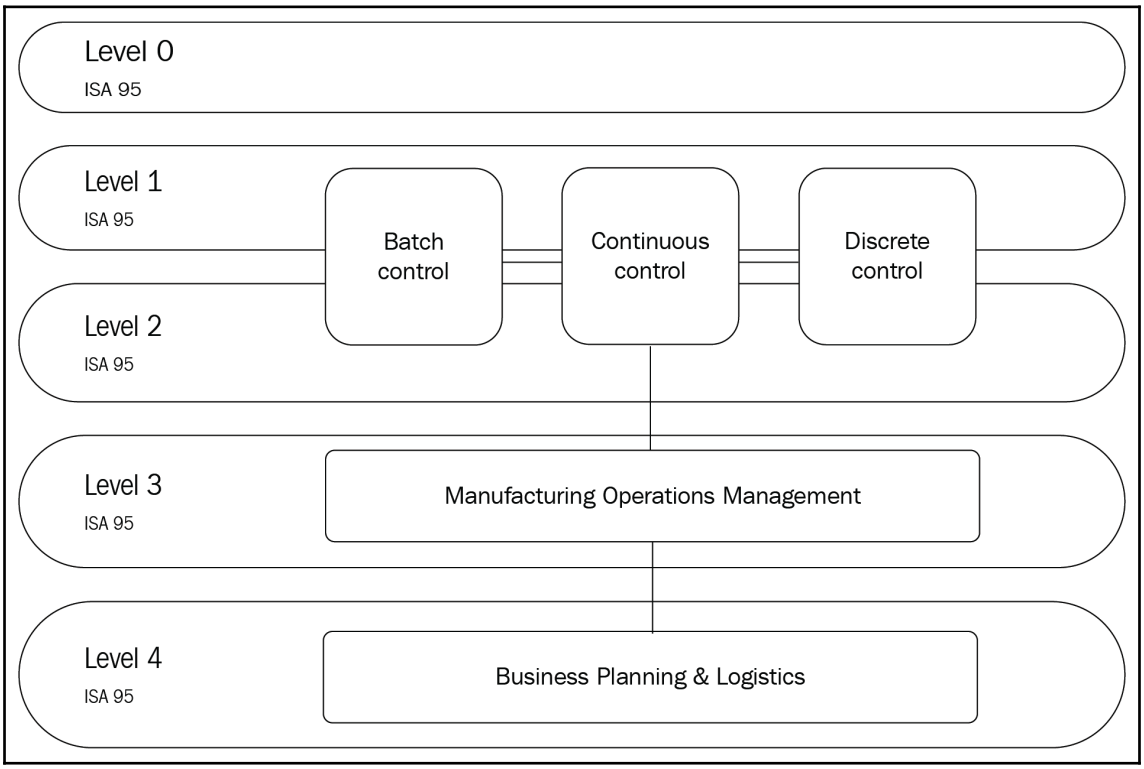
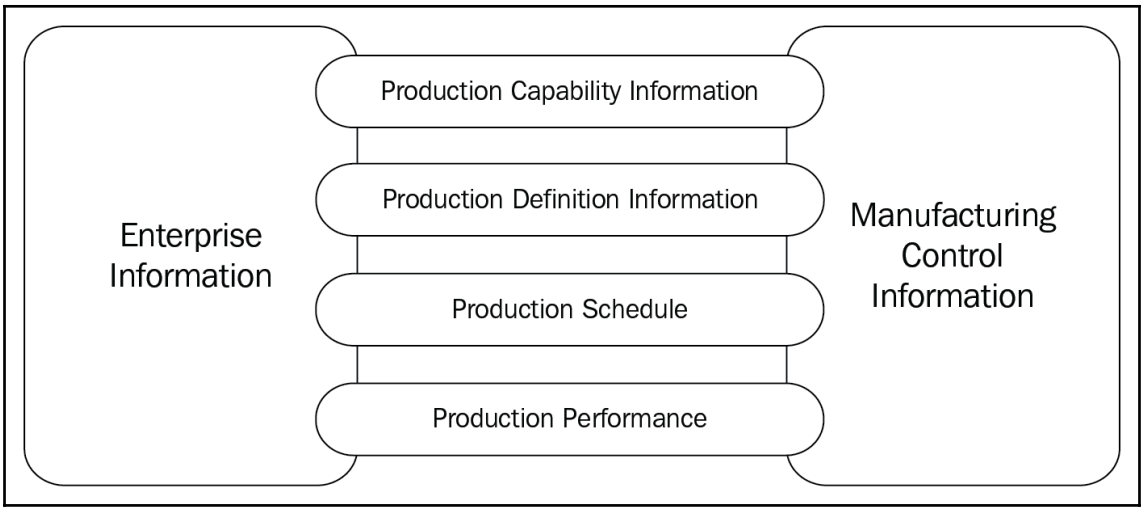
Feedback
Applications on
tensorflow-python36
Channels
Refresh
notebook
5.5.0
Web-based, interactive computing notebook environment. Edit and run human-readable docs while describing the data analysis.
Launch
glueviz
0.13.3
Multidimensional data visualization across files. Explore relationships within and among related datasets.
Install
jupyterlab
0.32.1
An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture.
Install
orange3
3.13.0
Component based data mining framework. Data visualization and data analysis for novice and expert. Interactive workflows
qtconsole
4.3.1
PyQt GUI that supports inline figures, proper multiline editing with syntax highlighting, graphical calltips, and more.
rstudio
1.1.423
A set of integrated tools designed to help you be more productive with R. Includes R essentials and notebooks.


jupyter
test
Last Checkpoint: a few seconds ago
(unsaved changes)
Logout
File
Edit
View
Insert
Cell
Kernel
Help
Trusted
Python 3
Run
Code
In [ ]:
1


%sql
select date, open from google where open > 700.0
READY
settings
open
807.08
800
780
760
740
720
700.32
2016-01-18
2016-03-07
2016-04-11
2016-05-23
2016-07-18
2016-08-22
2016-09-26
2016-10-31
2016-12-05
2017-01-

Chapter 6: Developing Your First Application for IIoT

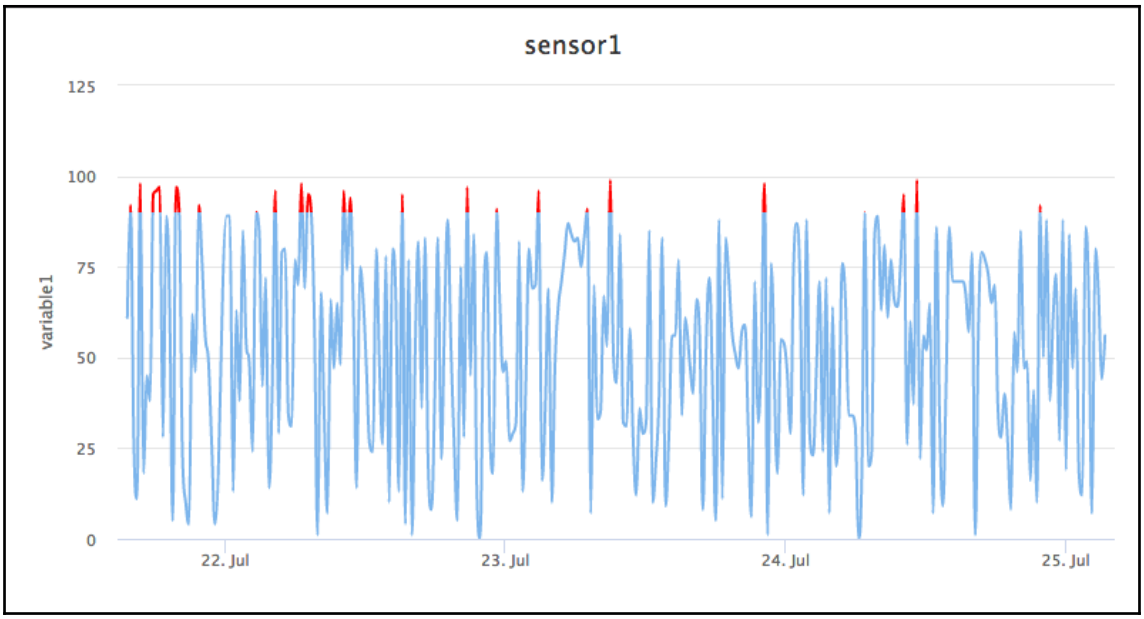


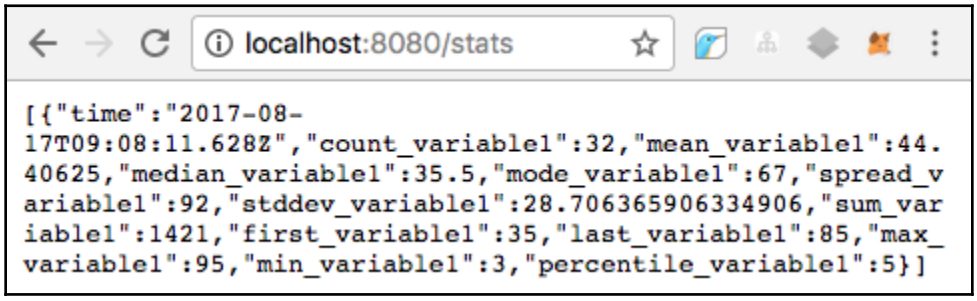


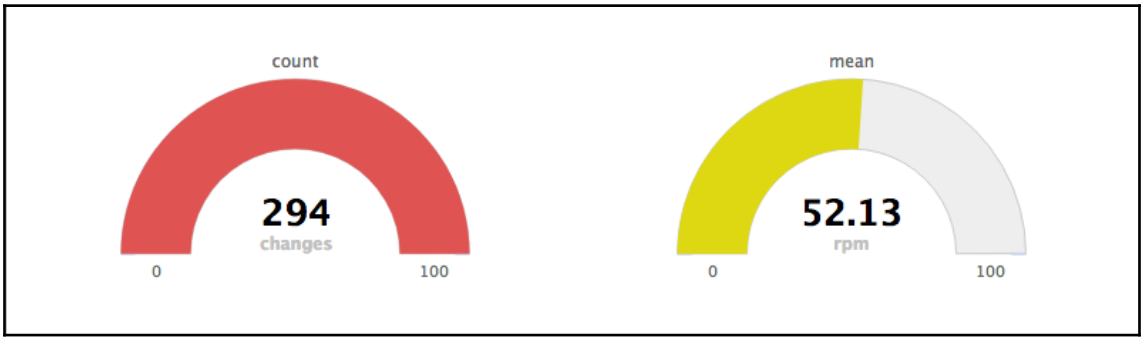

```
em:timeseries [redacted]$ docker run -p 8086:8086 -v $PWD:/var/lib/influxdb influxdb

 8888888           .d888 888                   8888888b.  888888b.
   888            d88P"  888                   888  "Y88b 888  "88b
   888            888    888                   888    888 888  .88P
   888   88888b.  888888 888 888  888 888  888 888    888 8888888K.
   888   888 "88b 888    888 888  888  Y8bd8P' 888    888 888  "Y88b
   888   888  888 888    888 888  888   X88K   888    888 888    888
   888   888  888 888    888 888 Y88b 888 .d8""8b. 888  .d88P 888   d88P
 8888888 888  888 888    888  "Y88888 888  888 8888888P"  8888888P"

[I] 2017-07-11T11:02:48Z InfluxDB starting, version 1.3.0, branch master, commit 76124df5c121e411e99807b9473a03eb785cd43b
[I] 2017-07-11T11:02:48Z Go version go1.8.3, GOMAXPROCS set to 4
[I] 2017-07-11T11:02:48Z Using configuration at: /etc/influxdb/influxdb.conf
[I] 2017-07-11T11:02:48Z Using data dir: /var/lib/influxdb/data service=store
[I] 2017-07-11T11:02:48Z reading file /var/lib/influxdb/wal/_internal/monitor/1/_00001.wal, size 5616229 engine=tsm1 service=cacheloader
[I] 2017-07-11T11:02:48Z /var/lib/influxdb/data/mydb/autogen/2/000000004-000000003.tsm (#0) opened in 1.694784ms engine=tsm1 service=filestore
[I] 2017-07-11T11:02:48Z /var/lib/influxdb/data/mydb/autogen/2/000000005-000000001.tsm (#1) opened in 9.925612ms engine=tsm1 service=filestore
[I] 2017-07-11T11:02:48Z reading file /var/lib/influxdb/wal/mydb/autogen/2/_00007.wal, size 0 engine=tsm1 service=cacheloader
[I] 2017-07-11T11:02:48Z /var/lib/influxdb/data/mydb/autogen/2 opened in 36.63897ms service=store
[I] 2017-07-11T11:02:49Z reading file /var/lib/influxdb/wal/_internal/monitor/1/_00002.wal, size 0 engine=tsm1 service=cacheloader
[I] 2017-07-11T11:02:49Z /var/lib/influxdb/data/_internal/monitor/1 opened in 375.409264ms service=store
[I] 2017-07-11T11:02:49Z opened service service=subscriber
[I] 2017-07-11T11:02:49Z Starting monitor system service=monitor
[I] 2017-07-11T11:02:49Z 'build' registered for diagnostics monitoring service=monitor
[I] 2017-07-11T11:02:49Z 'runtime' registered for diagnostics monitoring service=monitor
[I] 2017-07-11T11:02:49Z 'network' registered for diagnostics monitoring service=monitor
[I] 2017-07-11T11:02:49Z 'system' registered for diagnostics monitoring service=monitor
[I] 2017-07-11T11:02:49Z Starting precreation service with check interval of 10m0s, advance period of 30m0s service=shard-precreation
[I] 2017-07-11T11:02:49Z Starting snapshot service service=snapshot
[I] 2017-07-11T11:02:49Z Starting continuous query service service=continuous_querier
[I] 2017-07-11T11:02:49Z Starting HTTP service service=httpd
[I] 2017-07-11T11:02:49Z Authentication enabled:false service=httpd
[I] 2017-07-11T11:02:49Z Listening on HTTP:[::]:8086 service=httpd
[I] 2017-07-11T11:02:49Z Starting retention policy enforcement service with check interval of 30m0s service=retention
[I] 2017-07-11T11:02:49Z Listening for signals
[I] 2017-07-11T11:02:49Z Storing statistics in database '_internal' retention policy 'monitor', at interval 10s service=monitor
[I] 2017-07-11T11:02:49Z Sending usage statistics to usage.influxdata.com
```

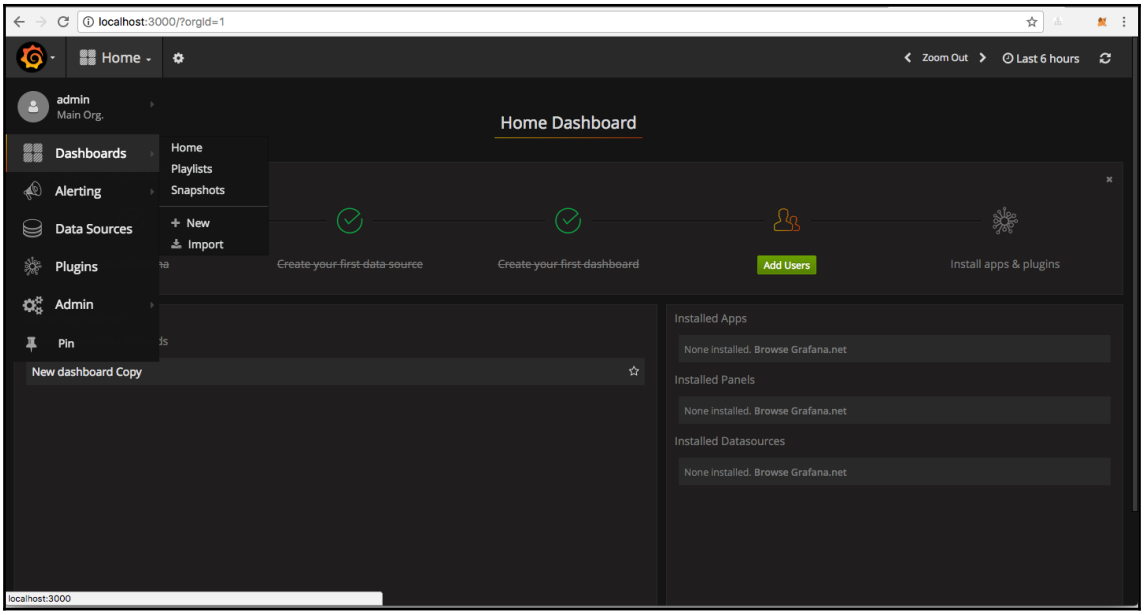
```
em:timeseries melnikaite$ curl -i -XPOST http://localhost:8086/query --data-urlencode "q=CREATE DATABASE mydb"
HTTP/1.1 200 OK
Connection: close
Content-Type: application/json
Request-Id: a3fb7a41-6628-11e7-8001-000000000000
X-Influxdb-Version: 1.3.0
Date: Tue, 11 Jul 2017 11:03:59 GMT
Transfer-Encoding: chunked

{"results":[{"statement_id":0}]}
```

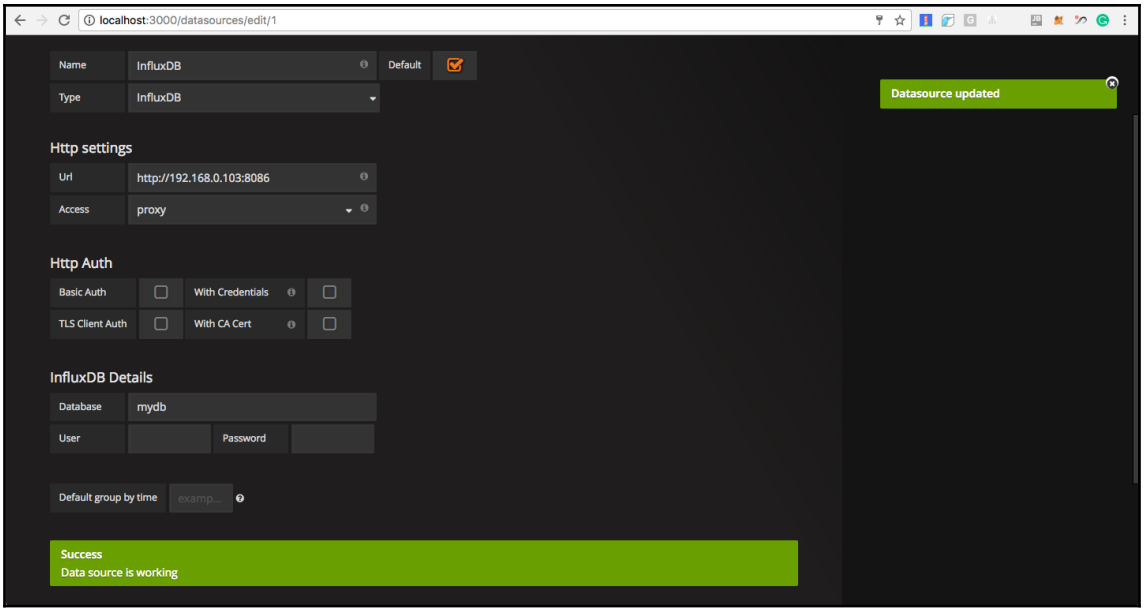
```
em:timeseries [redacted]$ npm start

> timeseries@1.0.0 start /Users/[redacted]/projects/iot-book/timeseries
> node index.js

26
82
62
9
18
17
91
95
24
{ attachments: [],
  alternative: null,
  header:
   { 'message-id': '<1499771164791.0.33523@em.local>',
     date: 'Tue, 11 Jul 2017 14:06:04 +0300',
     from: '[redacted].com',
     to: '[redacted].com',
     subject: '=?UTF-8?Q?Alert?=' },
  content: 'text/plain; charset=utf-8',
  text: 'variable1 exceeded 91 rpm' }
17
{ attachments: [],
  alternative: null,
  header:
   { 'message-id': '<1499771165813.1.33523@em.local>',
     date: 'Tue, 11 Jul 2017 14:06:05 +0300',
     from: '[redacted].com',
     to: '[redacted].com',
     subject: '=?UTF-8?Q?Alert?=' },
  content: 'text/plain; charset=utf-8',
  text: 'variable1 exceeded 95 rpm' }
8
55
17
75
63
69
33
62
13
```

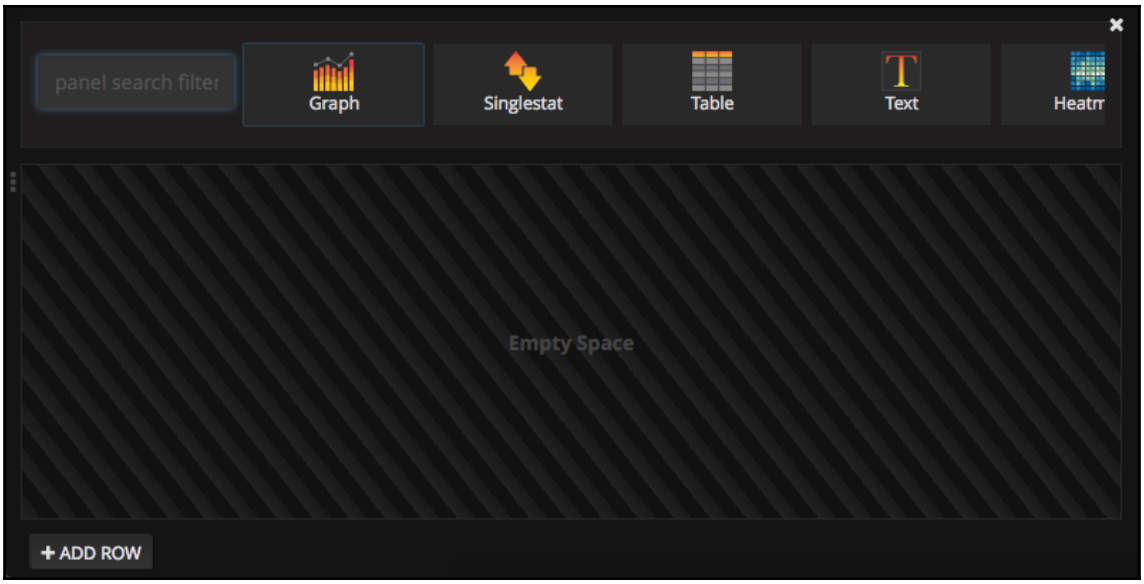

sensor1
125
100
75
50
25
0
variable1
22. Jul
23. Jul
24. Jul
25. Jul

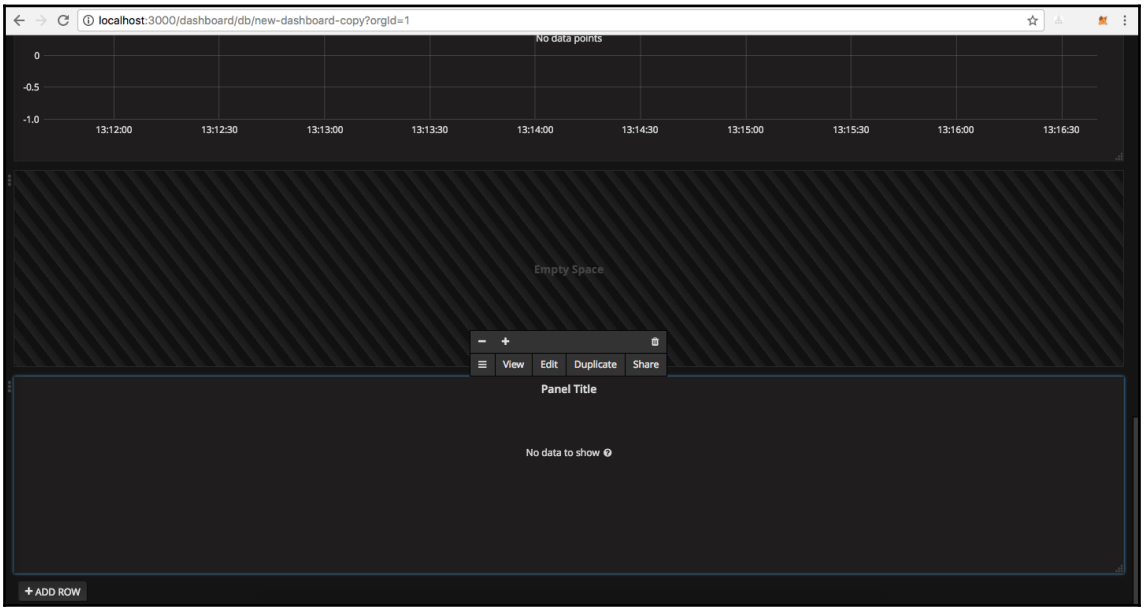

localhost:8080/stats
[{"time":"2017-08-17T09:08:11.628Z","count_variable1":32,"mean_variable1":44.40625,"median_variable1":35.5,"mode_variable1":67,"spread_variable1":92,"stddev_variable1":28.706365906334906,"sum_variable1":1421,"first_variable1":35,"last_variable1":85,"max_variable1":95,"min_variable1":3,"percentile_variable1":5}]

