IoT with Apache ActiveMQ, Camel and Spark

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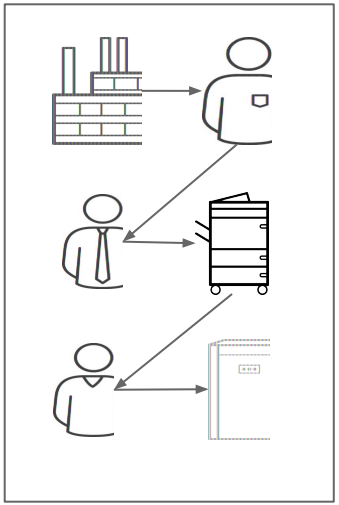
Agenda

- Business & IT Architecture
- IoT Architecture
- IETF IoT Use Case
- Ingestion: Apache ActiveMQ, Apache Camel
- Analytics: Apache Spark
- Demos

Business & IT: 80’s to Future

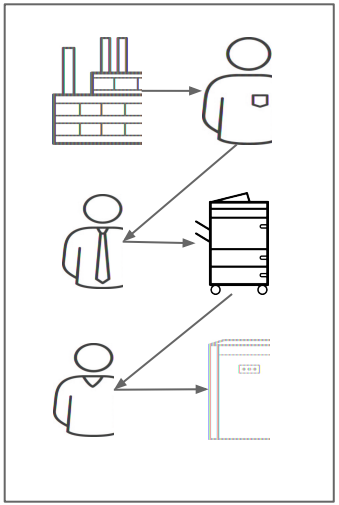
ChUI



80’s

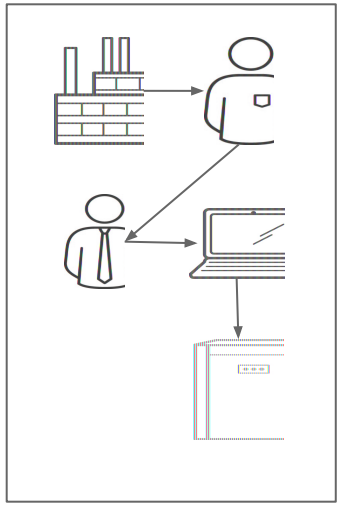
Business & IT: 80’s to Future

ChUI



80’s

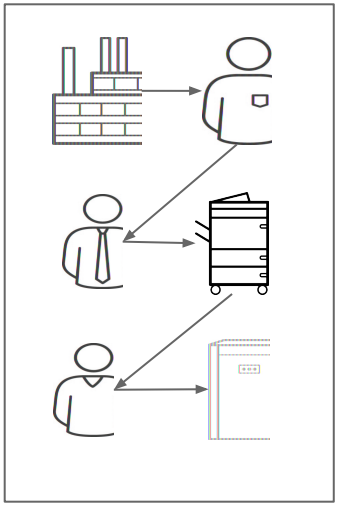