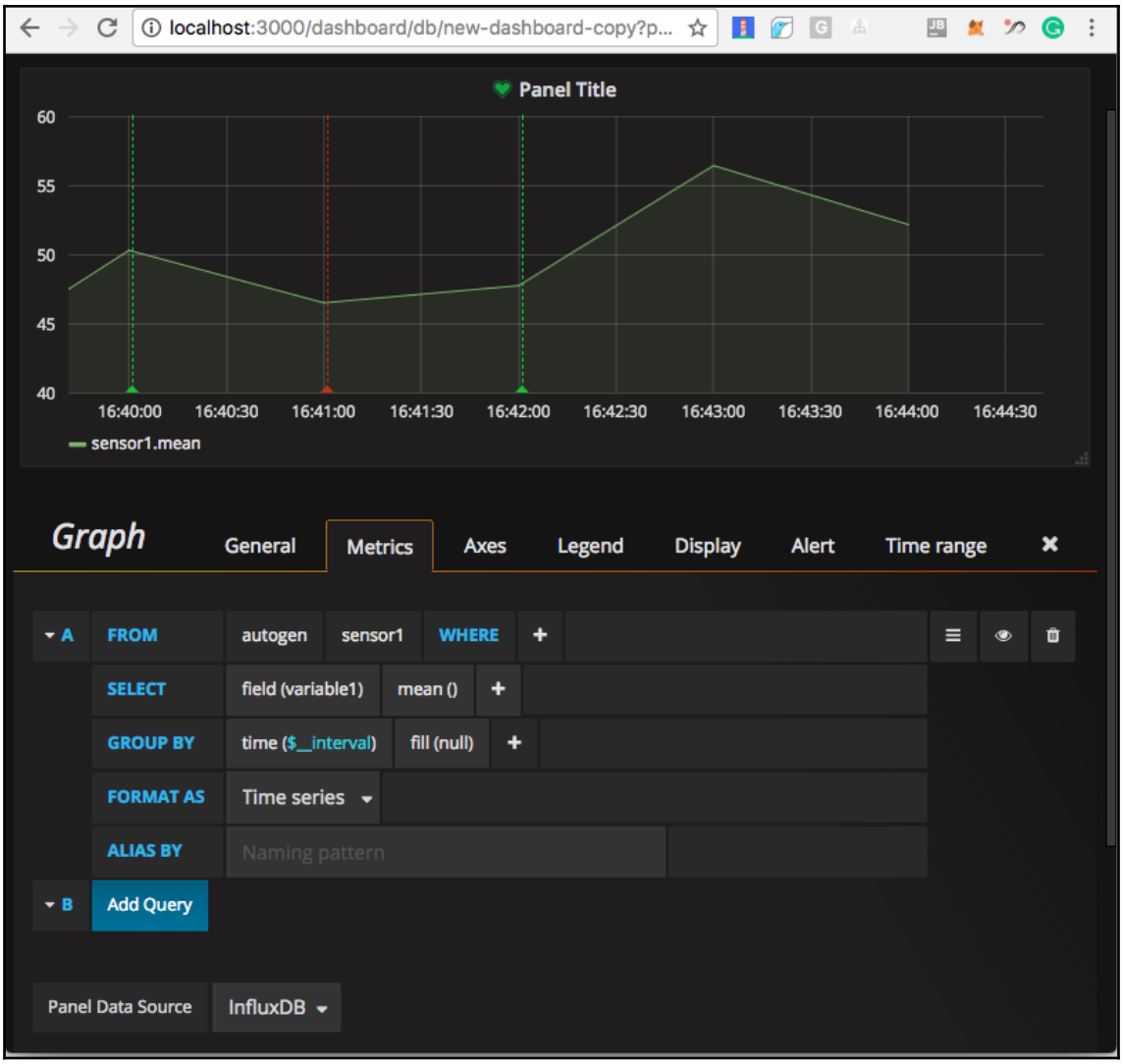

count
294
changes
0
100
mean
52.13
rpm
0
100

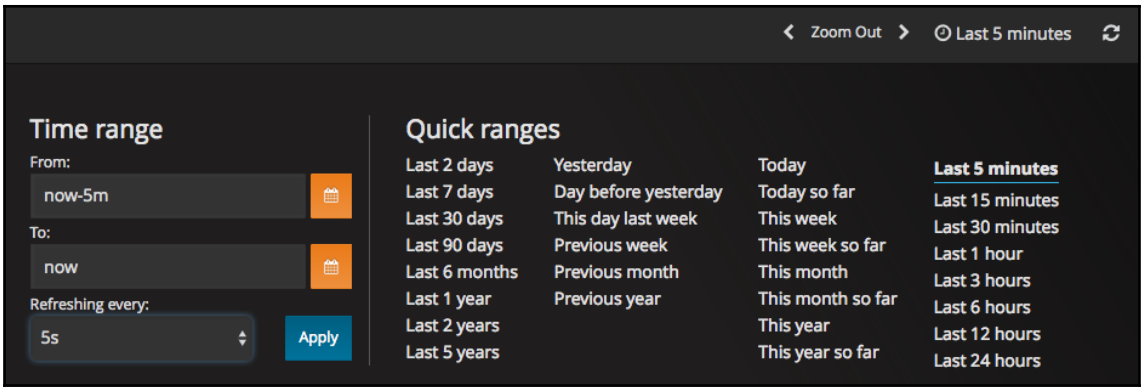

localhost:3000/?orgId=1
Home
Zoom Out
Last 6 hours
admin
Main Org.
Home Dashboard
Dashboards
Home
Playlists
Snapshots
Alerting
+ New
Import
Data Sources
Plugins
Admin
Pin
Create your first data source
Create your first dashboard
Add Users
Install apps & plugins
New dashboard Copy
Installed Apps
None installed. Browse Grafana.net
Installed Panels
None installed. Browse Grafana.net
Installed Datasources
None installed. Browse Grafana.net
localhost:3000

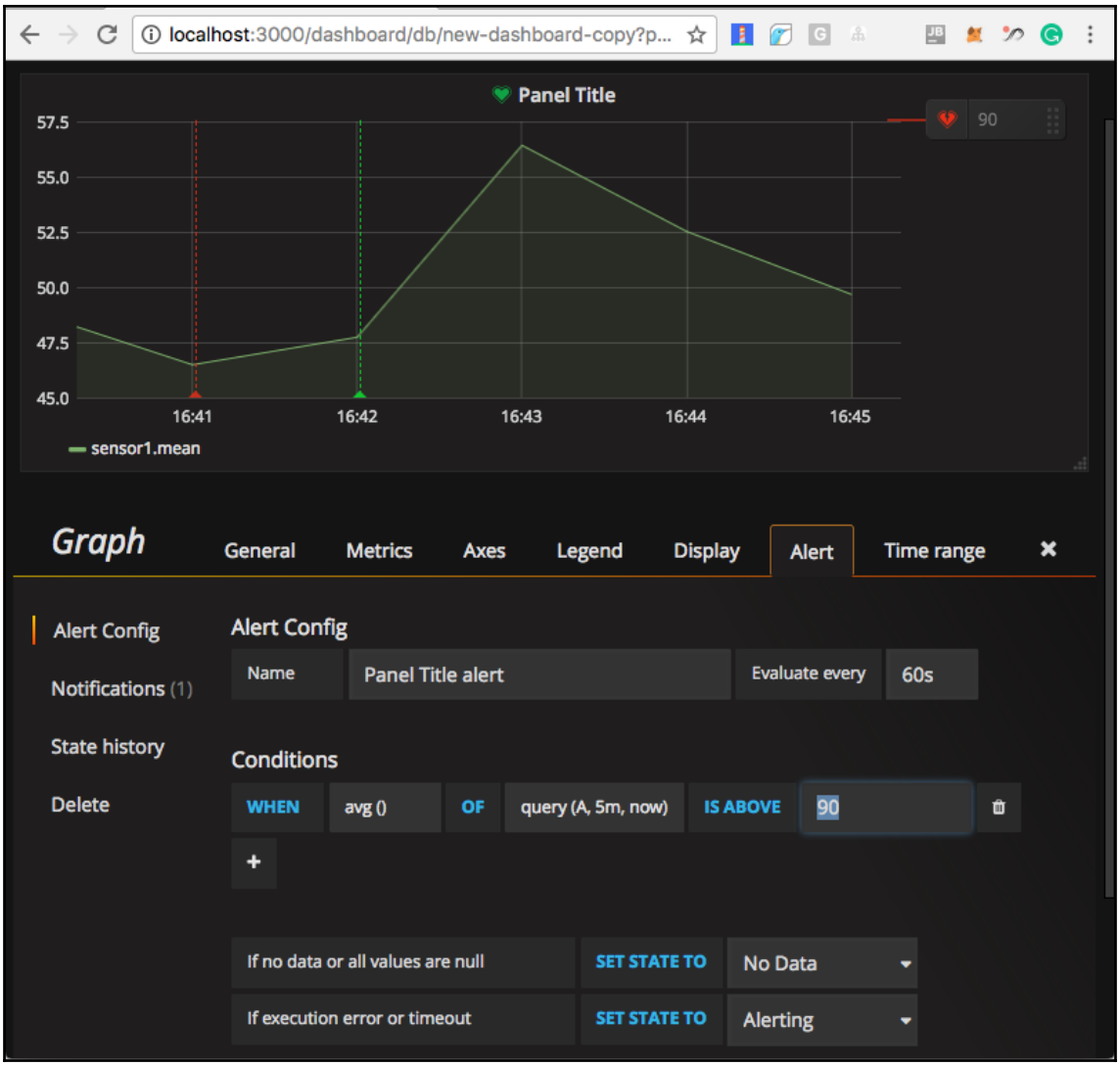

localhost:3000/datasources/edit/1
Name
InfluxDB
Default
Type
InfluxDB
Datasource updated
Http settings
Url
http://192.168.0.103:8086
Access
proxy
Http Auth
Basic Auth
With Credentials
TLS Client Auth
With CA Cert
InfluxDB Details
Database
mydb
User
Password
Default group by time
Success
Data source is working

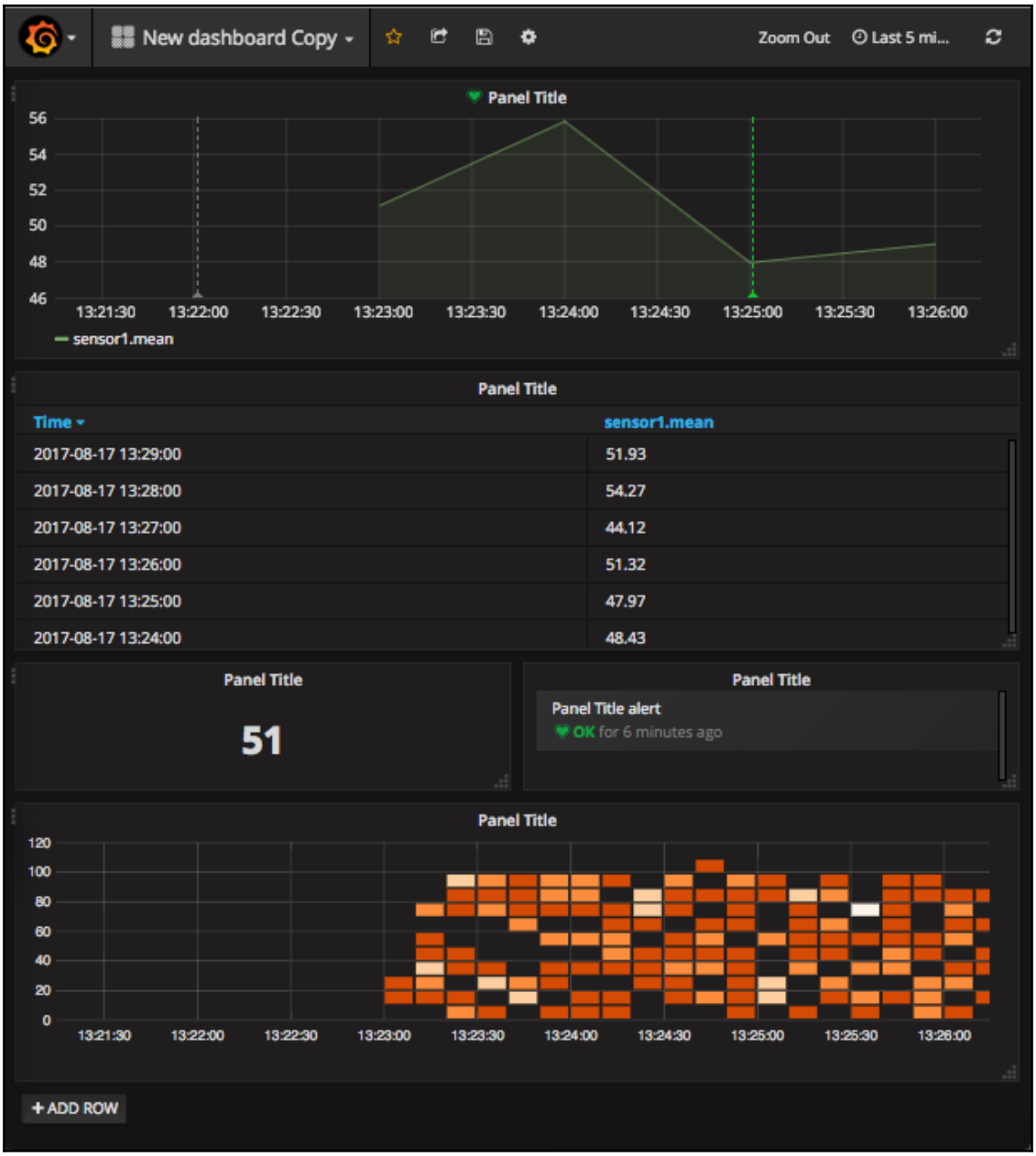

panel search filter
Graph
Singlestat
Table
Text
Heatm
Empty Space
+ ADD ROW

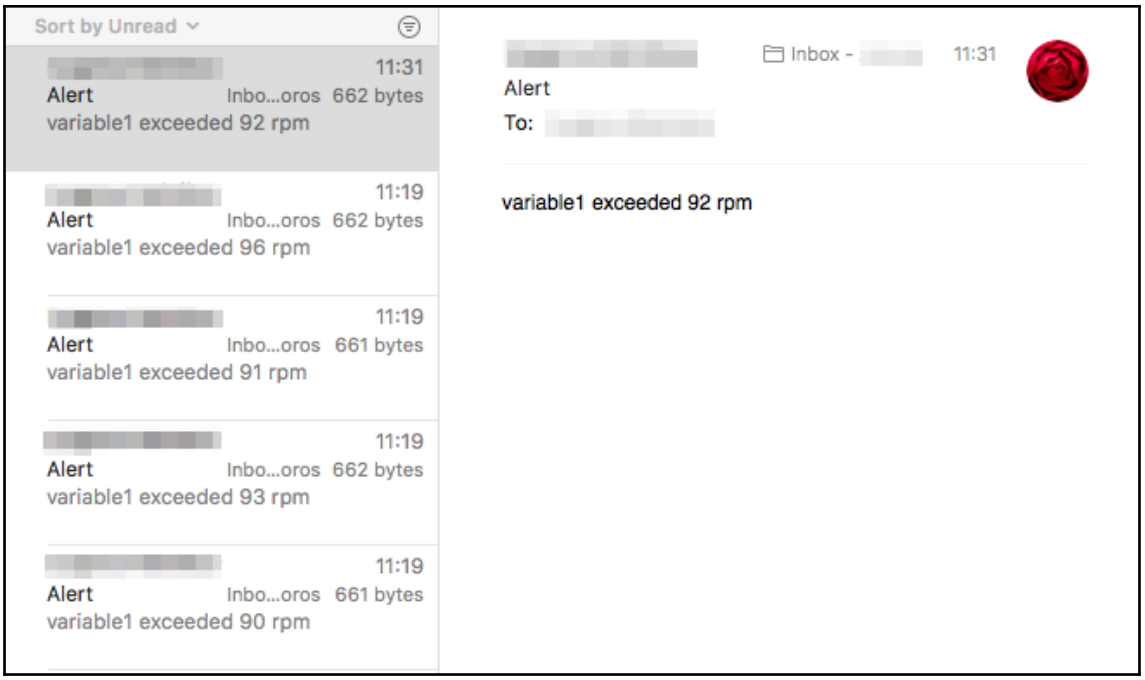

localhost:3000/dashboard/db/new-dashboard-copy?orgId=1
No data points
0
-0.5
-1.0
13:12:00
13:12:30
13:13:00
13:13:30
13:14:00
13:14:30
13:15:00
13:15:30
13:16:00
13:16:30
Empty Space
View
Edit
Duplicate
Share
Panel Title
No data to show
+ ADD ROW

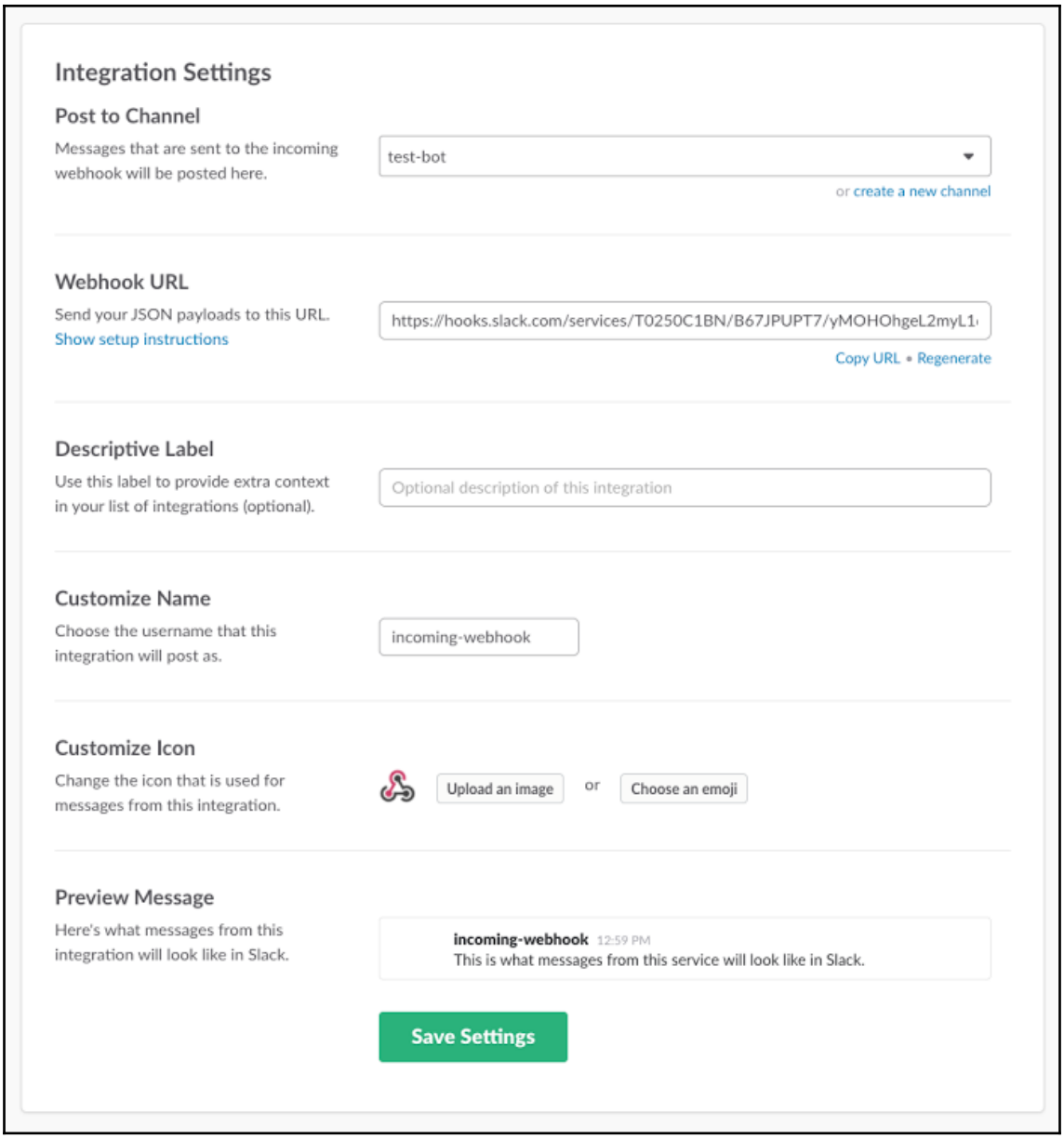

localhost:3000/dashboard/db/new-dashboard-copy?p...
Panel Title
60
55
50
45
40
16:40:00
16:40:30
16:41:00
16:41:30
16:42:00
16:42:30
16:43:00
16:43:30
16:44:00
16:44:30
sensor1.mean
Graph
General
Metrics
Axes
Legend
Display
Alert
Time range
A
FROM
autogen
sensor1
WHERE
SELECT
field (variable1)
mean ()
GROUP BY
time ($__interval)
fill (null)
FORMAT AS
Time series
ALIAS BY
Naming pattern
B
Add Query
Panel Data Source
InfluxDB

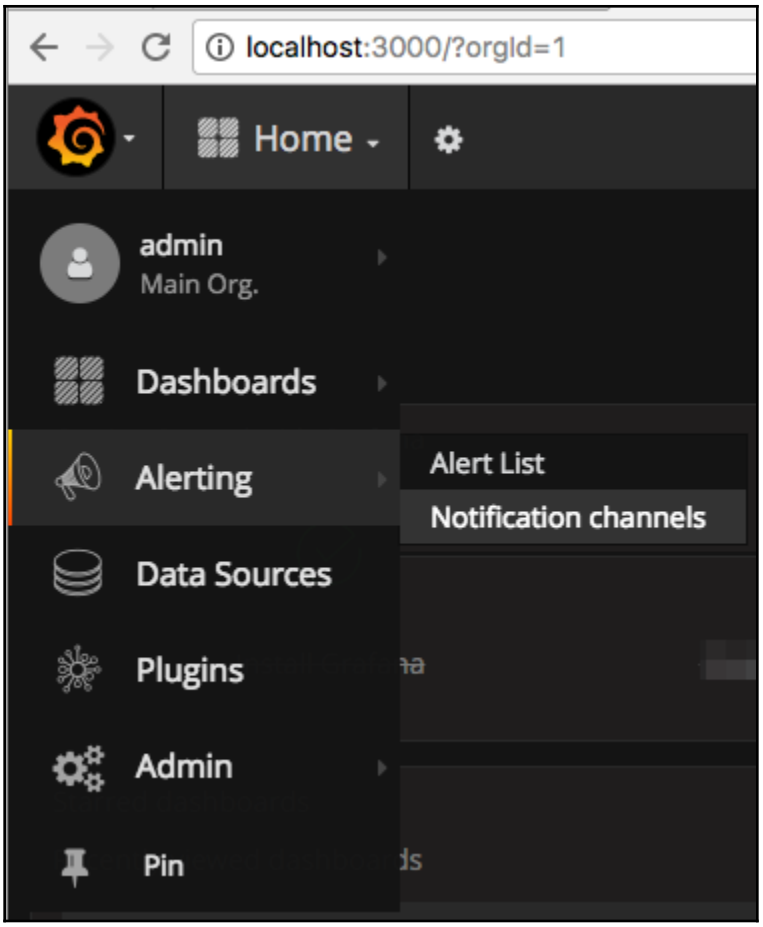

Zoom Out
Last 5 minutes
Time range
From:
now-5m
To:
now
Refreshing every:
5s
Apply
Quick ranges
Last 2 days
Last 7 days
Last 30 days
Last 90 days
Last 6 months
Last 1 year
Last 2 years
Last 5 years
Yesterday
Day before yesterday
This day last week
Previous week
Previous month
Previous year
Today
Today so far
This week
This week so far
This month
This month so far
This year
This year so far
Last 5 minutes
Last 15 minutes
Last 30 minutes
Last 1 hour
Last 3 hours
Last 6 hours
Last 12 hours
Last 24 hours

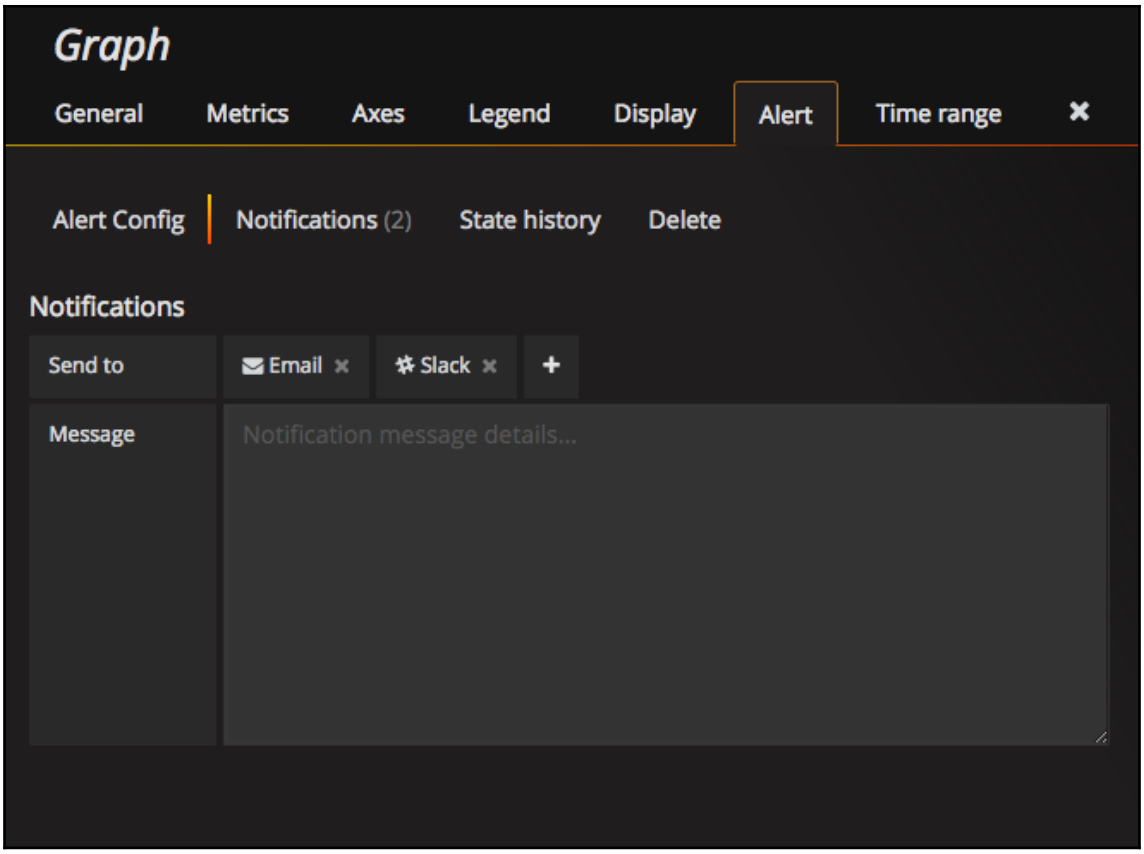

localhost:3000/dashboard/db/new-dashboard-copy?p...
Panel Title
90
57.5
55.0
52.5
50.0
47.5
45.0
16:41
16:42
16:43
16:44
16:45
sensor1.mean
Graph
General
Metrics
Axes
Legend
Display
Alert
Time range
Alert Config
Notifications (1)
State history
Delete
Alert Config
Name
Panel Title alert
Evaluate every
60s
Conditions
WHEN
avg ()
OF
query (A, 5m, now)
IS ABOVE
90
+
If no data or all values are null
SET STATE TO
No Data
If execution error or timeout
SET STATE TO
Alerting


New dashboard Copy
Zoom Out
Last 5 mi...
Panel Title
56
54
52
50
48
46
13:21:30
13:22:00
13:22:30
13:23:00
13:23:30
13:24:00
13:24:30
13:25:00
13:25:30
13:26:00
sensor1.mean
Panel Title
Time
sensor1.mean
2017-08-17 13:29:00
51.93
2017-08-17 13:28:00
54.27
2017-08-17 13:27:00
44.12
2017-08-17 13:26:00
51.32
2017-08-17 13:25:00
47.97
2017-08-17 13:24:00
48.43
Panel Title
51
Panel Title
Panel Title alert
OK for 6 minutes ago
Panel Title
120
100
80
60
40
20
0
13:21:30
13:22:00
13:22:30
13:23:00
13:23:30
13:24:00
13:24:30
13:25:00
13:25:30
13:26:00
+ ADD ROW


Sort by Unread
11:31
Alert
Inbo...oros 662 bytes
variable1 exceeded 92 rpm
11:19
Alert
Inbo...oros 662 bytes
variable1 exceeded 96 rpm
11:19
Alert
Inbo...oros 661 bytes
variable1 exceeded 91 rpm
11:19
Alert
Inbo...oros 662 bytes
variable1 exceeded 93 rpm
11:19
Alert
Inbo...oros 661 bytes
variable1 exceeded 90 rpm
Inbox -
11:31
Alert
To:
variable1 exceeded 92 rpm


Integration Settings
Post to Channel
Messages that are sent to the incoming webhook will be posted here.
test-bot
or create a new channel
Webhook URL
Send your JSON payloads to this URL.
Show setup instructions
https://hooks.slack.com/services/T0250C1BN/B67JPUPT7/yMOHOhgeL2myL1
Copy URL • Regenerate
Descriptive Label
Use this label to provide extra context in your list of integrations (optional).
Optional description of this integration
Customize Name
Choose the username that this integration will post as.
incoming-webhook
Customize Icon
Change the icon that is used for messages from this integration.
Upload an image
or
Choose an emoji
Preview Message
Here's what messages from this integration will look like in Slack.
incoming-webhook 12:59 PM
This is what messages from this service will look like in Slack.
Save Settings


localhost:3000/?orgId=1
Home
admin
Main Org.
Dashboards
Alerting
Alert List
Notification channels
Data Sources
Plugins
Admin
Pin


Graph
General
Metrics
Axes
Legend
Display
Alert
Time range
Alert Config
Notifications (2)
State history
Delete
Notifications
Send to
Email
Slack
Message
Notification message details...

test-bot

1 | Add a topic

Search

Today

variable1 exceeded 92 rpm

incoming-webhook APP 11:49 AM

variable exceeded 93 rpm

incoming-webhook APP 12:18 PM

[Alerting] Test notification

Someone is testing the alert notification within grafana.

High value

100

Higher Value

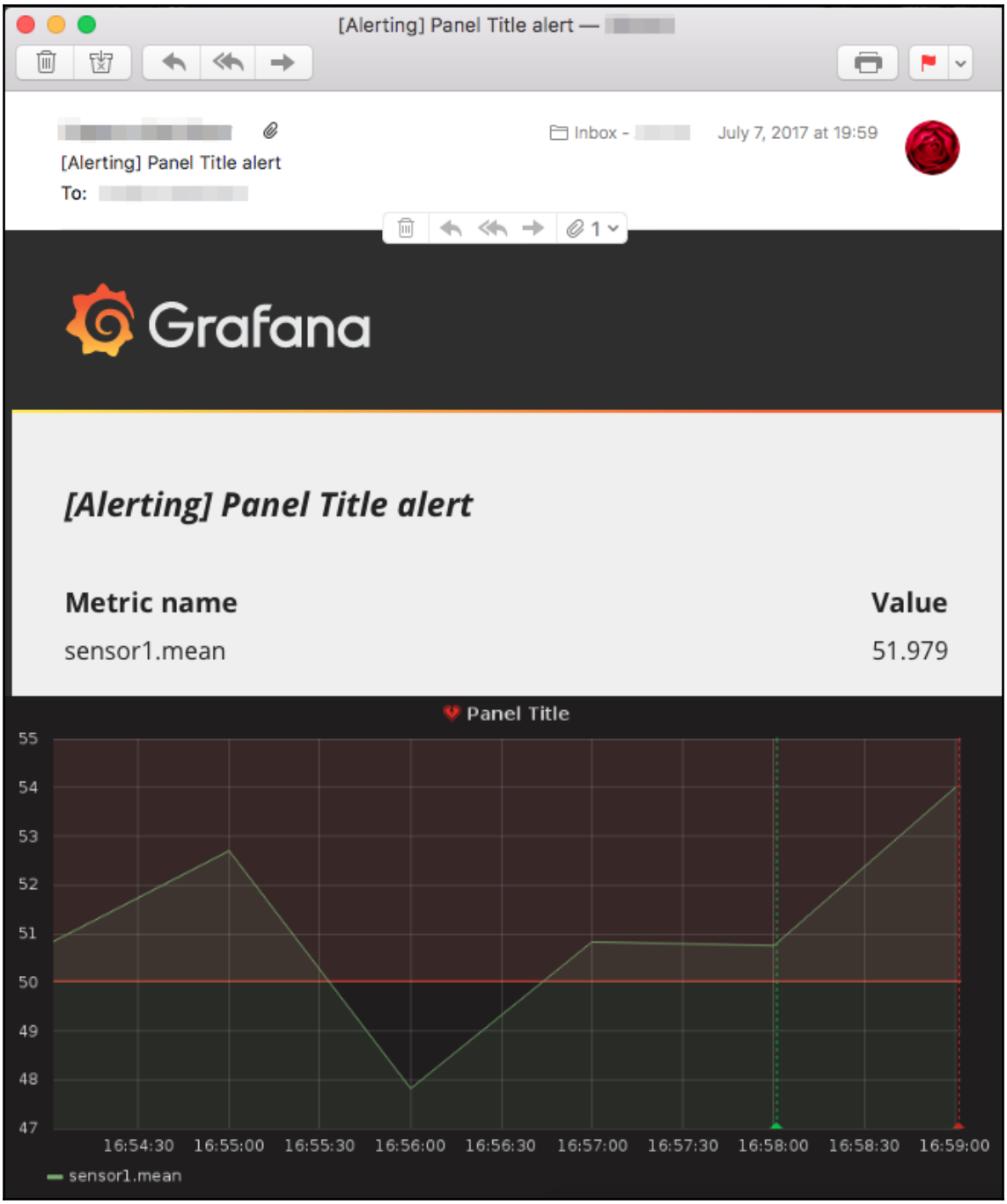
200

Error message

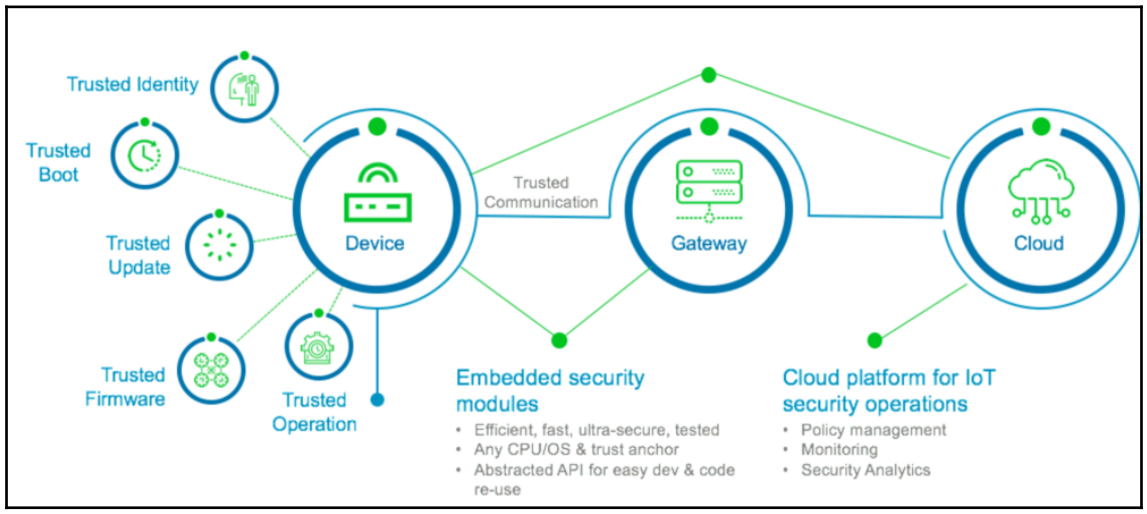
This is only a test

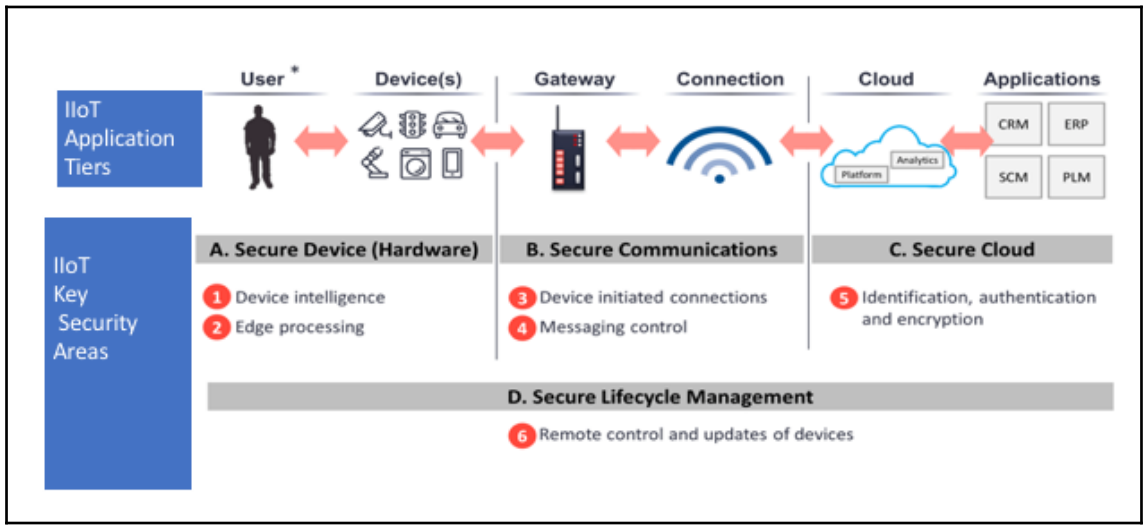
Grafana v4.4.1 | Today at 12:18 PM (30kB)

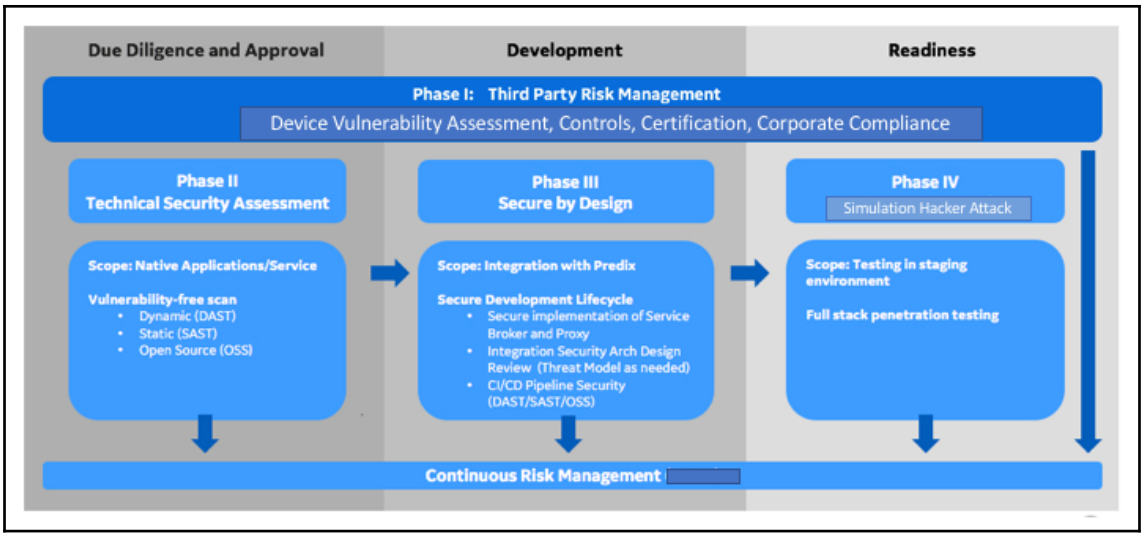
Message test-bot

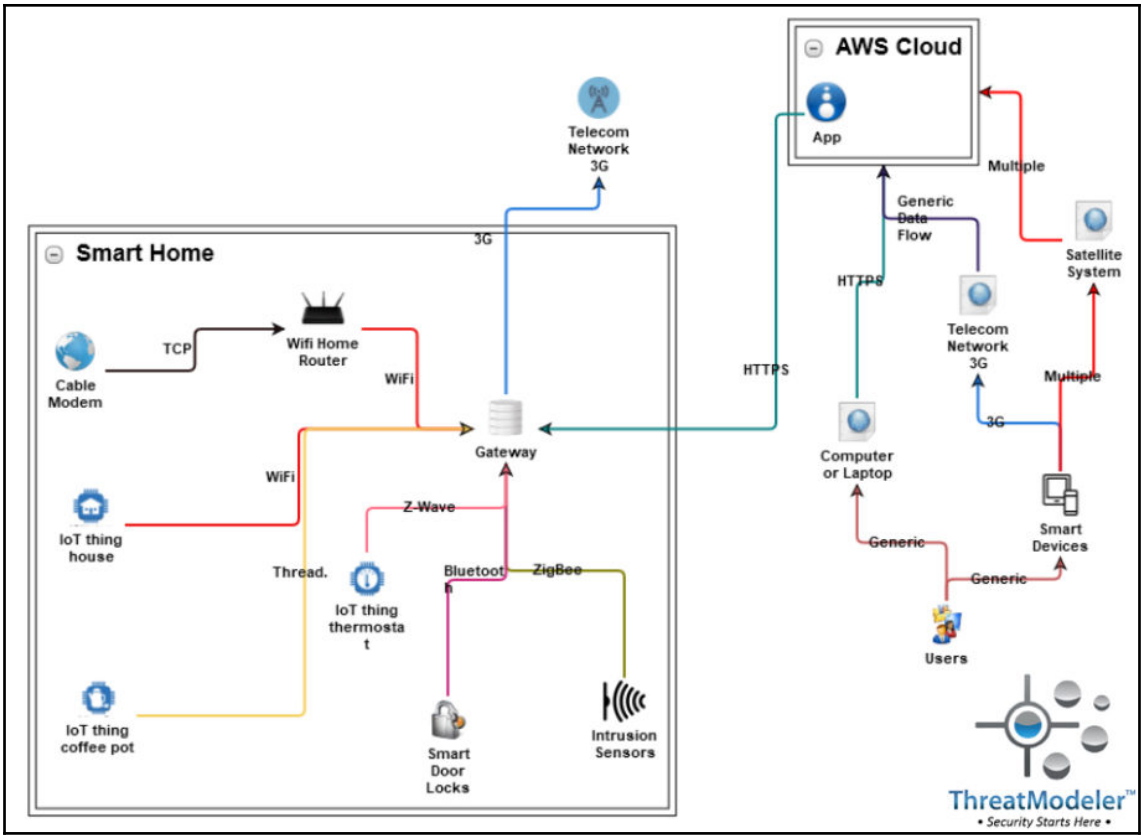

[Alerting] Panel Title alert —
Inbox -
July 7, 2017 at 19:59
[Alerting] Panel Title alert
To:
Grafana
[Alerting] Panel Title alert
Metric name
Value
sensor1.mean
51.979
Panel Title
55
54
53
52
51
50
49
48
47
16:54:30
16:55:00
16:55:30
16:56:00
16:56:30
16:57:00
16:57:30
16:58:00
16:58:30
16:59:00
sensor1.mean

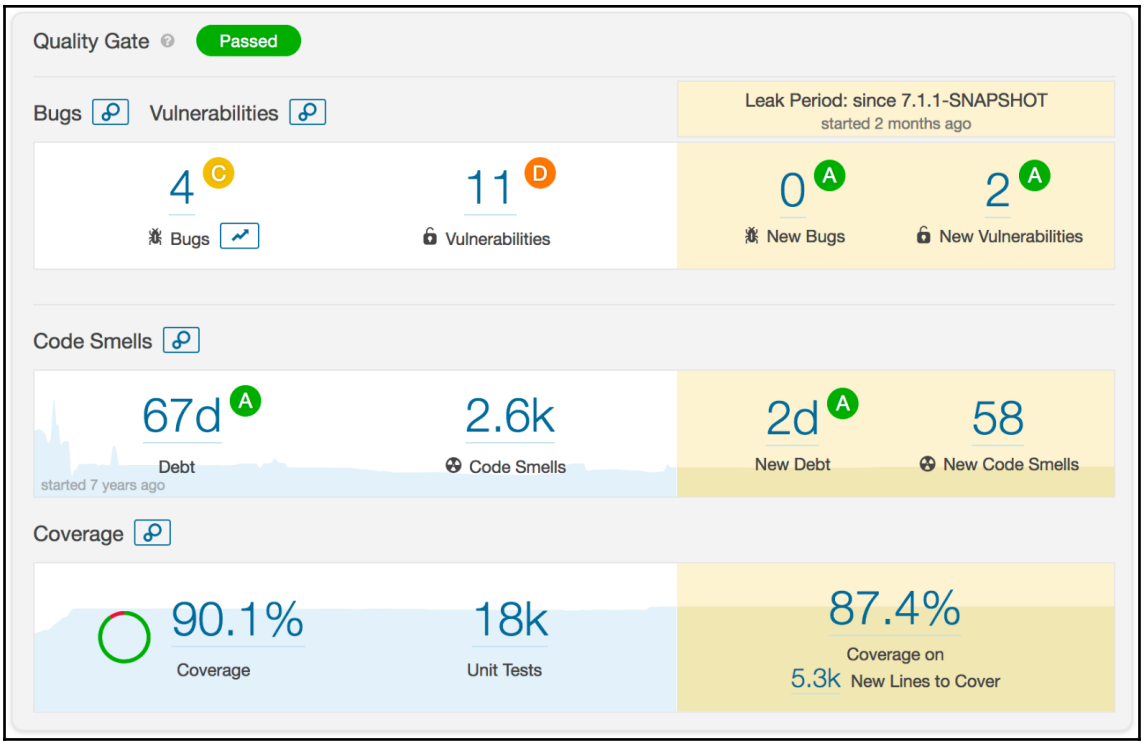
Chapter 7: Deployment, Scale, and Security






Due Diligence and Approval
Development
Readiness
Phase I: Third Party Risk Management
Device Vulnerability Assessment, Controls, Certification, Corporate Compliance
Phase II
Technical Security Assessment
Phase III
Secure by Design
Phase IV
Simulation Hacker Attack
Scope: Native Applications/Service
Vulnerability-free scan
Dynamic (DAST)
Static (SAST)
Open Source (OSS)
Scope: Integration with Predix
Secure Development Lifecycle
Secure implementation of Service Broker and Proxy
Integration Security Arch Design Review (Threat Model as needed)
CI/CD Pipeline Security (DAST/SAST/OSS)
Scope: Testing in staging environment
Full stack penetration testing
Continuous Risk Management


AWS Cloud
App
Telecom Network 3G
Multiple
Generic Data Flow
Satellite System
HTTPS
Telecom Network 3G
3G
Multiple
Smart Home
3G
HTTPS
Computer or Laptop
TCP
Wifi Home Router
WiFi
Cable Modem
Gateway
WiFi
Z-Wave
Smart Devices
IoT thing house
Thread.
Bluetooth
ZigBee
Generic
Generic
IoT thing thermostat
Users
IoT thing coffee pot
Smart Door Locks
Intrusion Sensors
ThreatModeler™
• Security Starts Here •

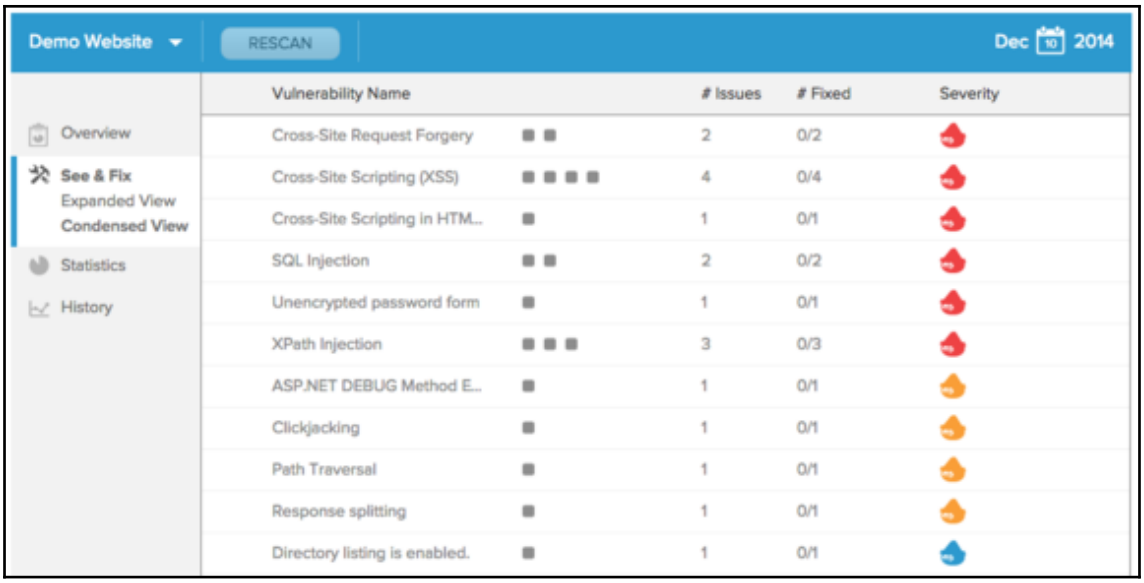


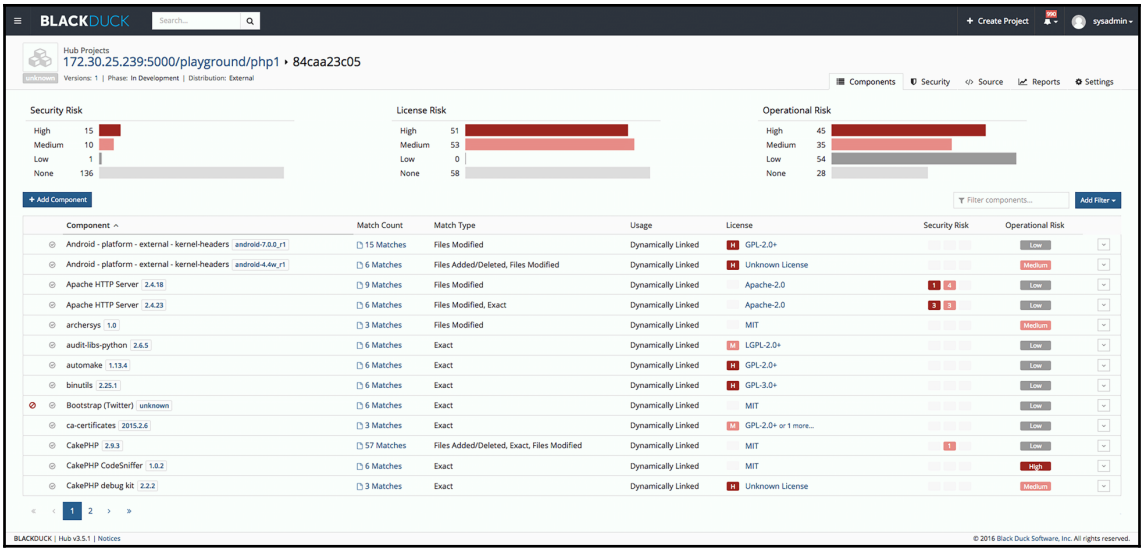

```
// dumpObj:
dumpObj: function( spec ) {
  var val = "<undefined>";
  try {
    val = eval( "this."+spec ).toString();
```

Review the arguments of this "eval" call to make sure they are validated. 7 months ago L989

Vulnerability Critical Open Not assigned 30min effort Comment cwe, owasp-a3

```
  } catch( exception ) {
  }
  this.dump( spec + "=" + val + "\n" );
},
```


Demo Website
RESCAN
Dec 10 2014
Overview
See & Fix
Expanded View
Condensed View
Statistics
History
Vulnerability Name
Issues
Fixed
Severity
Cross-Site Request Forgery 2 0/2
Cross-Site Scripting (XSS) 4 0/4
Cross-Site Scripting in HTM... 1 0/1
SQL Injection 2 0/2
Unencrypted password form 1 0/1
XPath Injection 3 0/3
ASP.NET DEBUG Method E... 1 0/1
Clickjacking 1 0/1
Path Traversal 1 0/1
Response splitting 1 0/1
Directory listing is enabled. 1 0/1


BLACKDUCK
Create Project
sysadmin
Hub Projects
172.30.25.239:5000/playground/php1 ▸ 84caa23c05
Components
Security
Source
Reports
Settings
Security Risk
High 15
Medium 10
Low 1
None 136
License Risk
High 51
Medium 53
Low 0
None 58
Operational Risk
High 45
Medium 35
Low 54
None 28
+ Add Component
Add Filter
Component
Match Count
Match Type
Usage
License
Security Risk
Operational Risk
Android - platform - external - kernel-headers android-7.0.0_r1 15 Matches Files Modified Dynamically Linked GPL-2.0+ Low
Android - platform - external - kernel-headers android-4.4w_r1 6 Matches Files Added/Deleted, Files Modified Dynamically Linked Unknown License Medium
Apache HTTP Server 2.4.18 9 Matches Files Modified Dynamically Linked Apache-2.0 Low
Apache HTTP Server 2.4.23 6 Matches Files Modified, Exact Dynamically Linked Apache-2.0 Low
archersys 1.0 3 Matches Files Modified Dynamically Linked MIT Medium
audit-libs-python 2.6.5 6 Matches Exact Dynamically Linked LGPL-2.0+ Low
automake 1.13.4 6 Matches Exact Dynamically Linked GPL-2.0+ Low
binutils 2.25.1 6 Matches Exact Dynamically Linked GPL-3.0+ Low
Bootstrap (Twitter) unknown 6 Matches Exact Dynamically Linked MIT Low
ca-certificates 2015.2.6 3 Matches Exact Dynamically Linked GPL-2.0+ or 1 more... Low
CakePHP 2.9.3 57 Matches Files Added/Deleted, Exact, Files Modified Dynamically Linked MIT Low
CakePHP CodeSniffer 1.0.2 6 Matches Exact Dynamically Linked MIT High
CakePHP debug kit 2.2.2 3 Matches Exact Dynamically Linked Unknown License Medium
BLACKDUCK | Hub v3.5.1 | Notices
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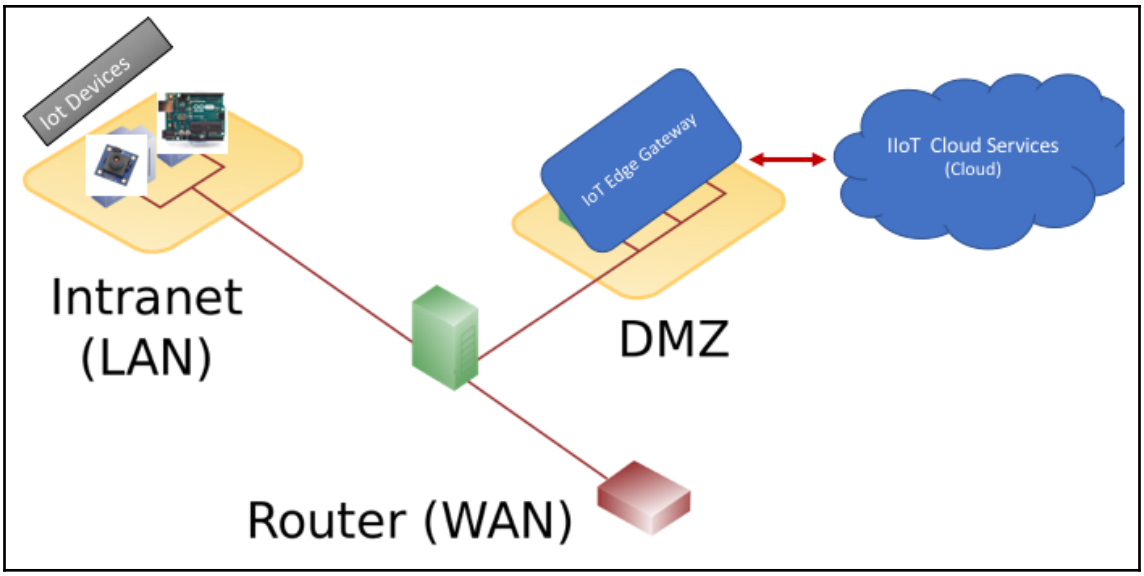
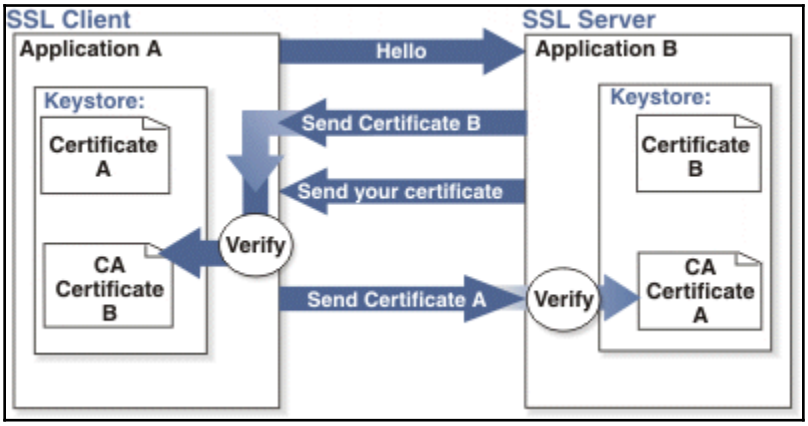
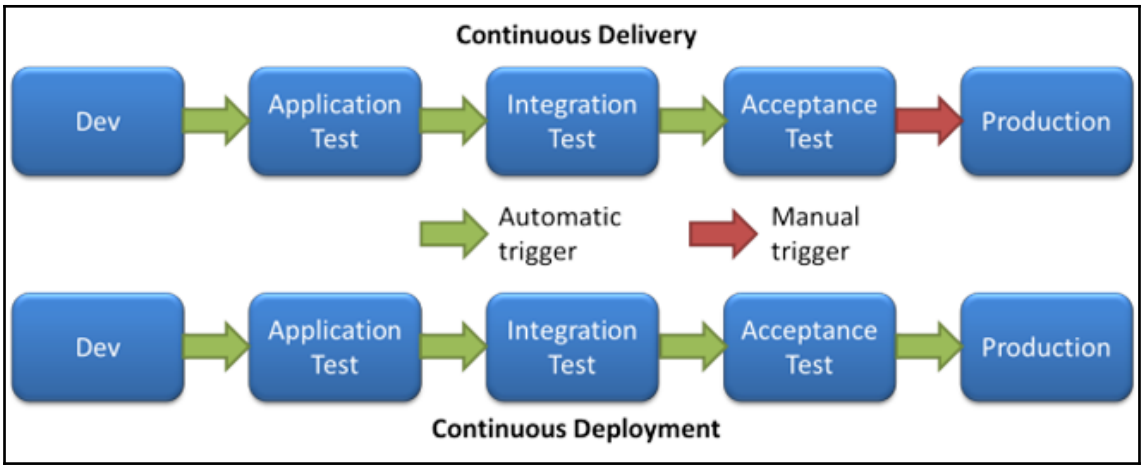
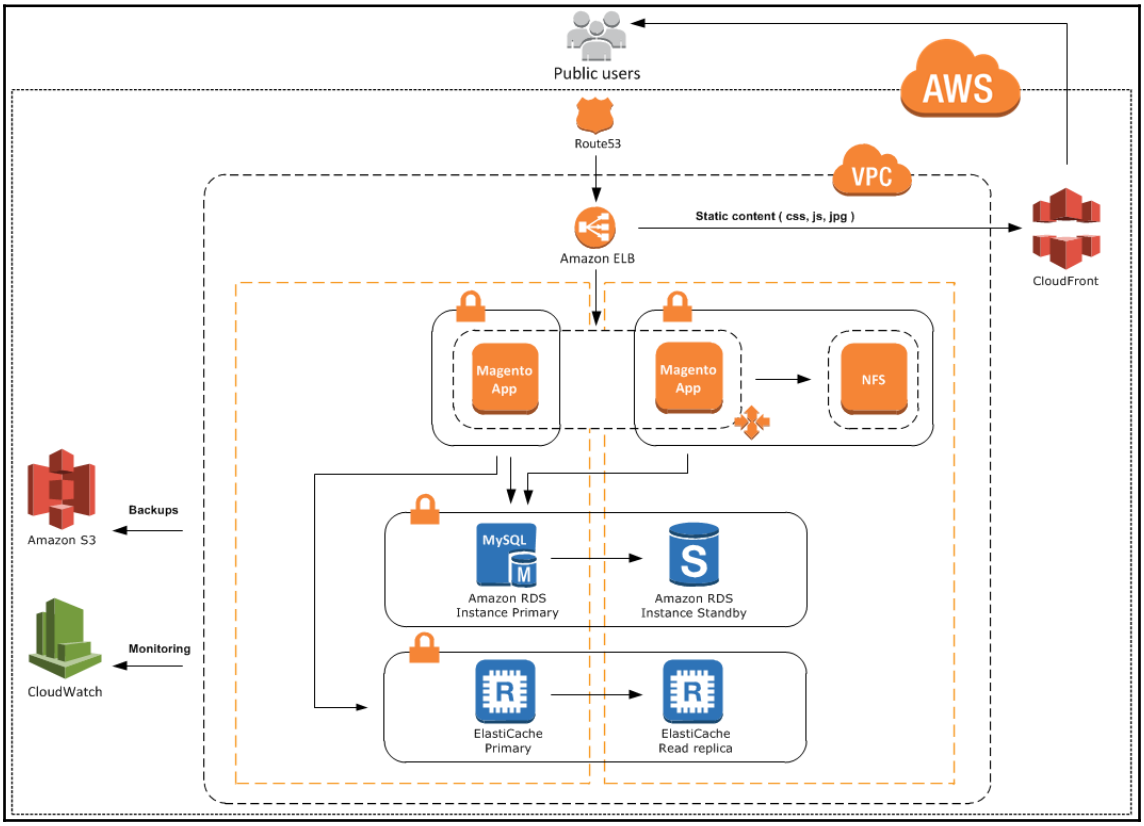
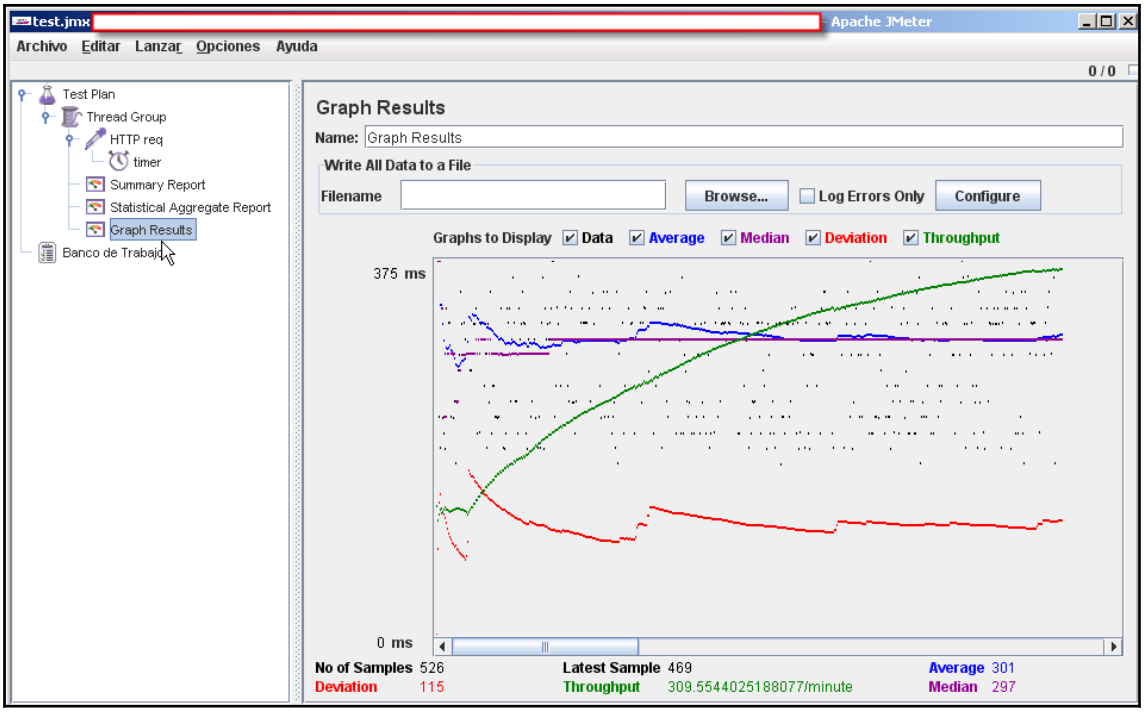

Iot Devices
IoT Edge Gateway
IIoT Cloud Services
(Cloud)
Intranet
(LAN)
DMZ
Router (WAN)

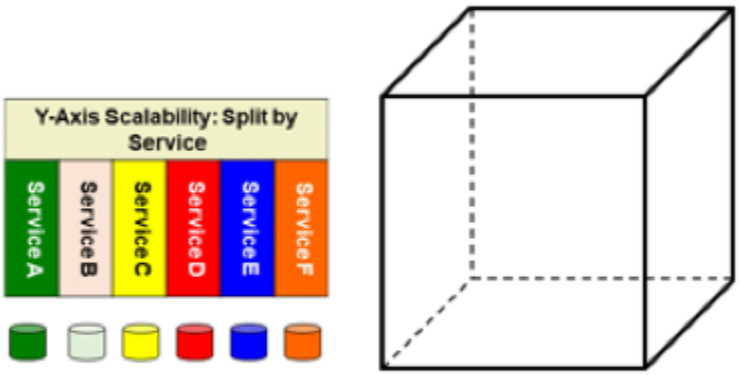

SSL Client
Application A
Keystore:
Certificate A
CA Certificate B
Verify
Hello
Send Certificate B
Send your certificate
Send Certificate A
SSL Server
Application B
Keystore:
Certificate B
CA Certificate A
Verify


Continuous Delivery
Dev
Application Test
Integration Test
Acceptance Test
Production
Automatic trigger
Manual trigger
Dev
Application Test
Integration Test
Acceptance Test
Production
Continuous Deployment


Public users
AWS
Route53
VPC
Static content (css, js, jpg)
Amazon ELB
CloudFront
Magento App
Magento App
NFS
Backups
Amazon S3
MySQL
Amazon RDS Instance Primary
Amazon RDS Instance Standby
Monitoring
CloudWatch
ElastiCache Primary
ElastiCache Read replica

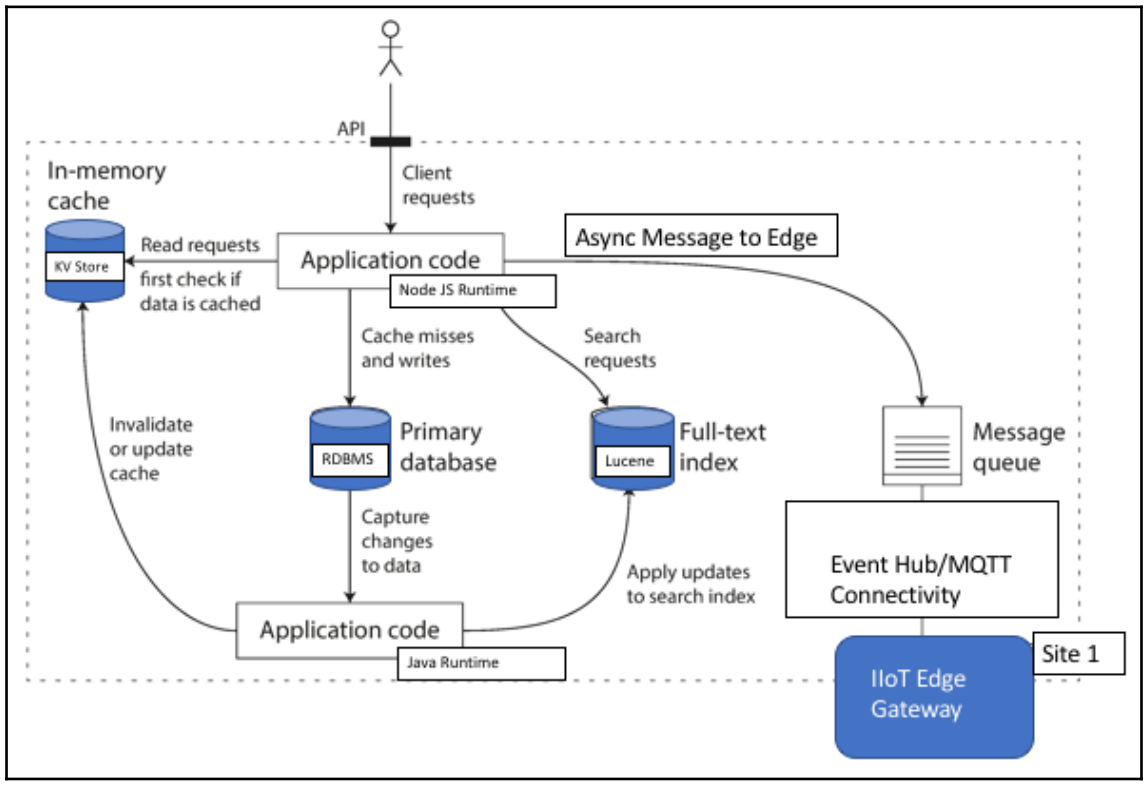

test.jmx
Apache JMeter
Archivo Editar Lanzar Opciones Ayuda
0 / 0
Test Plan
Thread Group
HTTP req
timer
Summary Report
Statistical Aggregate Report
Graph Results
Banco de Trabajo
Graph Results
Name: Graph Results
Write All Data to a File
Filename
Browse...
Log Errors Only
Configure
Graphs to Display
Data
Average
Median
Deviation
Throughput
375 ms
0 ms
No of Samples 526
Latest Sample 469
Average 301
Deviation 115
Throughput 309.5544025188077/minute
Median 297

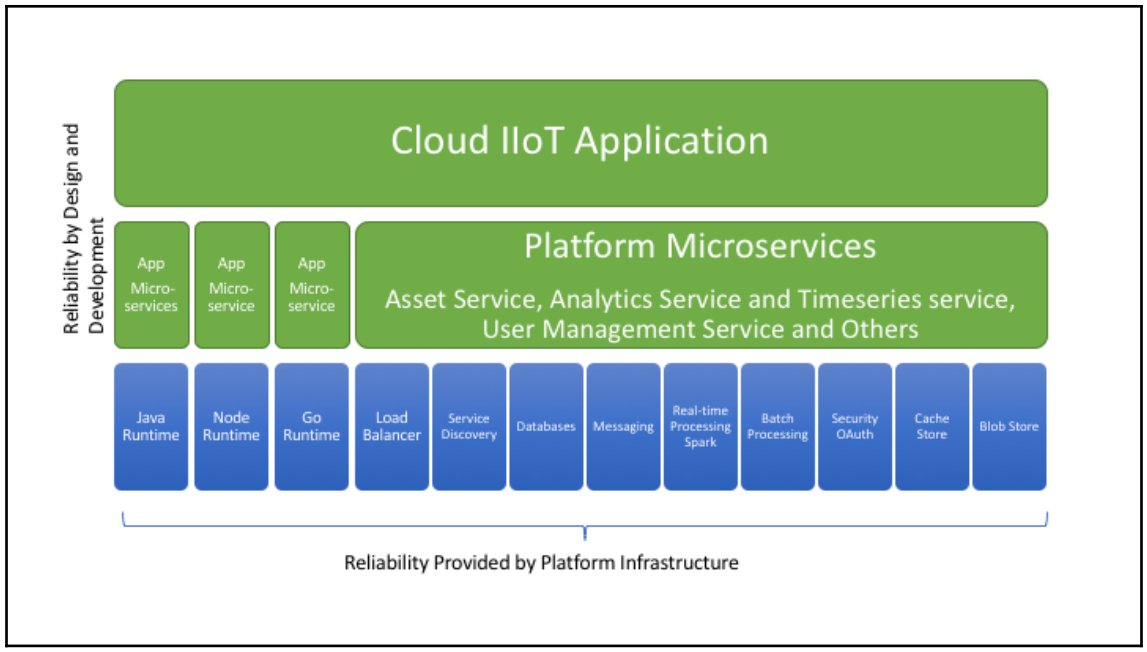
Scale Cube



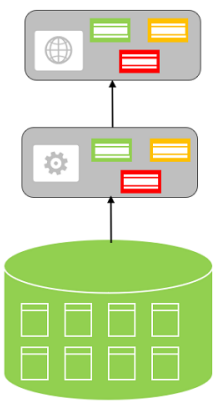
X-Axis Scalability: Replicate & LB	
Web Tier	Replicate Web Servers & Load Balance
App Tier	Store Session in browser or separated Object Cache to horizontally scale app tier independent of web tier
DB Tier	Use Read-Replicas for read-only use cases like reporting, search, etc.

Chapter 8: Reliability, Fault Tolerance, and Monitoring IIoT Applications

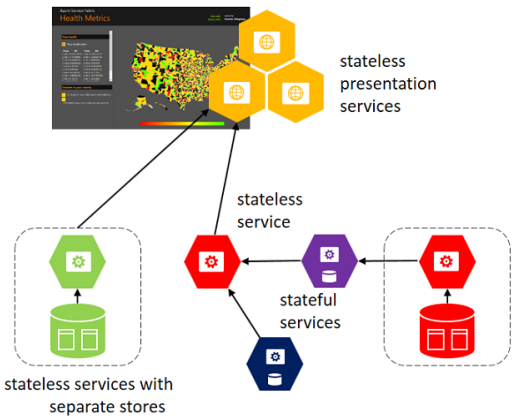


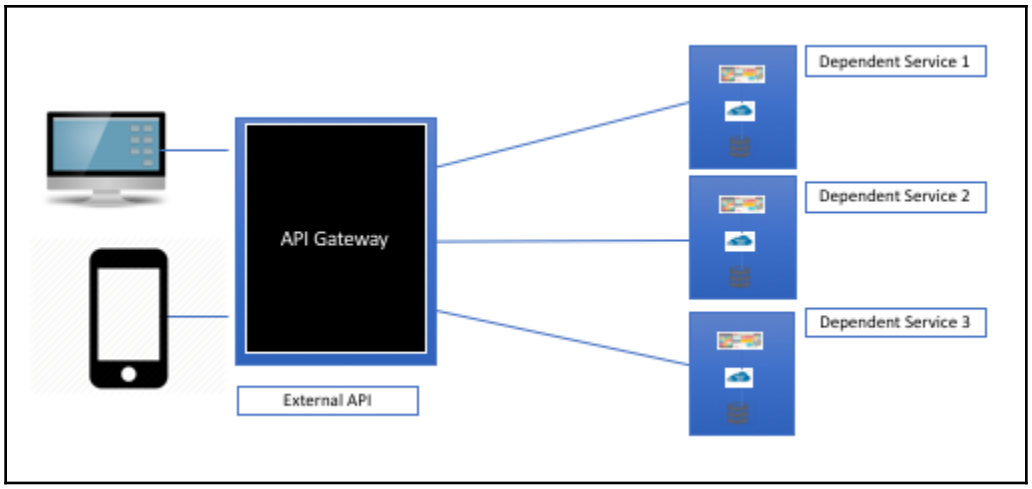


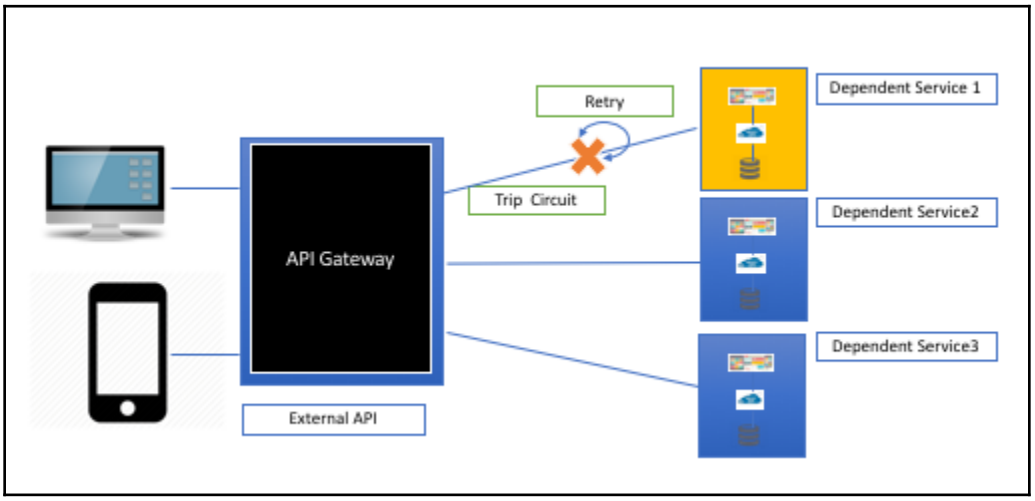
State in Monolithic approach

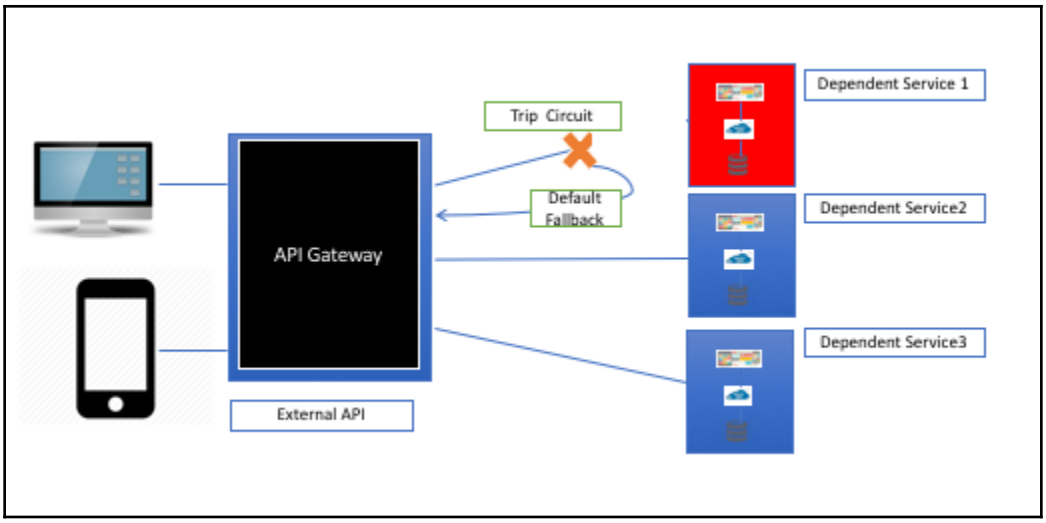


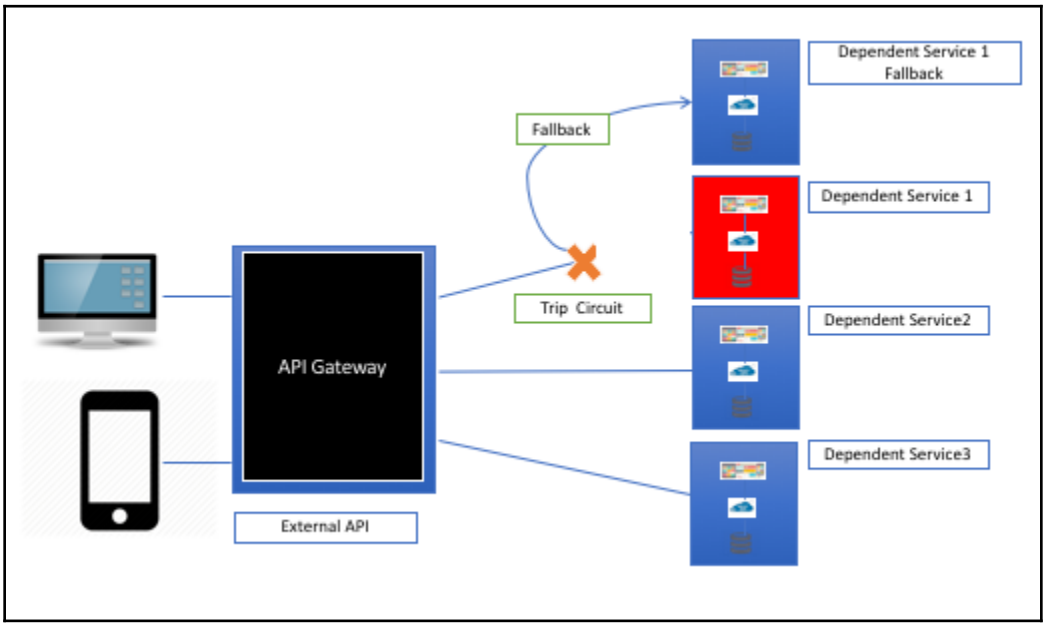
State in Microservices approach

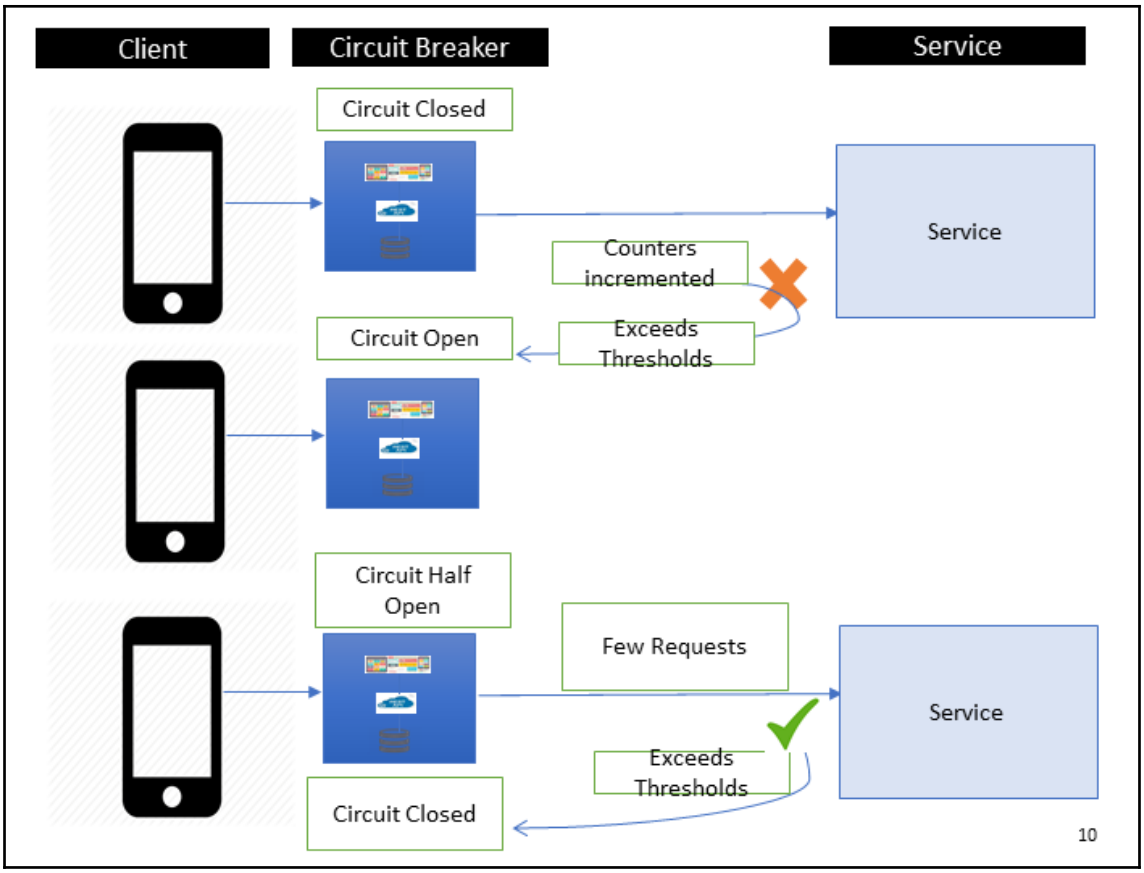


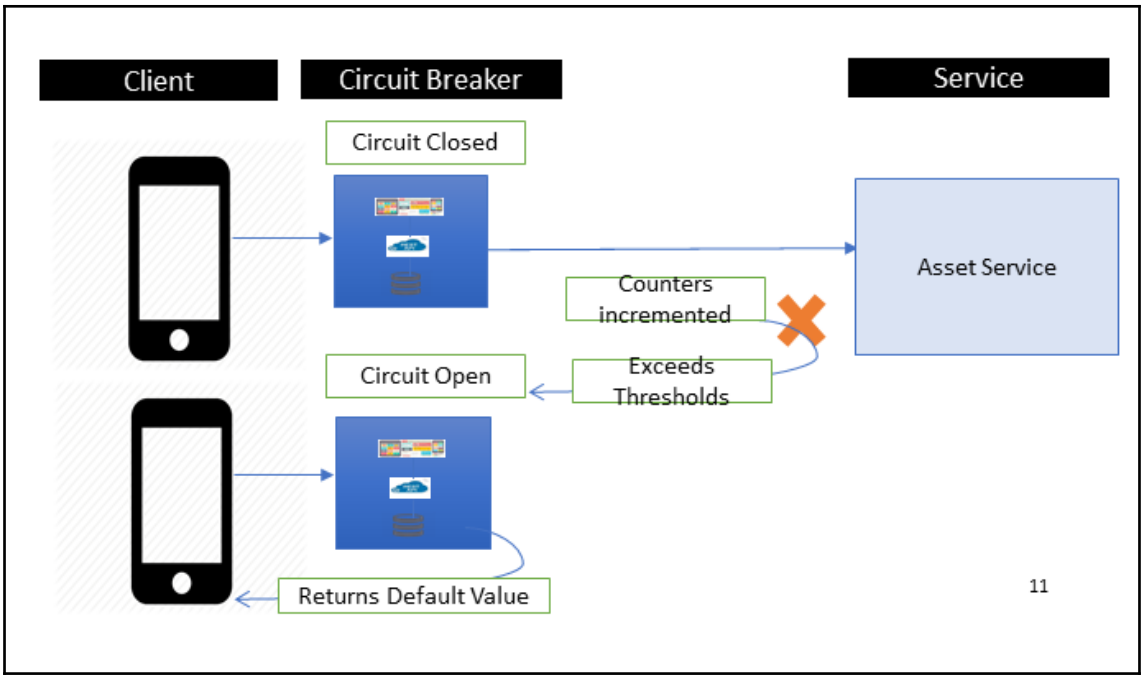

Dependent Service 1
Dependent Service 2
Dependent Service 3
API Gateway
External API

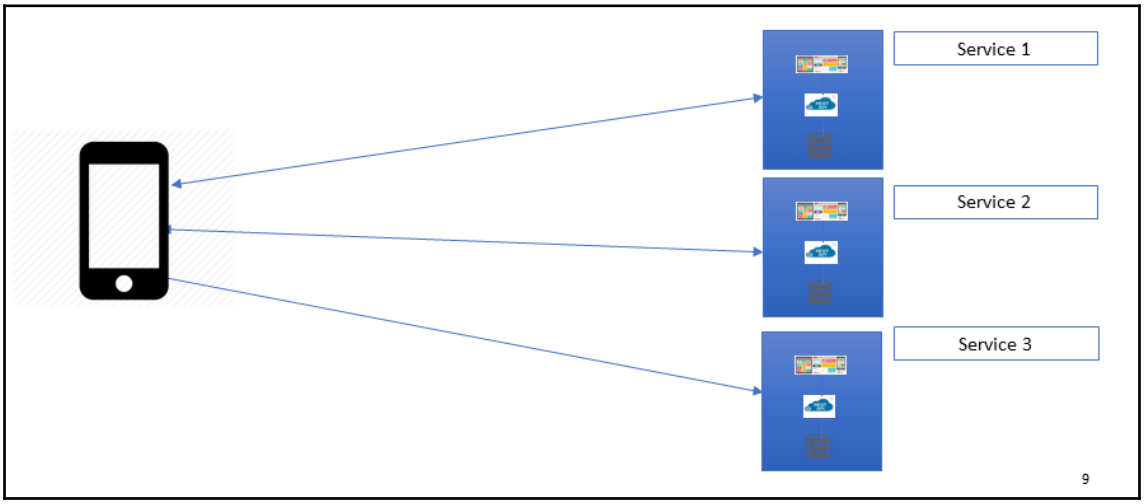

Retry
Dependent Service 1
Trip Circuit
Dependent Service2
API Gateway
Dependent Service3
External API

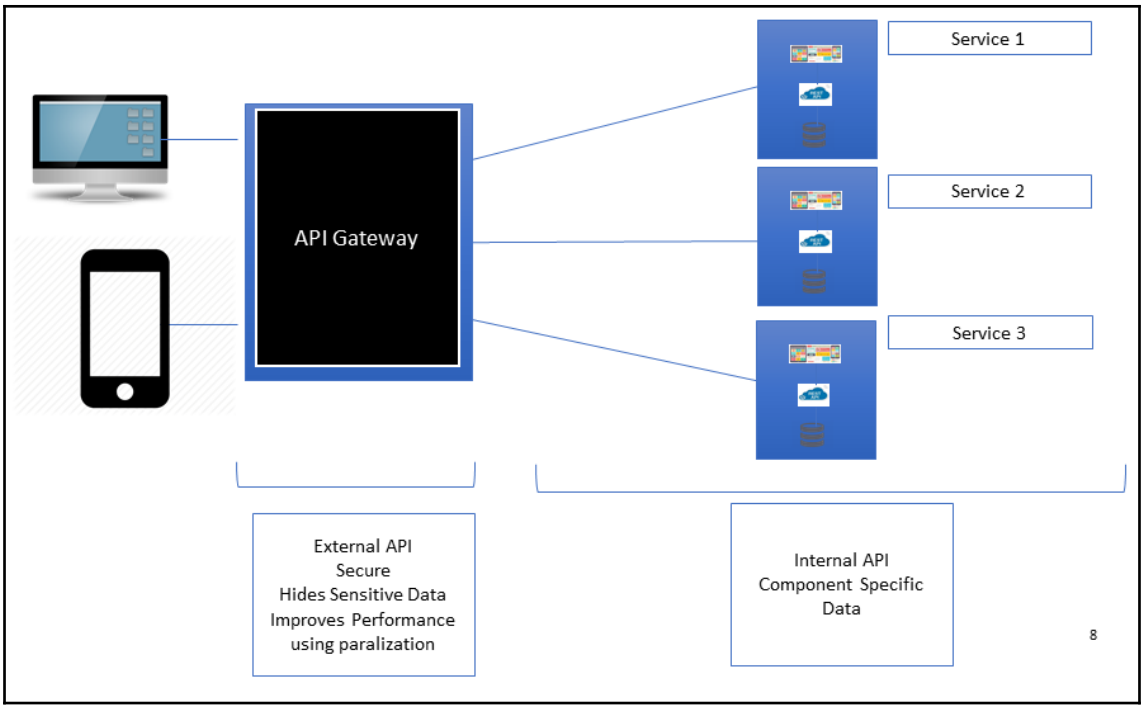

Trip Circuit
Default Fallback
API Gateway
External API
Dependent Service 1
Dependent Service2
Dependent Service3

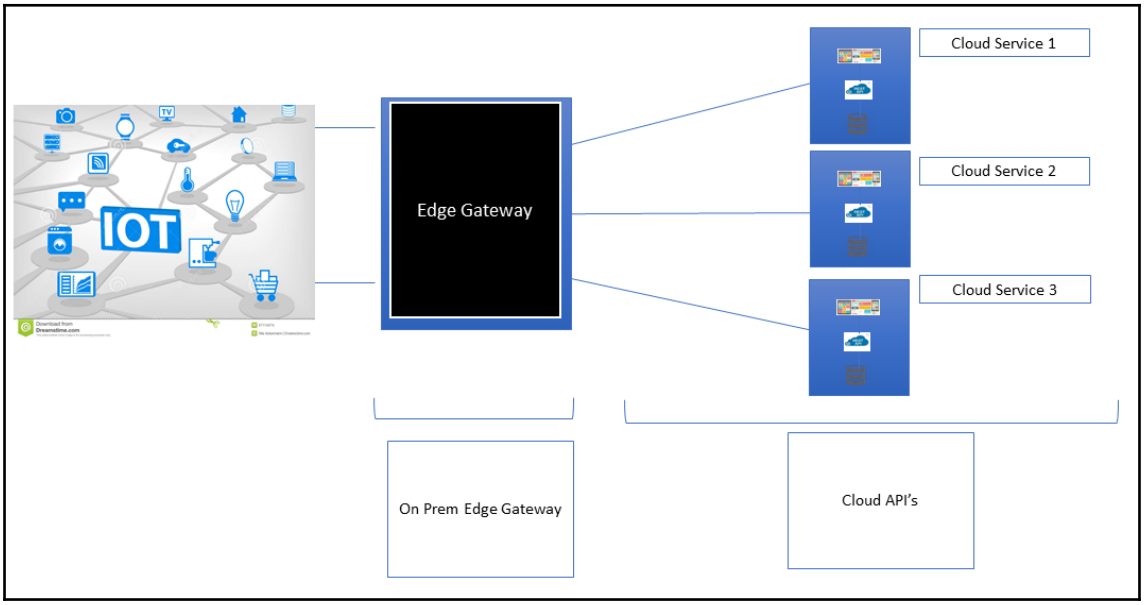

Fallback
Trip Circuit
API Gateway
External API
Dependent Service 1 Fallback
Dependent Service 1
Dependent Service2
Dependent Service3

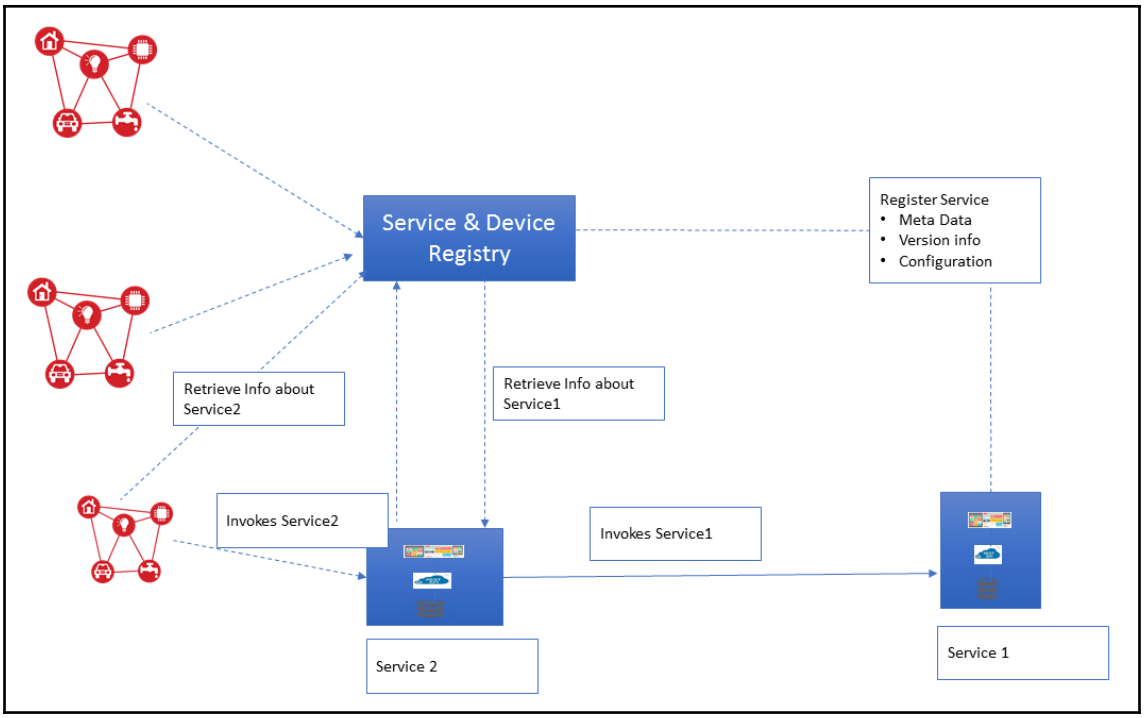

Client
Circuit Breaker
Service
Circuit Closed
Service
Counters incremented
Exceeds Thresholds
Circuit Open
Circuit Half Open
Few Requests
Service
Exceeds Thresholds
Circuit Closed
10

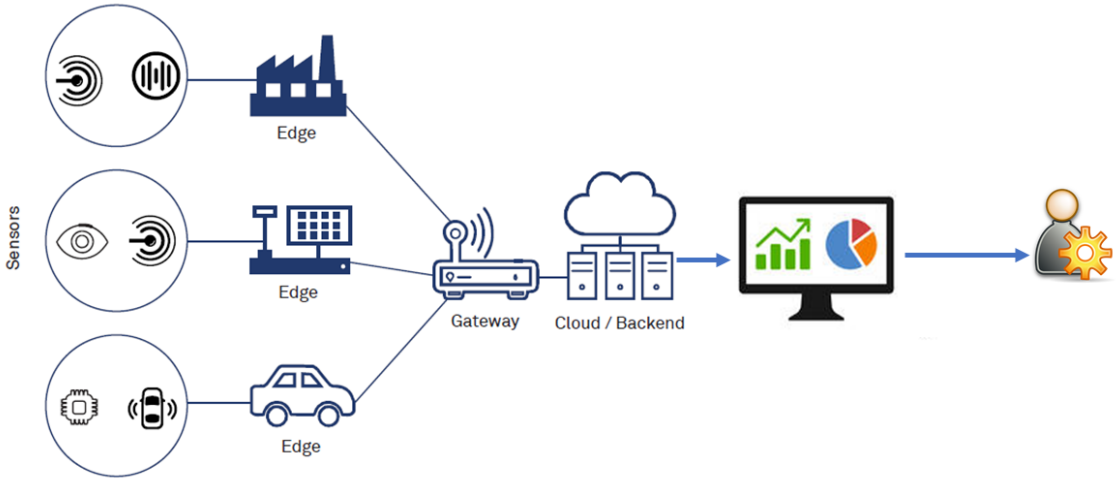

Client
Circuit Breaker
Service
Circuit Closed
Asset Service
Counters incremented
Exceeds Thresholds
Circuit Open
Returns Default Value
11

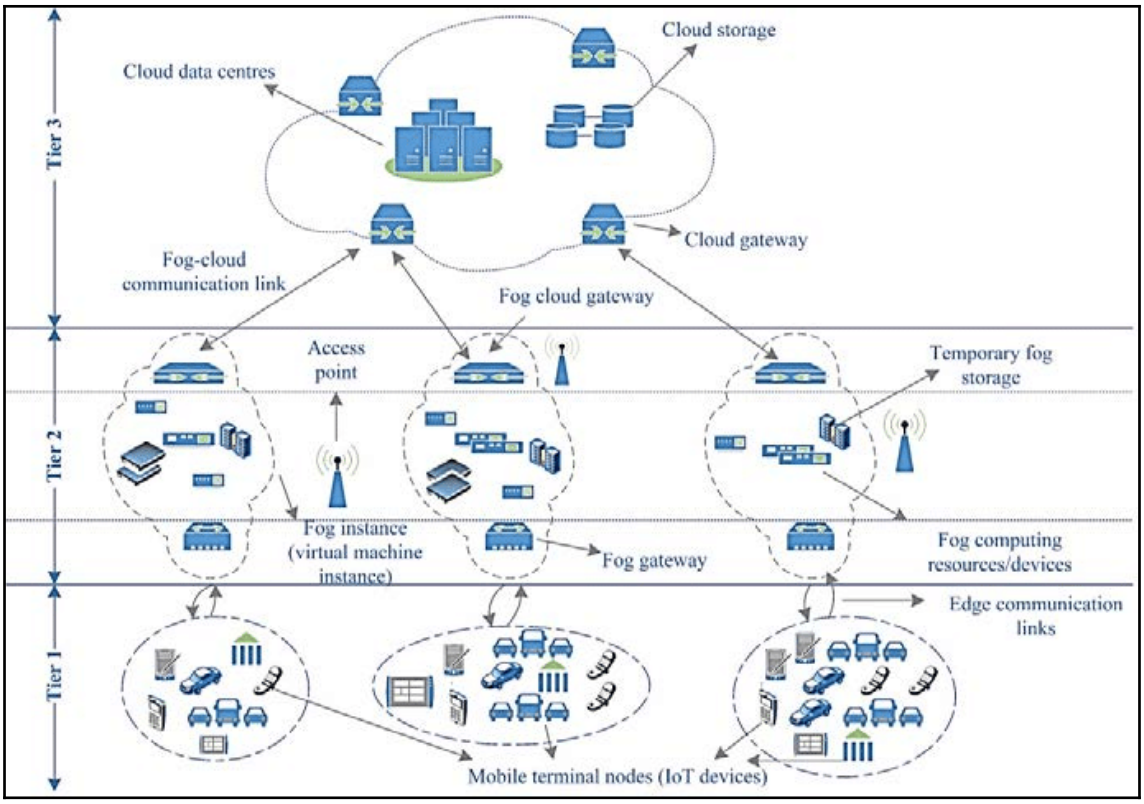

Service 1
Service 2
Service 3
9

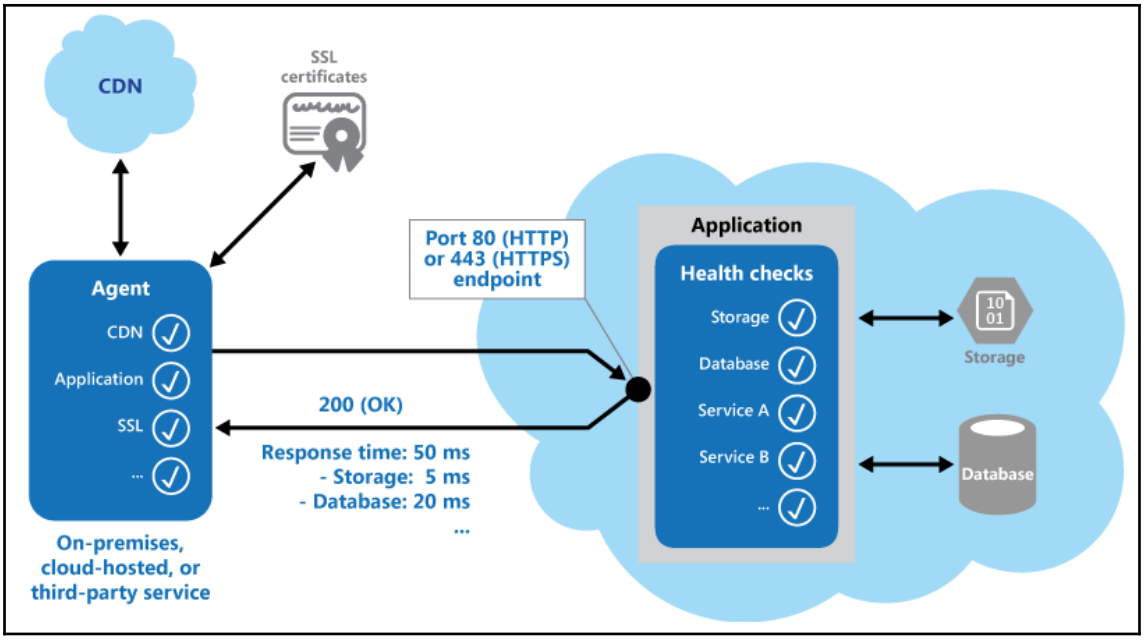

Service 1
Service 2
Service 3
API Gateway
External API
Secure
Hides Sensitive Data
Improves Performance
using paralization
Internal API
Component Specific
Data
8

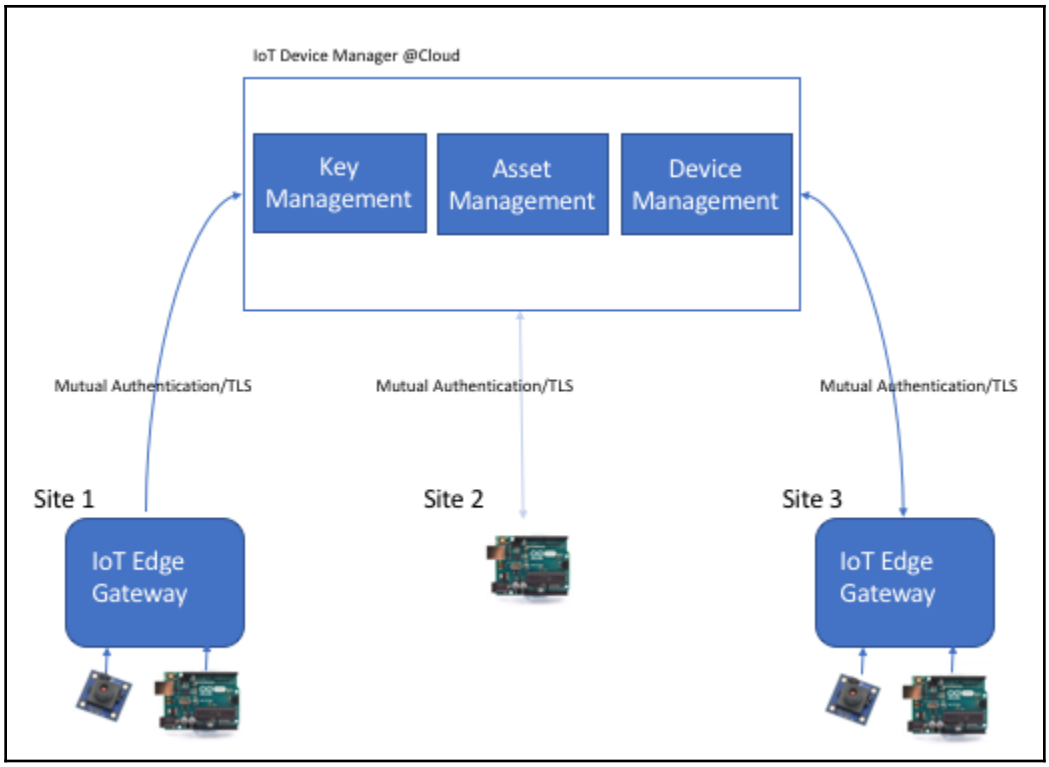

Cloud Service 1
Cloud Service 2
Cloud Service 3
Edge Gateway
IOT
On Prem Edge Gateway
Cloud API's

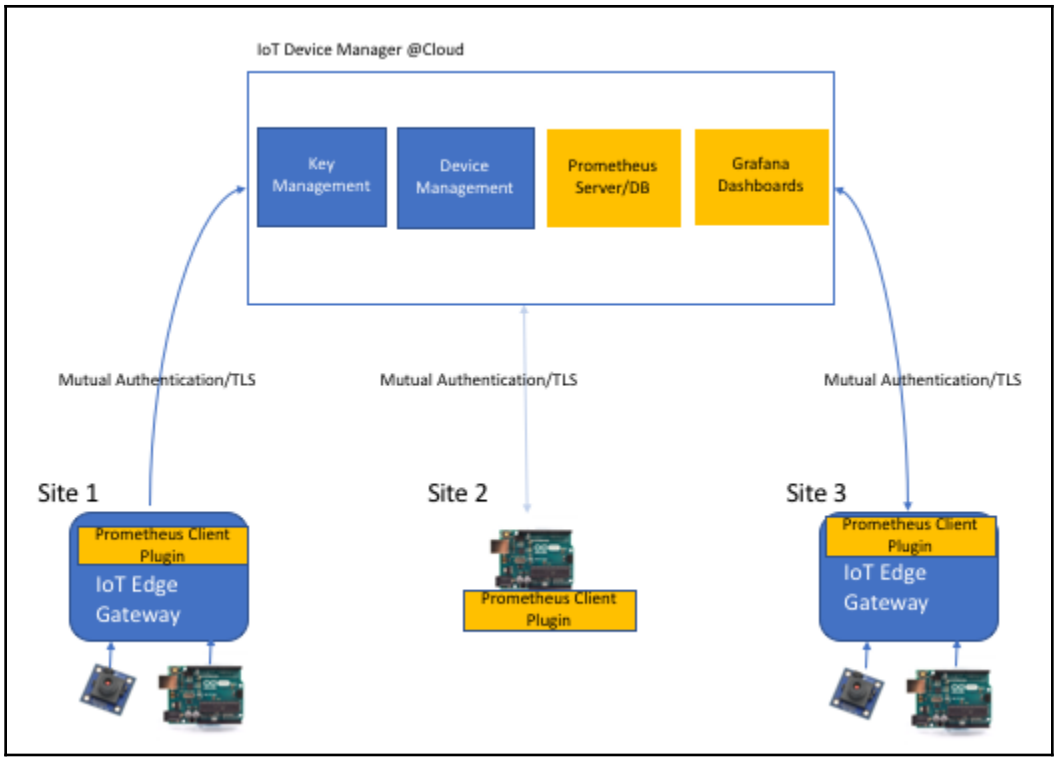

Service & Device Registry
Register Service
• Meta Data
• Version info
• Configuration
Retrieve Info about Service2
Retrieve Info about Service1
Invokes Service2
Invokes Service1
Service 2
Service 1


Sensors
Edge
Edge
Edge
Gateway
Cloud / Backend

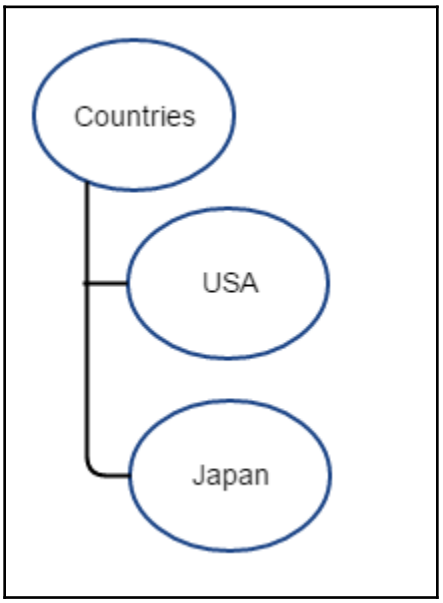

Tier 3
Tier 2
Tier 1
Cloud storage
Cloud data centres
Cloud gateway
Fog-cloud
communication link
Fog cloud gateway
Access
point
Temporary fog
storage
Fog instance
(virtual machine
instance)
Fog gateway
Fog computing
resources/devices
Edge communication
links
Mobile terminal nodes (IoT devices)


CDN
SSL certificates
Agent
CDN
Application
SSL
...
On-premises, cloud-hosted, or third-party service
Port 80 (HTTP) or 443 (HTTPS) endpoint
200 (OK)
Response time: 50 ms
- Storage: 5 ms
- Database: 20 ms
...
Application
Health checks
Storage
Database
Service A
Service B
...
Storage
Database

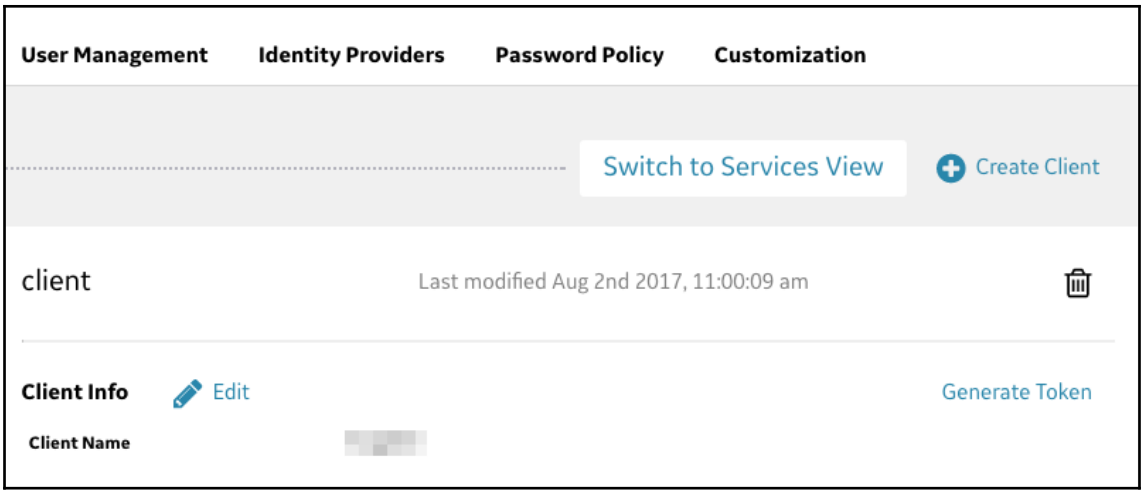

IoT Device Manager @Cloud
Key Management
Asset Management
Device Management
Mutual Authentication/TLS
Mutual Authentication/TLS
Mutual Authentication/TLS
Site 1
Site 2
Site 3
IoT Edge Gateway
IoT Edge Gateway

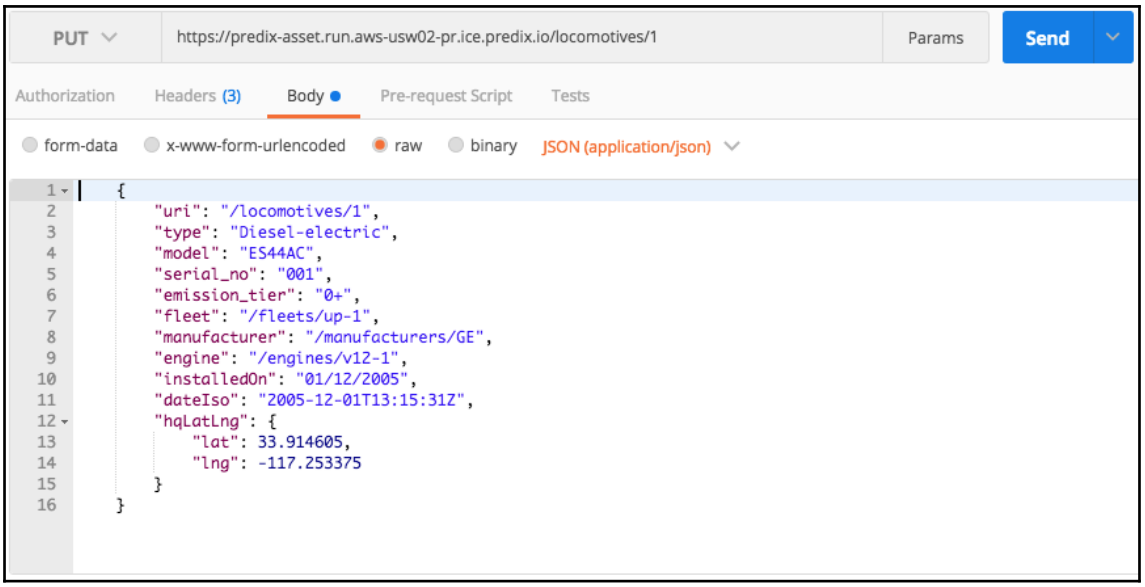

IoT Device Manager @Cloud
Key Management
Device Management
Prometheus Server/DB
Grafana Dashboards
Mutual Authentication/TLS
Mutual Authentication/TLS
Mutual Authentication/TLS
Site 1
Site 2
Site 3
Prometheus Client Plugin
IoT Edge Gateway
Prometheus Client Plugin
Prometheus Client Plugin
IoT Edge Gateway

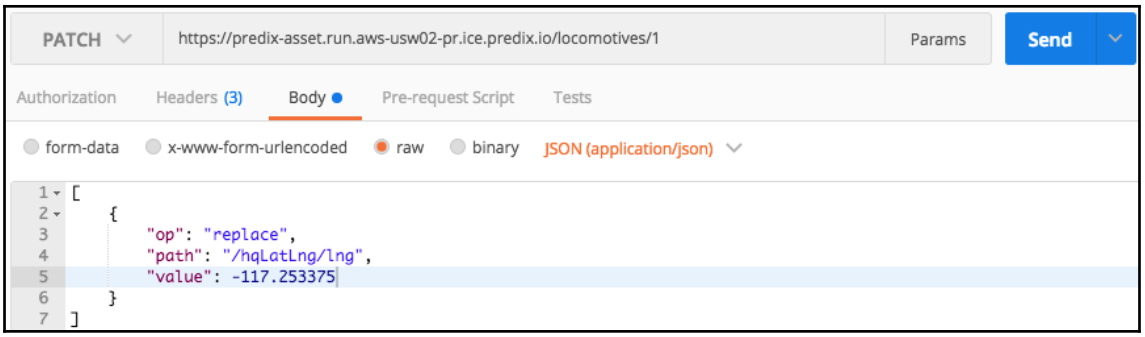
Chapter 9: Implementing IIoT Applications with Predix

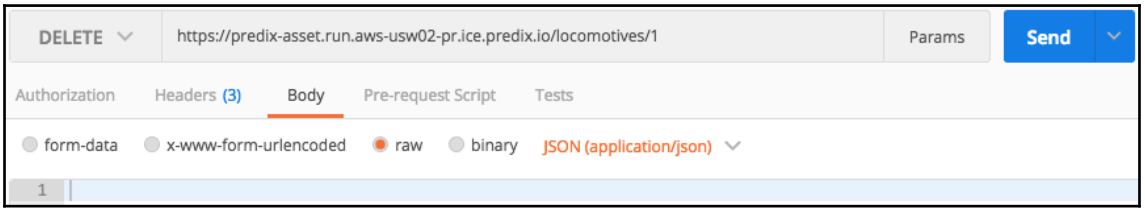



```
em:~ [redacted]$ cf bind-service ui asset-service-instance
Binding service asset-service-instance to app ui in org [redacted] / space dev as [redacted]...
OK
TIP: Use 'cf restage ui' to ensure your env variable changes take effect
em:~ [redacted]$
```

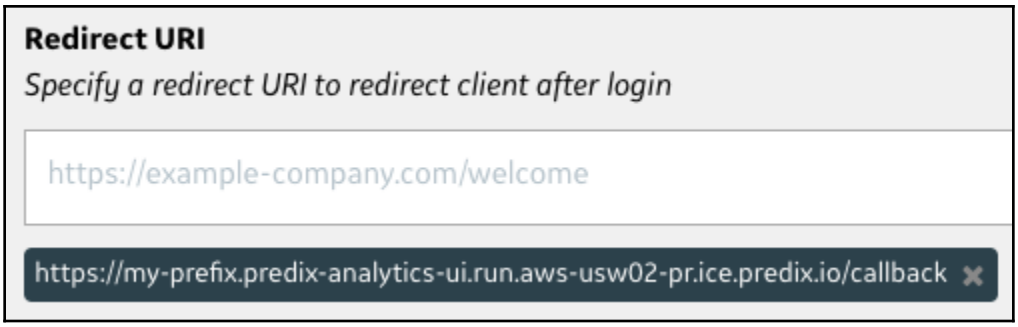

User Management
Identity Providers
Password Policy
Customization
Switch to Services View
Create Client
client
Last modified Aug 2nd 2017, 11:00:09 am
Client Info
Edit
Generate Token
Client Name

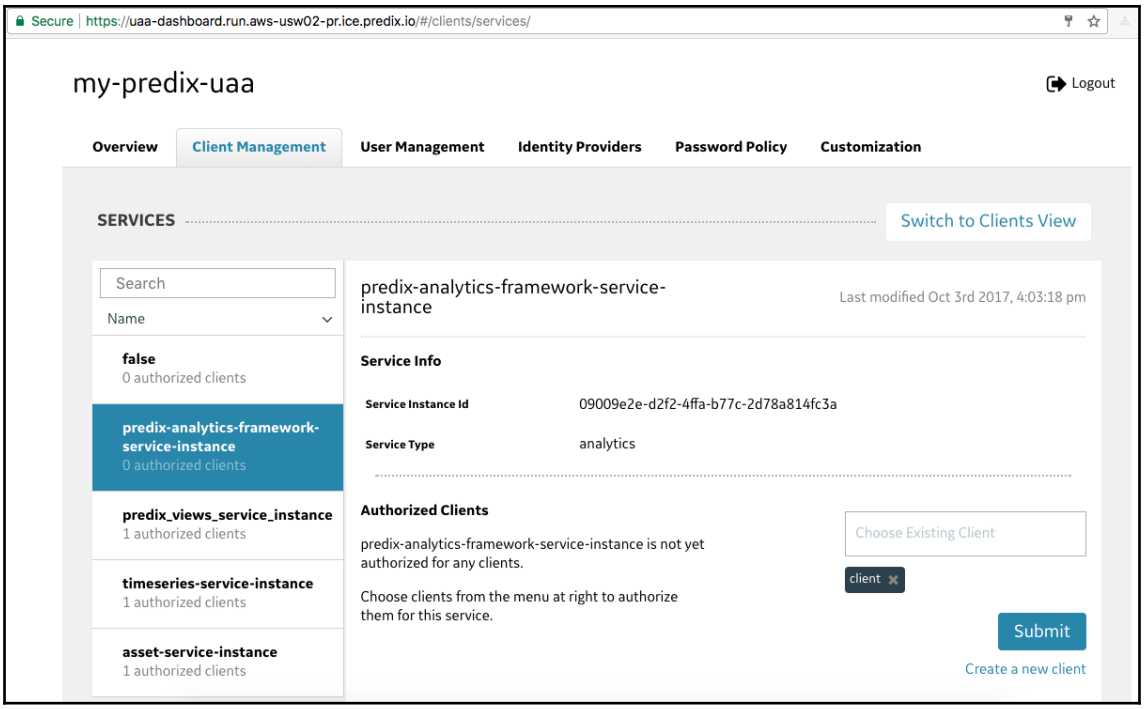

PUT
https://predix-asset.run.aws-usw02-pr.ice.predix.io/locomotives/1
Params
Send
Authorization
Headers (3)
Body
Pre-request Script
Tests
form-data
x-www-form-urlencoded
raw
binary
JSON (application/json)
{
"uri": "/locomotives/1",
"type": "Diesel-electric",
"model": "ES44AC",
"serial_no": "001",
"emission_tier": "0+",
"fleet": "/fleets/up-1",
"manufacturer": "/manufacturers/GE",
"engine": "/engines/v12-1",
"installedOn": "01/12/2005",
"dateIso": "2005-12-01T13:15:31Z",
"hqLatLng": {
"lat": 33.914605,
"lng": -117.253375
}
}

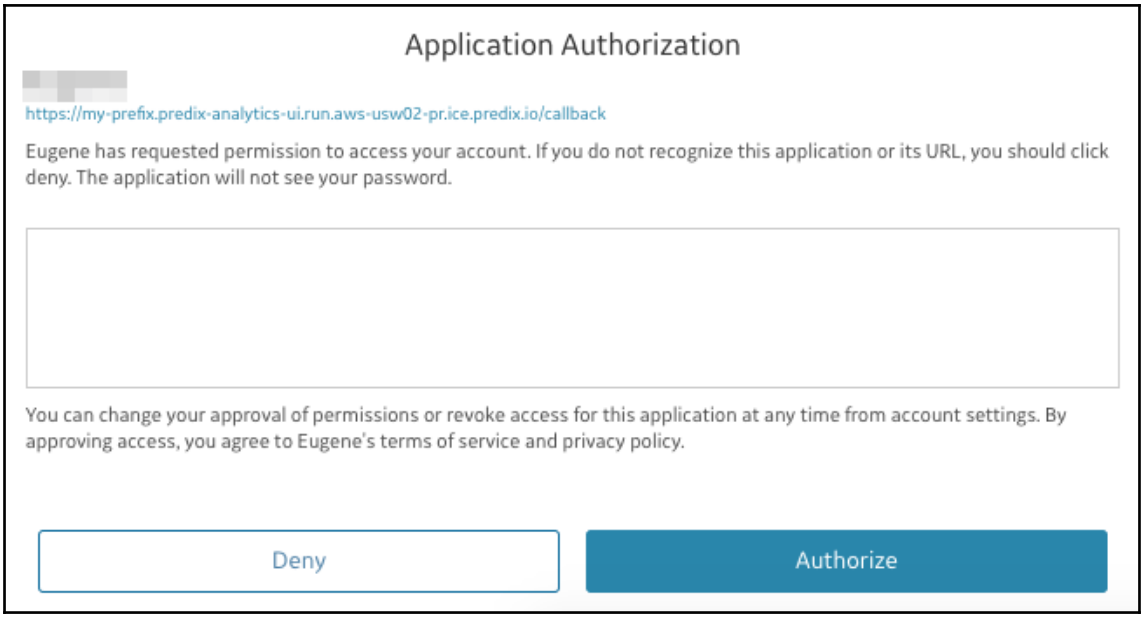


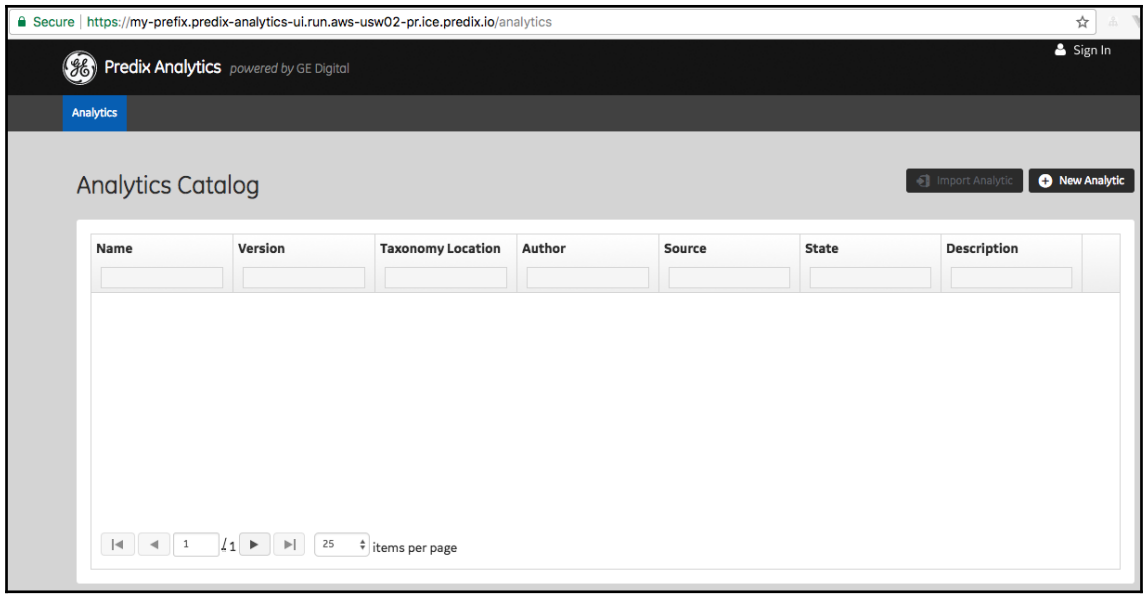


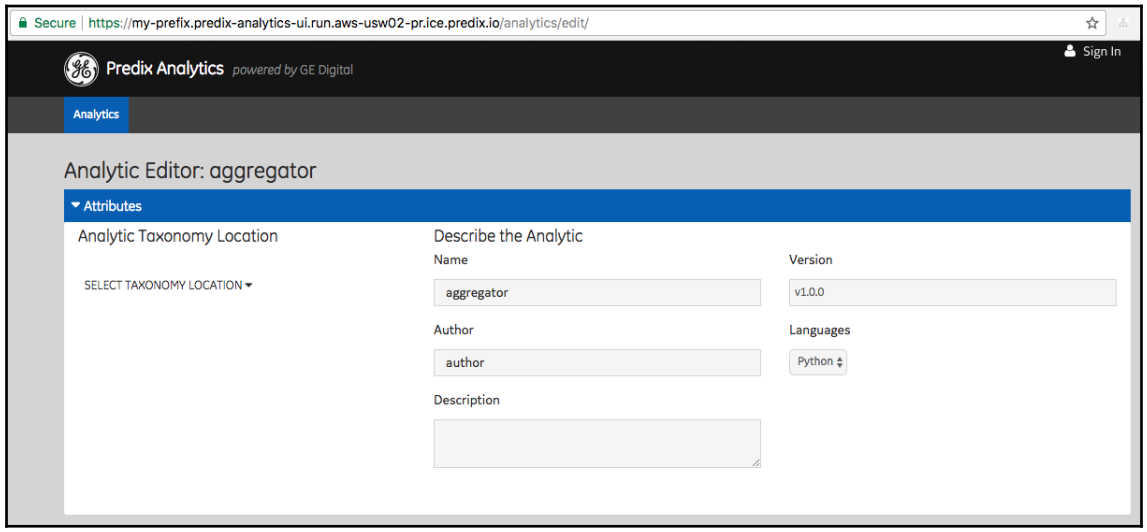

```
sending:  {"messageId":1501664966991,"body":[{"name":"sensor1:variable1","datapoints":[[1501664966991,86]],
"attributes":{"devices":"/device/raspberry"}}]}
response:  {"statusCode":202,"messageId":1501664966991}
```



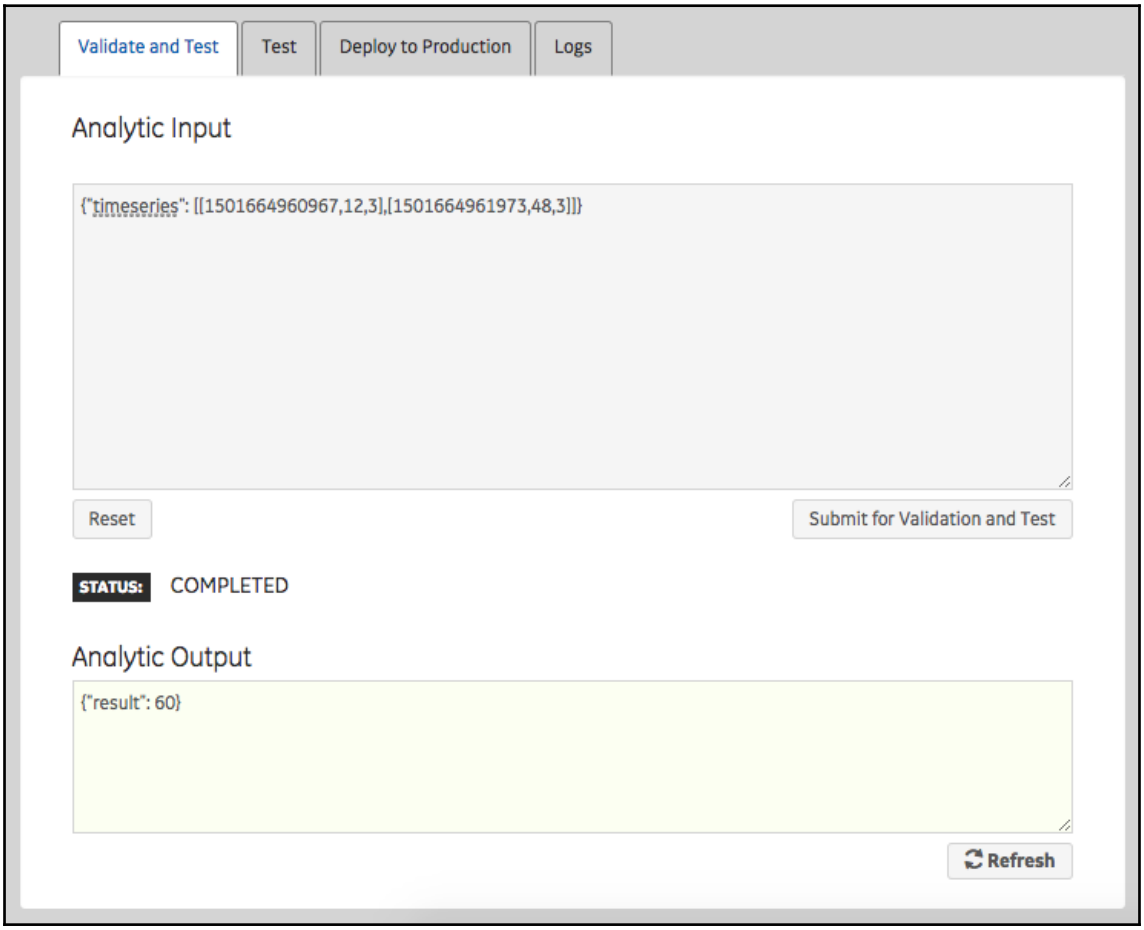

Secure | https://uaa-dashboard.run.aws-usw02-pr.ice.predix.io/#/clients/services/
my-predix-uaa
Logout
Overview
Client Management
User Management
Identity Providers
Password Policy
Customization
SERVICES
Switch to Clients View
Search
Name
false
0 authorized clients
predix-analytics-framework-service-instance
0 authorized clients
predix_views_service_instance
1 authorized clients
timeseries-service-instance
1 authorized clients
asset-service-instance
1 authorized clients
predix-analytics-framework-service-instance
Last modified Oct 3rd 2017, 4:03:18 pm
Service Info
Service Instance Id
09009e2e-d2f2-4ffa-b77c-2d78a814fc3a
Service Type
analytics
Authorized Clients
predix-analytics-framework-service-instance is not yet authorized for any clients.
Choose clients from the menu at right to authorize them for this service.
Choose Existing Client
client
Submit
Create a new client

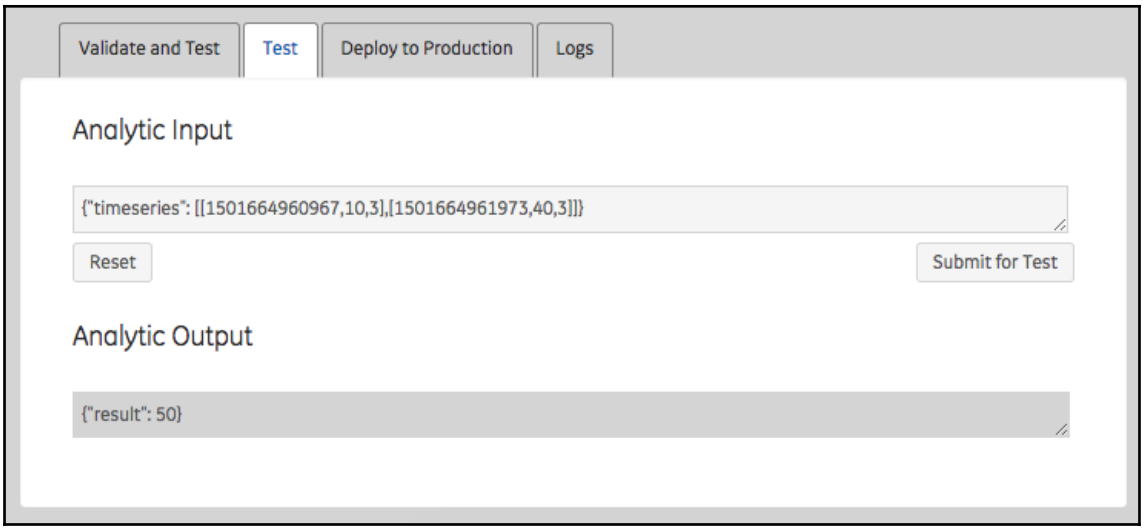

Application Authorization
https://my-prefix.predix-analytics-ui.run.aws-usw02-pr.ice.predix.io/callback
Eugene has requested permission to access your account. If you do not recognize this application or its URL, you should click deny. The application will not see your password.
You can change your approval of permissions or revoke access for this application at any time from account settings. By approving access, you agree to Eugene's terms of service and privacy policy.
Deny
Authorize

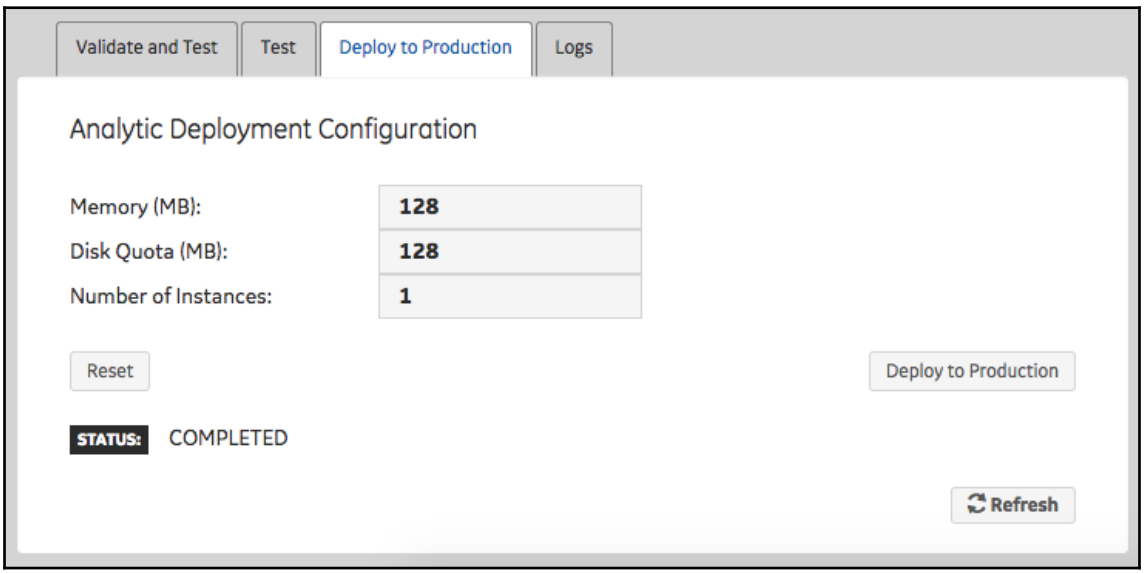

Secure | https://my-prefix.predix-analytics-ui.run.aws-usw02-pr.ice.predix.io/analytics
Predix Analytics powered by GE Digital
Sign In
Analytics
Analytics Catalog
Import Analytic
New Analytic
Name
Version
Taxonomy Location
Author
Source
State
Description
1
/ 1
25
items per page

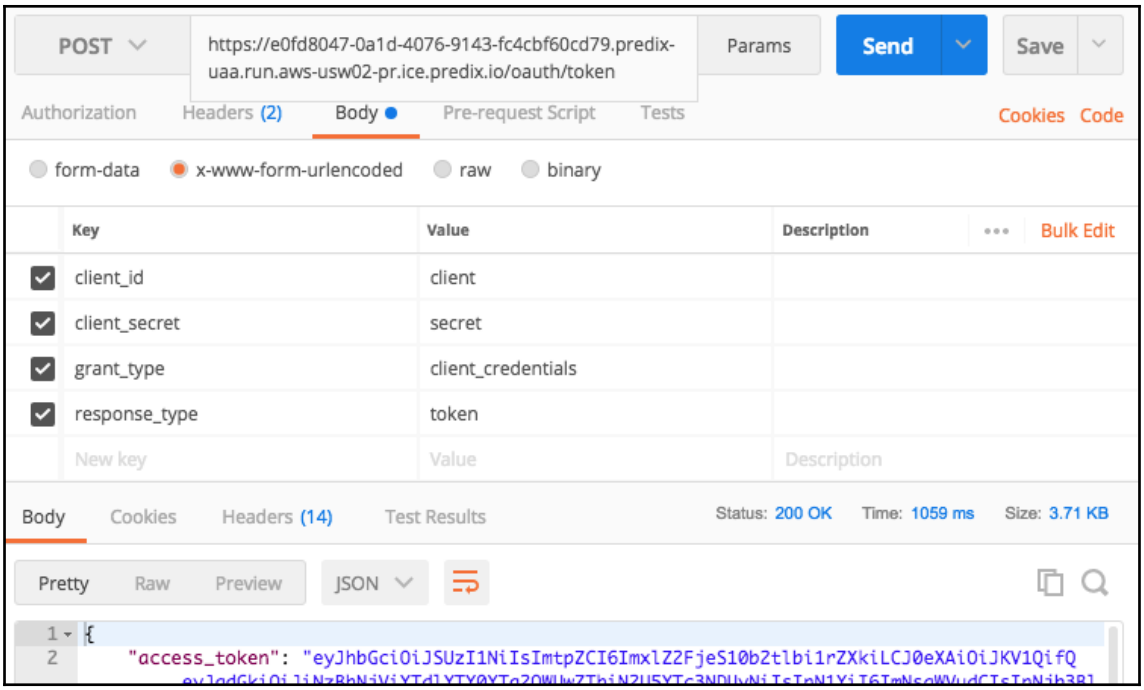

Secure | https://my-prefix.predix-analytics-ui.run.aws-usw02-pr.ice.predix.io/analytics/edit/
Predix Analytics powered by GE Digital
Sign In
Analytics
Analytic Editor: aggregator
Attributes
Analytic Taxonomy Location
SELECT TAXONOMY LOCATION
Describe the Analytic
Name
aggregator
Version
v1.0.0
Author
author
Languages
Python
Description

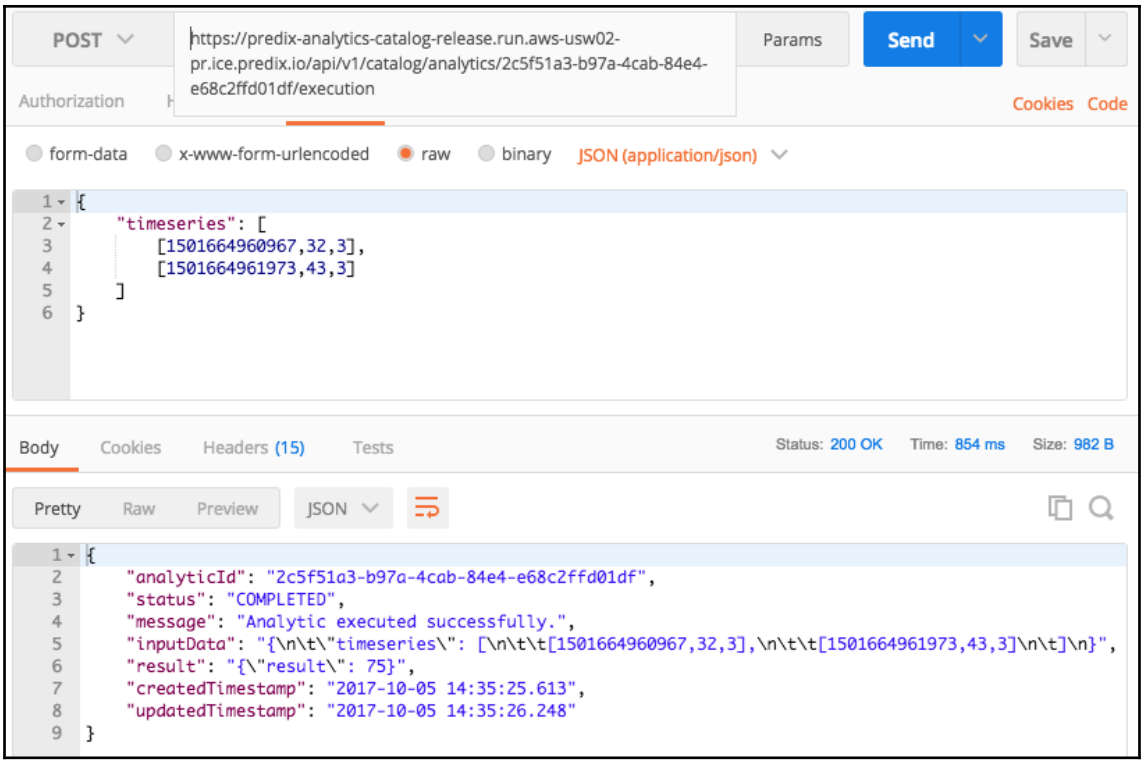

Files
Select a file to attach
Attached files
File Name
Type
Description
Size
aggregator.zip
Executable
Executable
2.09 KB
Save

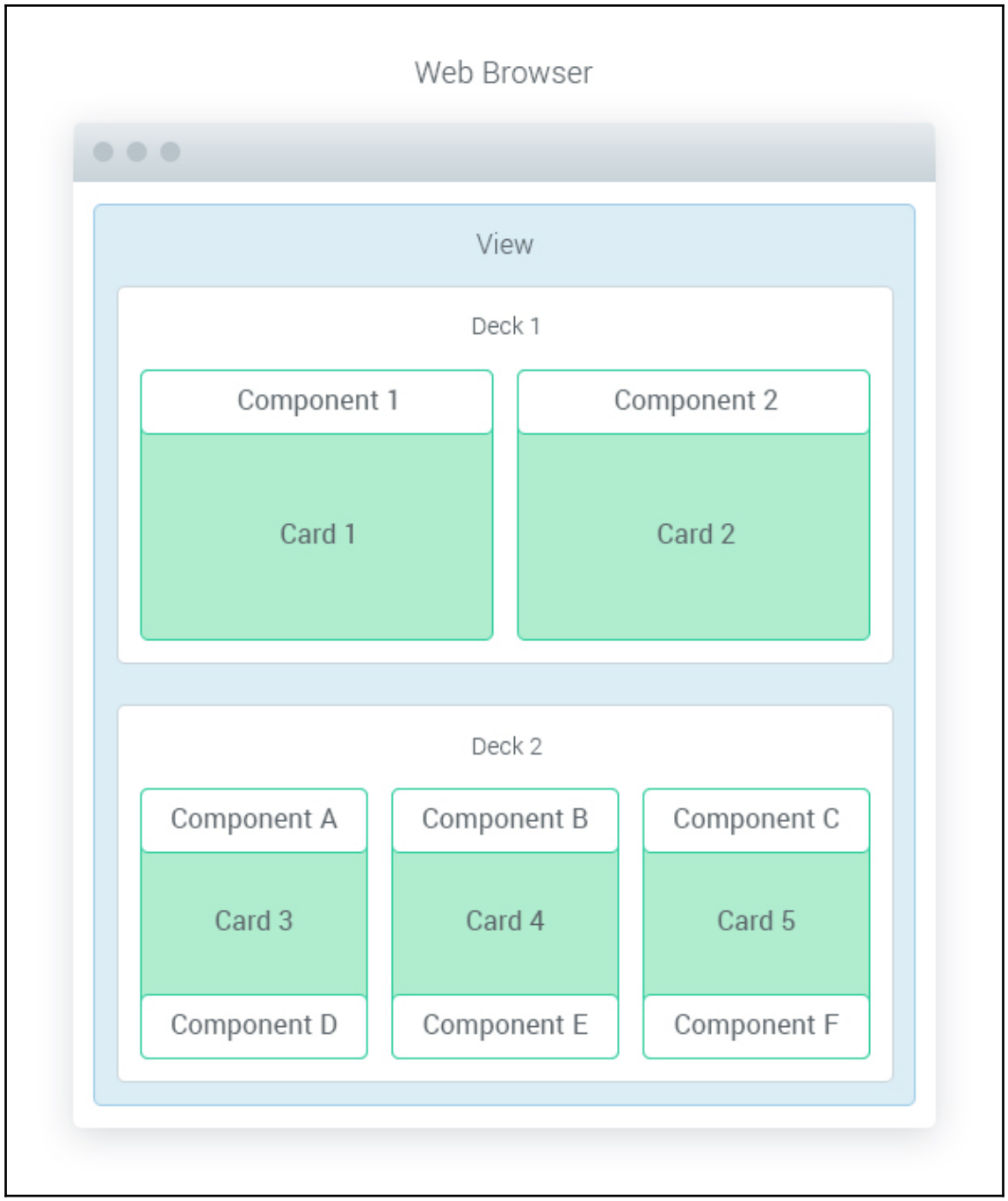

Validate and Test
Test
Deploy to Production
Logs
Analytic Input
{"timeseries": [[1501664960967,12,3],[1501664961973,48,3]]}
Reset
Submit for Validation and Test
STATUS:
COMPLETED
Analytic Output
{"result": 60}
Refresh

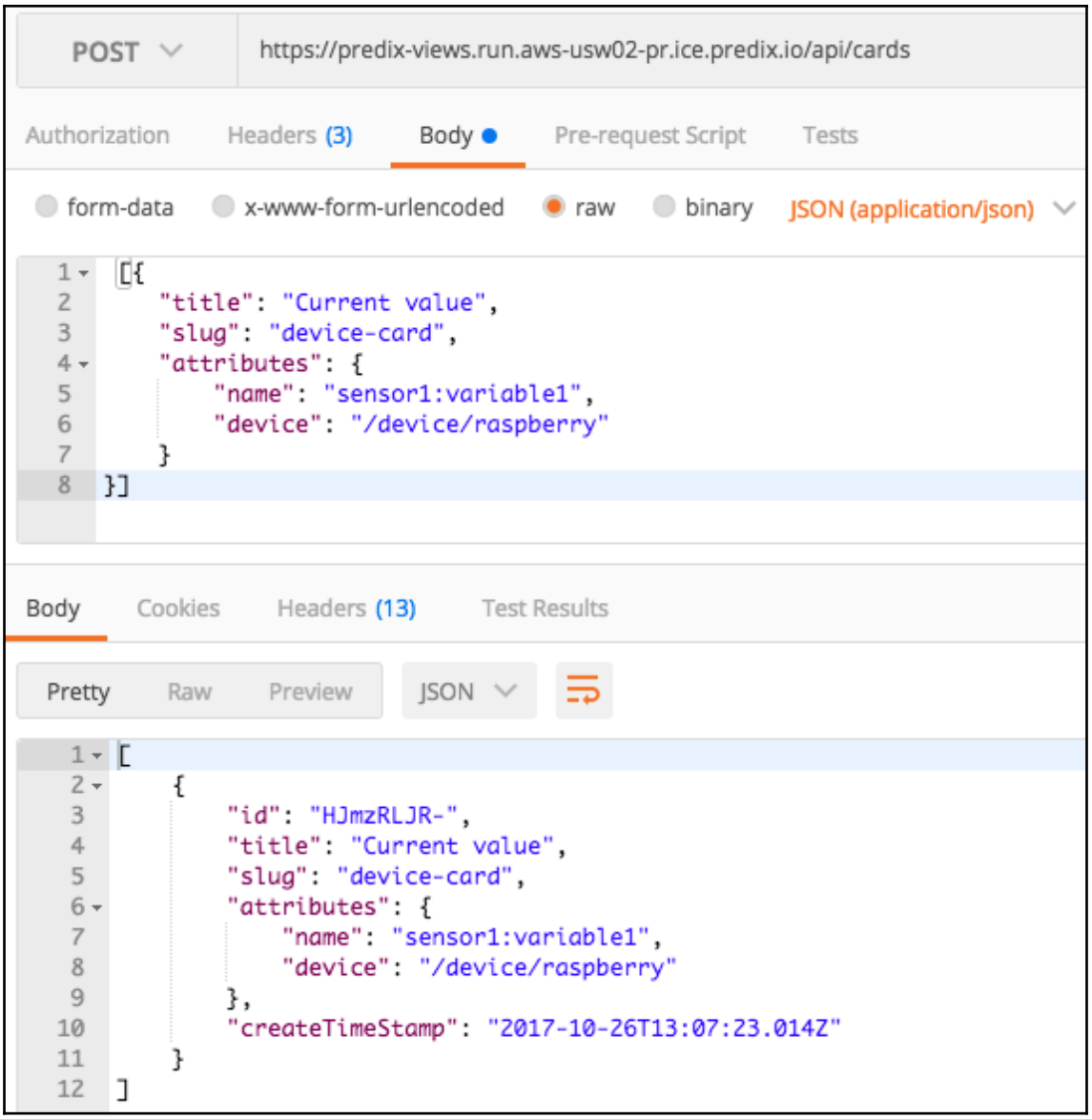

Validate and Test
Test
Deploy to Production
Logs
Analytic Input
{"timeseries": [[1501664960967,10,3],[1501664961973,40,3]]}
Reset
Submit for Test
Analytic Output
{"result": 50}

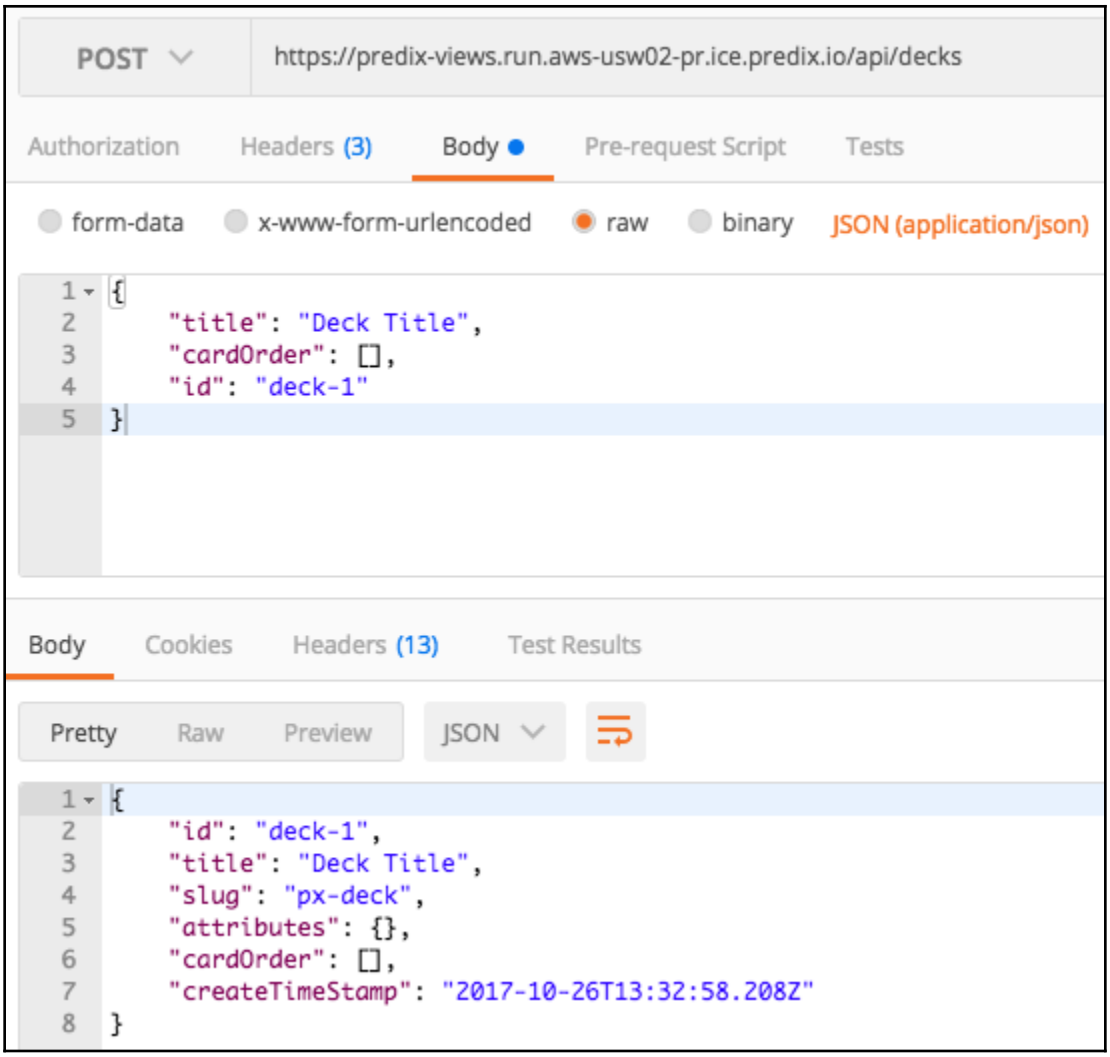

Validate and Test
Test
Deploy to Production
Logs
Analytic Deployment Configuration
Memory (MB):
128
Disk Quota (MB):
128
Number of Instances:
1
Reset
Deploy to Production
STATUS:
COMPLETED
Refresh


POST
https://e0fd8047-0a1d-4076-9143-fc4cbf60cd79.predix-uaa.run.aws-usw02-pr.ice.predix.io/oauth/token
Params
Send
Save
Authorization
Headers (2)
Body
Pre-request Script
Tests
Cookies
Code
form-data
x-www-form-urlencoded
raw
binary
Key
Value
Description
Bulk Edit
client_id
client
client_secret
secret
grant_type
client_credentials
response_type
token
New key
Value
Description
Body
Cookies
Headers (14)
Test Results
Status: 200 OK
Time: 1059 ms
Size: 3.71 KB
Pretty
Raw
Preview
JSON
{
"access_token": "eyJhbGciOiJSUzI1NiIsImtpZCI6ImxlZ2FjeS10b2tlbi1rZXkiLCJ0eXAiOiJKV1QifQ

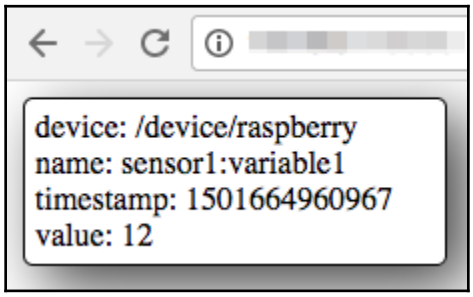

POST
https://predix-analytics-catalog-release.run.aws-usw02-pr.ice.predix.io/api/v1/catalog/analytics/2c5f51a3-b97a-4cab-84e4-e68c2ffd01df/execution
Params
Send
Save
Authorization
Cookies
Code
form-data
x-www-form-urlencoded
raw
binary
JSON (application/json)
{
"timeseries": [
[1501664960967,32,3],
[1501664961973,43,3]
]
}
Body
Cookies
Headers (15)
Tests
Status: 200 OK
Time: 854 ms
Size: 982 B
Pretty
Raw
Preview
JSON
{
"analyticId": "2c5f51a3-b97a-4cab-84e4-e68c2ffd01df",
"status": "COMPLETED",
"message": "Analytic executed successfully.",
"inputData": "{\n\t\"timeseries\": [\n\t\t[1501664960967,32,3],\n\t\t[1501664961973,43,3]\n\t]\n}",
"result": "{\"result\": 75}",
"createdTimestamp": "2017-10-05 14:35:25.613",
"updatedTimestamp": "2017-10-05 14:35:26.248"
}

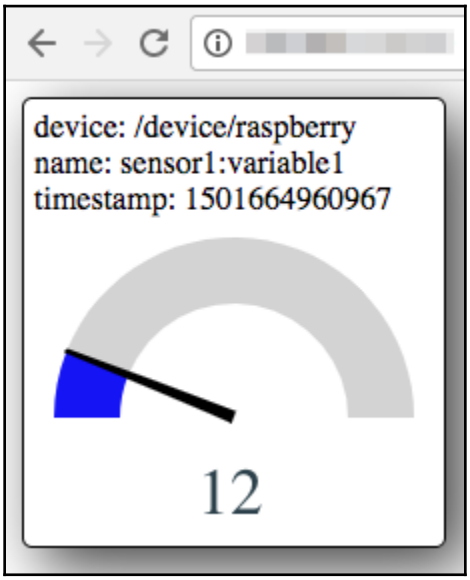

Web Browser
View
Deck 1
Component 1
Card 1
Component 2
Card 2
Deck 2
Component A
Card 3
Component D
Component B
Card 4
Component E
Component C
Card 5
Component F


POST
https://predix-views.run.aws-usw02-pr.ice.predix.io/api/cards
Authorization
Headers (3)
Body
Pre-request Script
Tests
form-data
x-www-form-urlencoded
raw
binary
JSON (application/json)
[{
"title": "Current value",
"slug": "device-card",
"attributes": {
"name": "sensor1:variable1",
"device": "/device/raspberry"
}
}]
Body
Cookies
Headers (13)
Test Results
Pretty
Raw
Preview
JSON
[
{
"id": "HJmzRLJR-",
"title": "Current value",
"slug": "device-card",
"attributes": {
"name": "sensor1:variable1",
"device": "/device/raspberry"
},
"createTimeStamp": "2017-10-26T13:07:23.014Z"
}
]

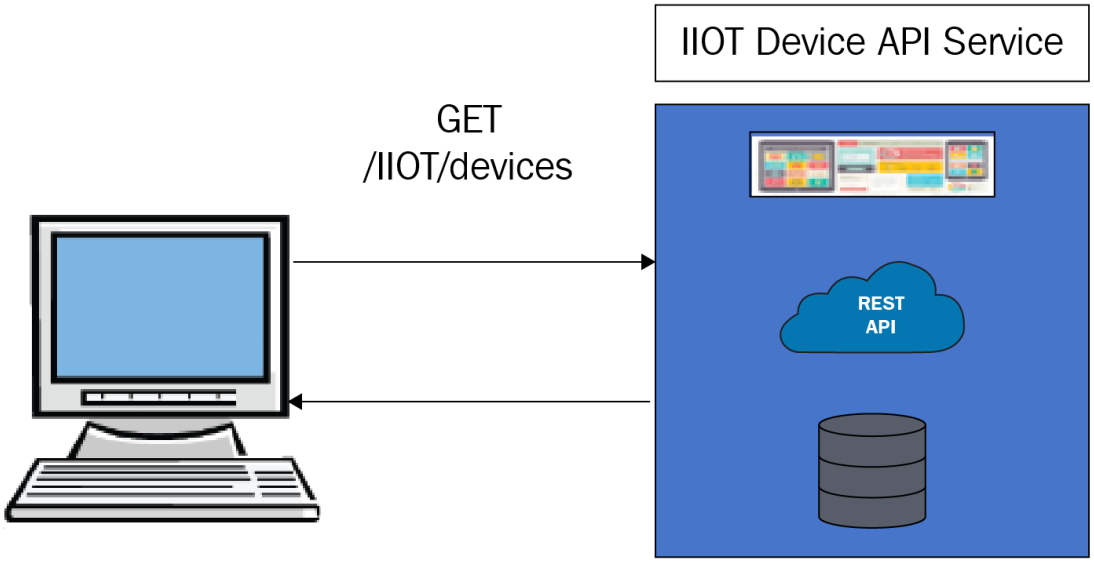

POST
https://predix-views.run.aws-usw02-pr.ice.predix.io/api/decks
Authorization
Headers (3)
Body
Pre-request Script
Tests
form-data
x-www-form-urlencoded
raw
binary
JSON (application/json)
{
"title": "Deck Title",
"cardOrder": [],
"id": "deck-1"
}
Body
Cookies
Headers (13)
Test Results
Pretty
Raw
Preview
JSON
{
"id": "deck-1",
"title": "Deck Title",
"slug": "px-deck",
"attributes": {},
"cardOrder": [],
"createTimeStamp": "2017-10-26T13:32:58.208Z"
}

```
[
    {
        "id": "HJmzRLJR-",
        "tenantId": "b3e07566-273f-4d1e-85ce-a5d4b2632a27",
        "title": "Current value",
        "slug": "device-card",
        "attributes": {
            "name": "sensor1:variable1",
            "device": "/device/raspberry"
        },
        "createTimeStamp": "2017-10-26T13:07:23.014Z"
    }
]
```

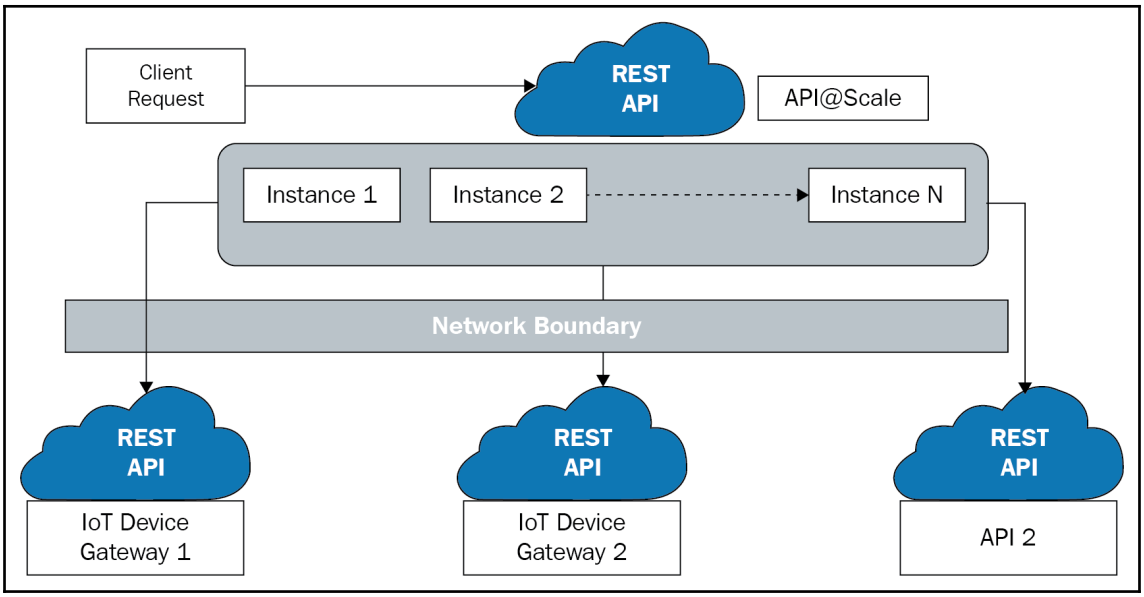



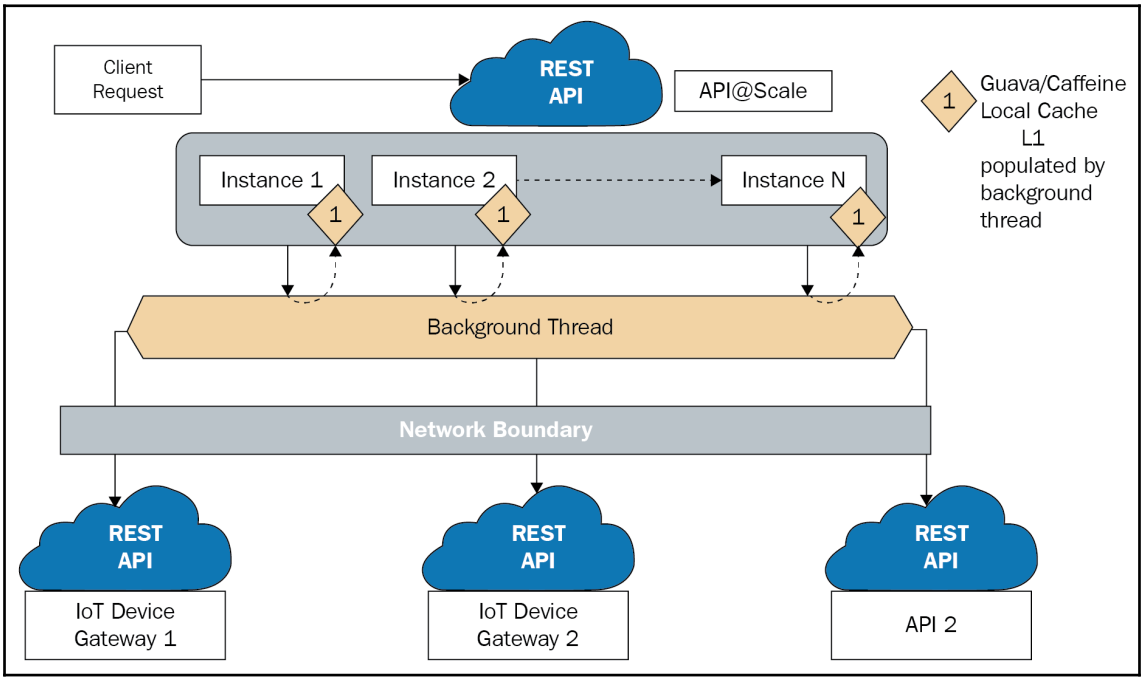


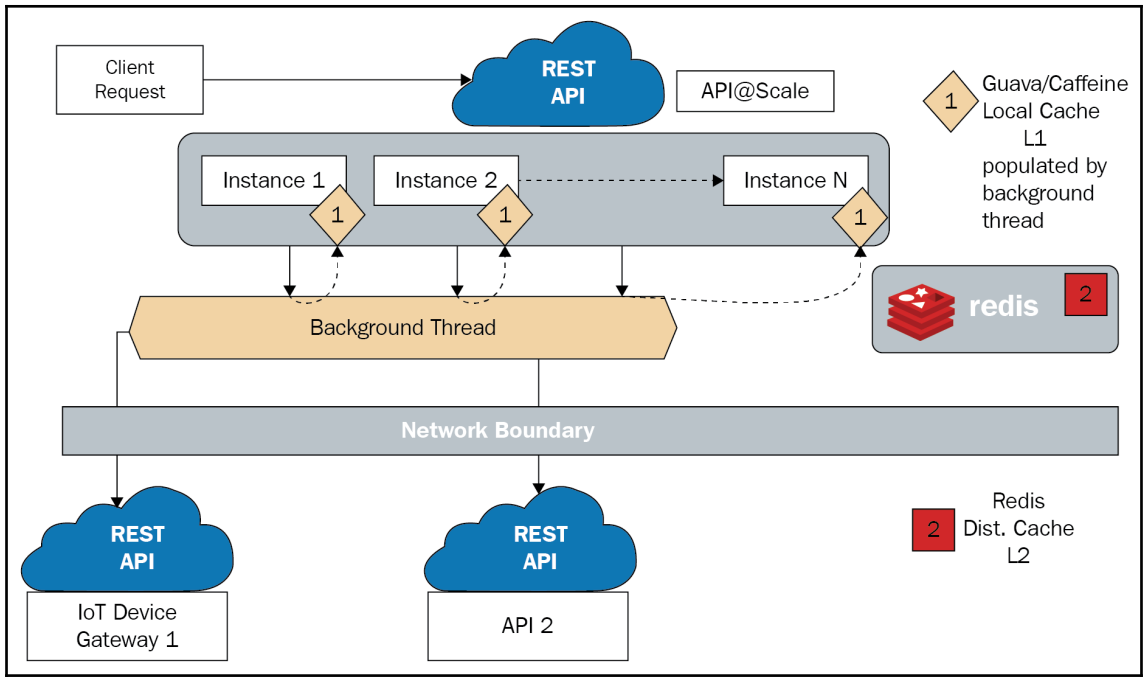
Chapter 10: Best Practices for IIoT Applications

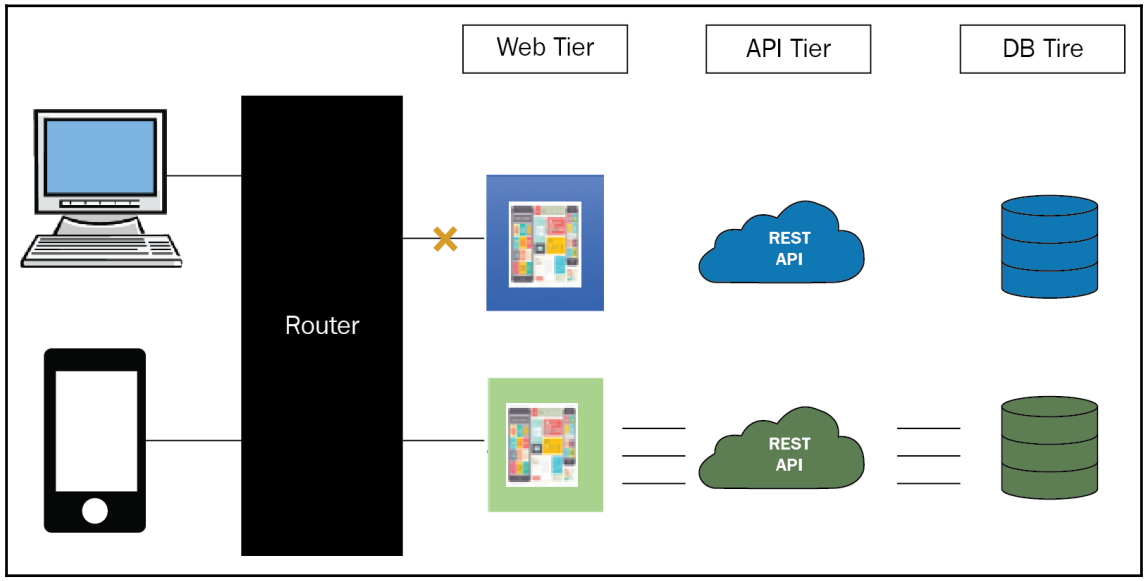


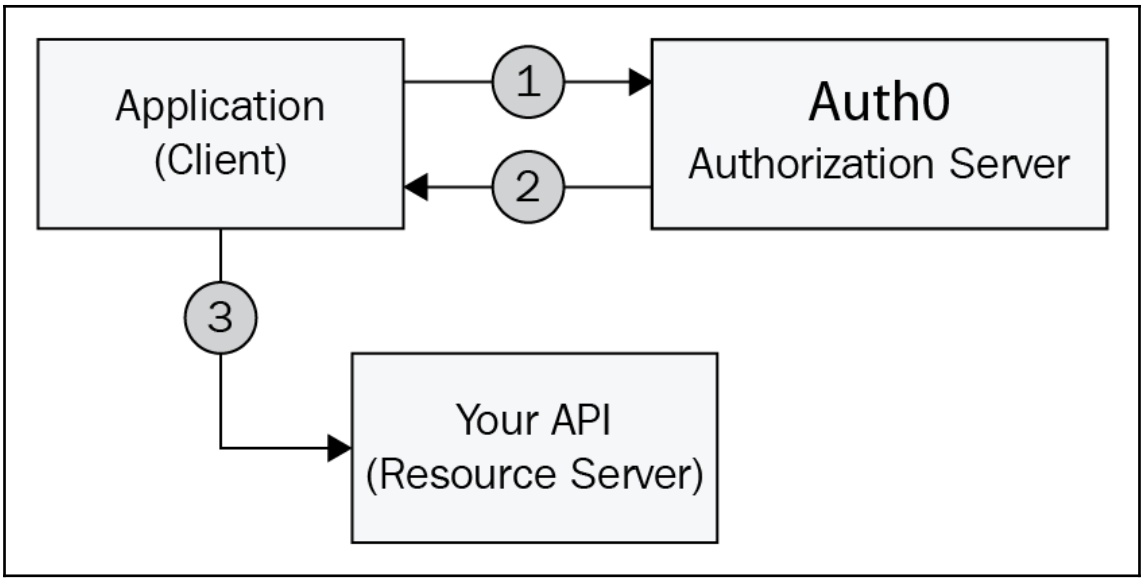

```
{
 "IIOTEcoSystem":"gets a list of IIOT Devices",
 "Version":"1.0",
 "CompanyName":"IIOTPlatform",
 "Devices";[
  {
    "deviceid":"10",
    "name":"device-pump",
    "asset-type":"pump",
    "active":"yes"
  }
  {
    "deviceid":"11",
    "name":"device-liquifier",
    "asset-type":"liquifier",
    "active":"yes"
  }
 ]
}
```

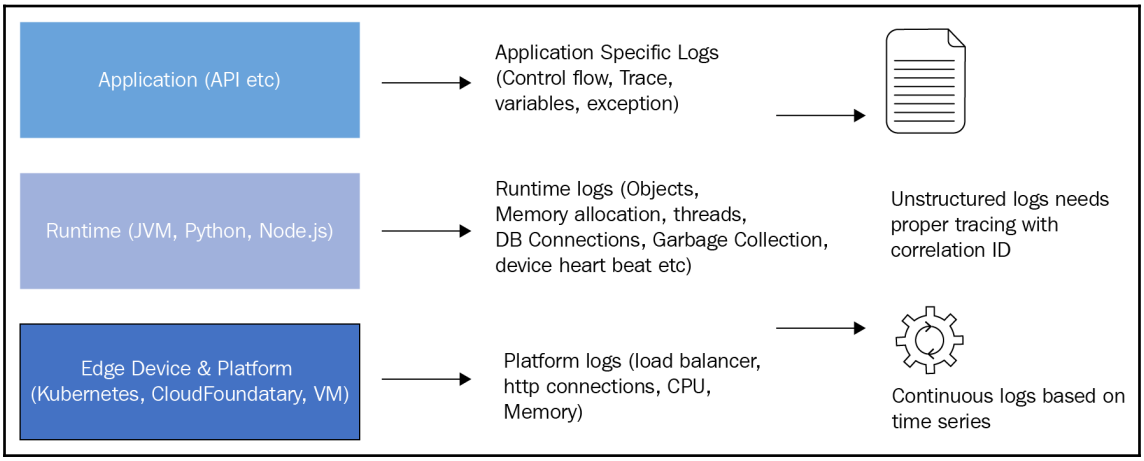

Client Request
REST API
API@Scale
Instance 1
Instance 2
Instance N
Network Boundary
REST API
IoT Device Gateway 1
REST API
IoT Device Gateway 2
REST API
API 2

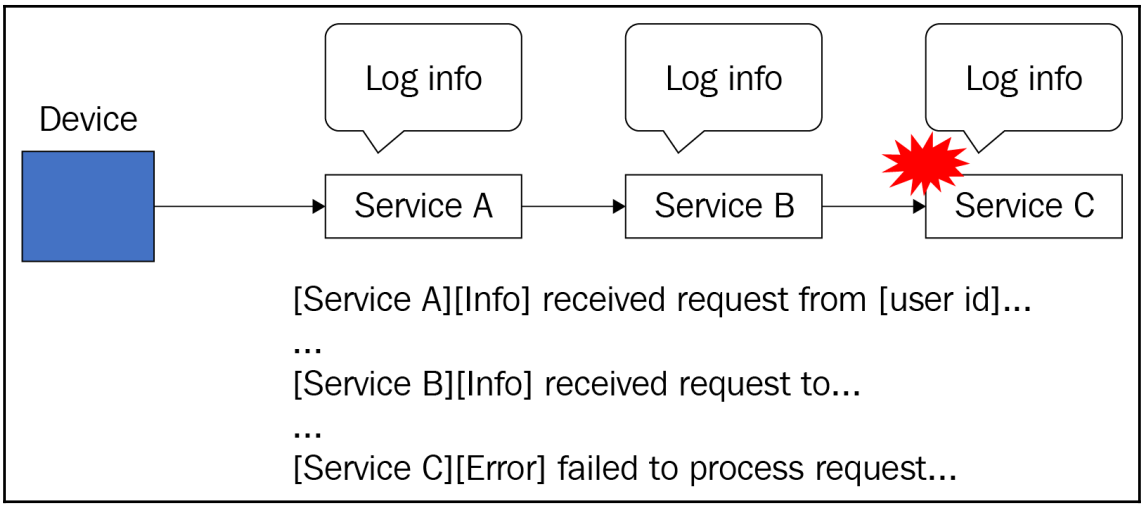

Client Request
REST API
API@Scale
1
Guava/Caffeine Local Cache L1 populated by background thread
Instance 1
Instance 2
Instance N
1
1
1
Background Thread
Network Boundary
REST API
IoT Device Gateway 1
REST API
IoT Device Gateway 2
REST API
API 2

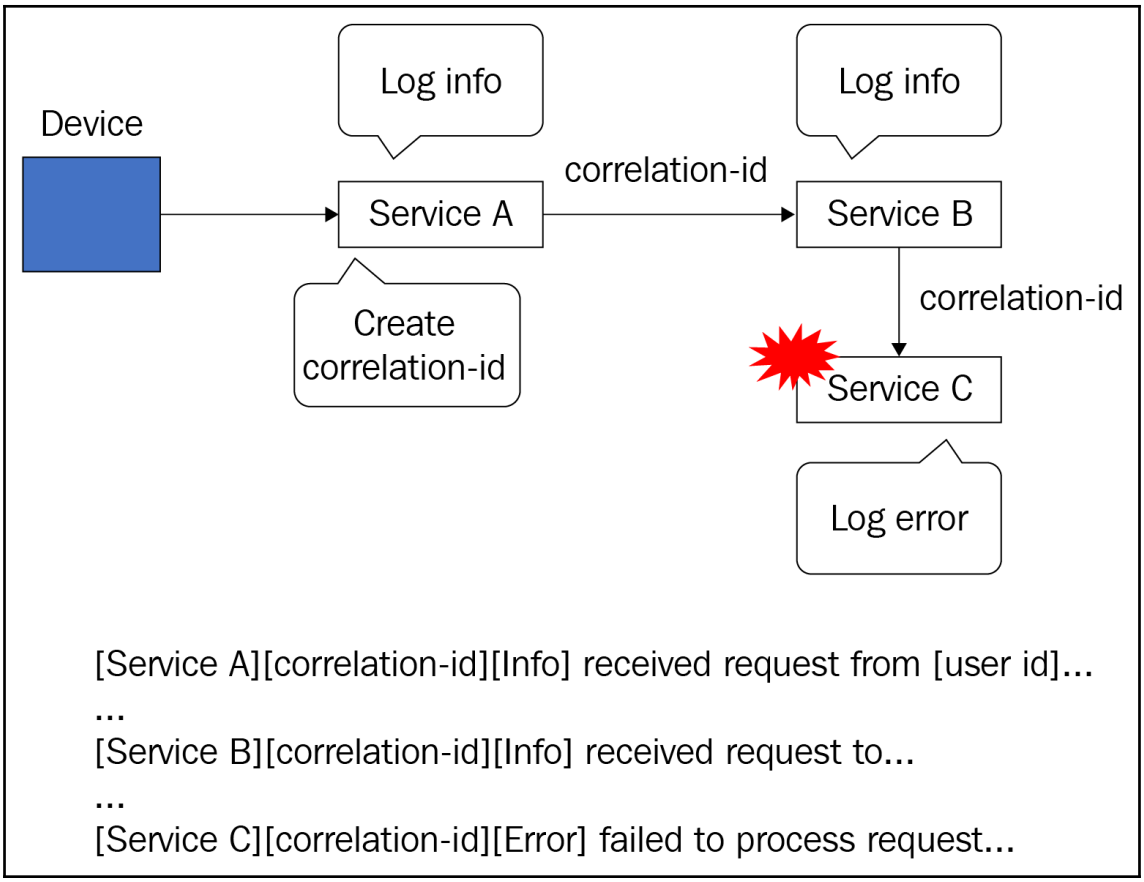

Client Request
REST API
API@Scale
1
Guava/Caffeine Local Cache L1 populated by background thread
Instance 1
Instance 2
Instance N
1
1
1
redis
2
Background Thread
Network Boundary
REST API
IoT Device Gateway 1
REST API
API 2
2
Redis Dist. Cache L2

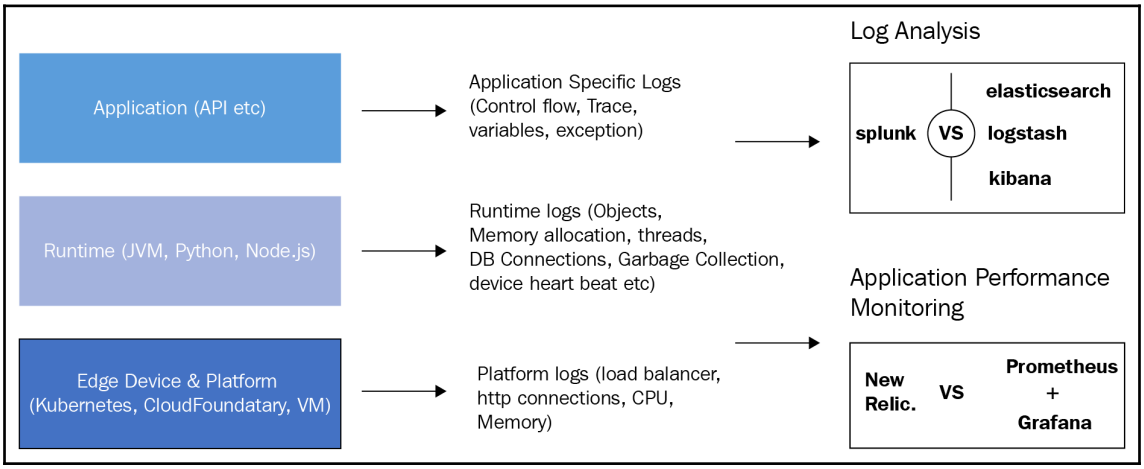

Web Tier
API Tier
DB Tire
Router
REST API
REST API

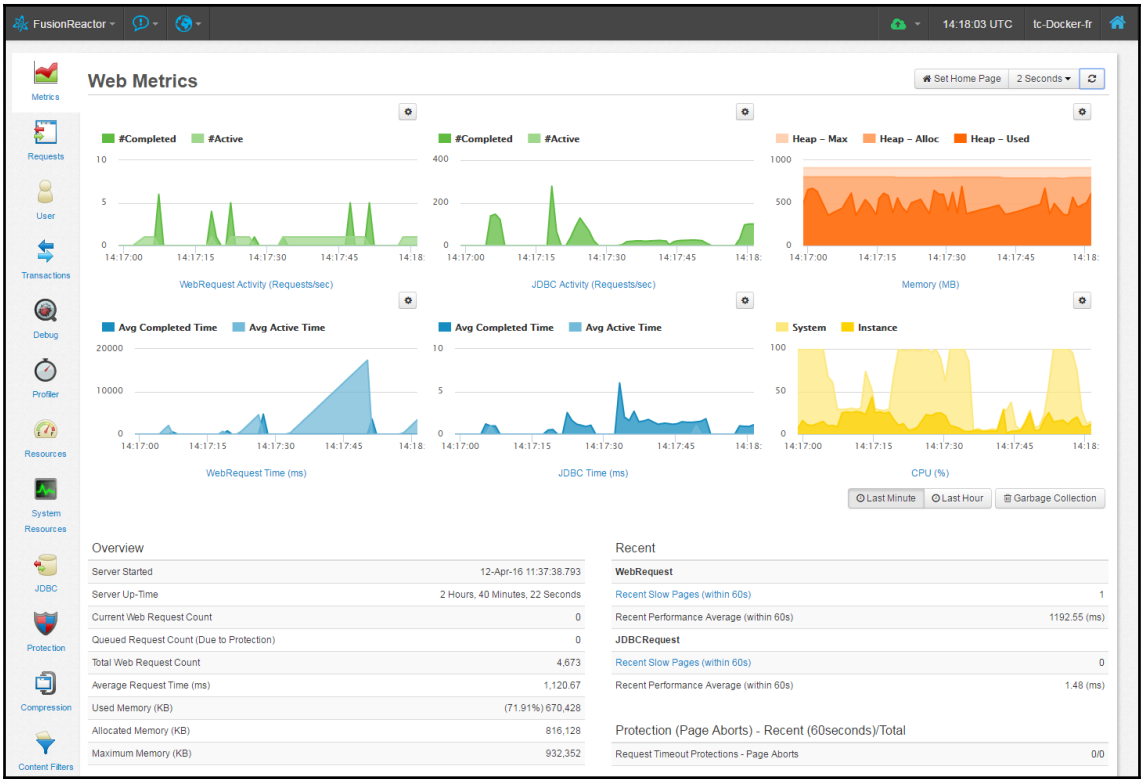

Application
(Client)
1
2
Auth0
Authorization Server
3
Your API
(Resource Server)


Application (API etc)
Application Specific Logs
(Control flow, Trace,
variables, exception)
Runtime (JVM, Python, Node.js)
Runtime logs (Objects,
Memory allocation, threads,
DB Connections, Garbage Collection,
device heart beat etc)
Unstructured logs needs
proper tracing with
correlation ID
Edge Device & Platform
(Kubernetes, CloudFoundatary, VM)
Platform logs (load balancer,
http connections, CPU,
Memory)
Continuous logs based on
time series


Log info
Log info
Log info
Device
Service A
Service B
Service C
[Service A][Info] received request from [user id]...
...
[Service B][Info] received request to...
...
[Service C][Error] failed to process request...


Log info
Log info
Device
correlation-id
Service A
Service B
correlation-id
Create
correlation-id
Service C
Log error
[Service A][correlation-id][Info] received request from [user id]...
...
[Service B][correlation-id][Info] received request to...
...
[Service C][correlation-id][Error] failed to process request...


Log Analysis
Application (API etc)
Application Specific Logs
(Control flow, Trace,
variables, exception)
elasticsearch
splunk
VS
logstash
kibana
Runtime (JVM, Python, Node.js)
Runtime logs (Objects,
Memory allocation, threads,
DB Connections, Garbage Collection,
device heart beat etc)
Application Performance
Monitoring
Edge Device & Platform
(Kubernetes, CloudFoundatary, VM)
Platform logs (load balancer,
http connections, CPU,
Memory)
New
Relic.
VS
Prometheus
+
Grafana


FusionReactor
14:18:03 UTC
tc-Docker-fr
Metrics
Requests
User
Transactions
Debug
Profiler
Resources
System Resources
JDBC
Protection
Compression
Content Filters
Web Metrics
Set Home Page
2 Seconds
#Completed
#Active
WebRequest Activity (Requests/sec)
JDBC Activity (Requests/sec)
Heap – Max
Heap – Alloc
Heap – Used
Memory (MB)
Avg Completed Time
Avg Active Time
WebRequest Time (ms)
JDBC Time (ms)
System
Instance
CPU (%)
Last Minute
Last Hour
Garbage Collection
Overview
Server Started 12-Apr-16 11:37:38.793
Server Up-Time 2 Hours, 40 Minutes, 22 Seconds
Current Web Request Count 0
Queued Request Count (Due to Protection) 0
Total Web Request Count 4,673
Average Request Time (ms) 1,120.67
Used Memory (KB) (71.91%) 670,428
Allocated Memory (KB) 816,128
Maximum Memory (KB) 932,352
Recent
WebRequest
Recent Slow Pages (within 60s) 1
Recent Performance Average (within 60s) 1192.55 (ms)
JDBCRequest
Recent Slow Pages (within 60s) 0
Recent Performance Average (within 60s) 1.48 (ms)
Protection (Page Aborts) - Recent (60seconds)/Total
Request Timeout Protections - Page Aborts 0/0

Chapter 11: Future Direction of the IIoT