GUI



90’s

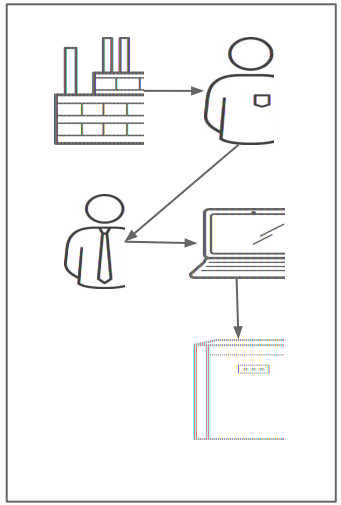
Business & IT: 80’s to Future

ChUI



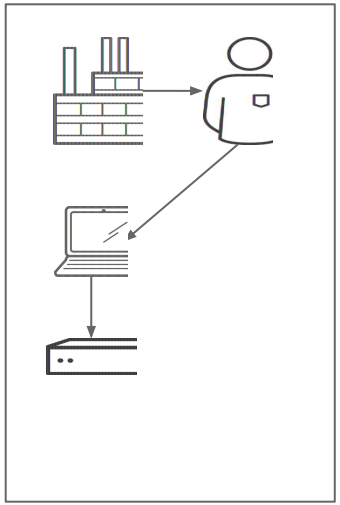
80’s

GUI



90’s

Web



00’s

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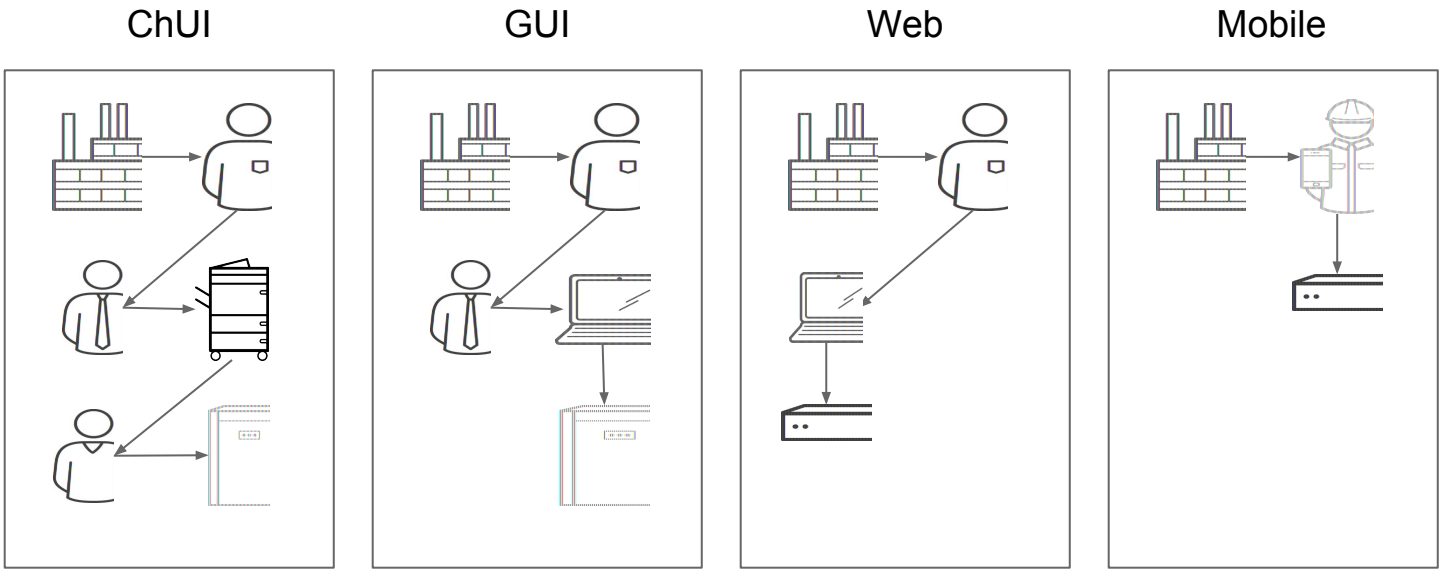
Business & IT: 80's to Future



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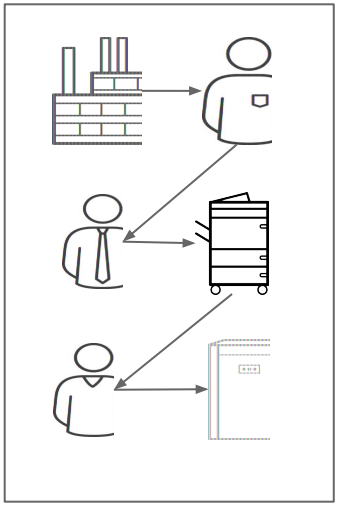
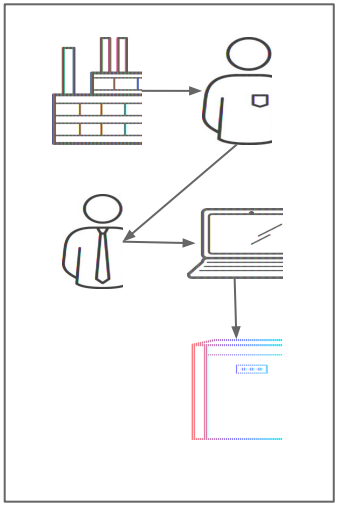
Business & IT: 80's to Future

ChUI



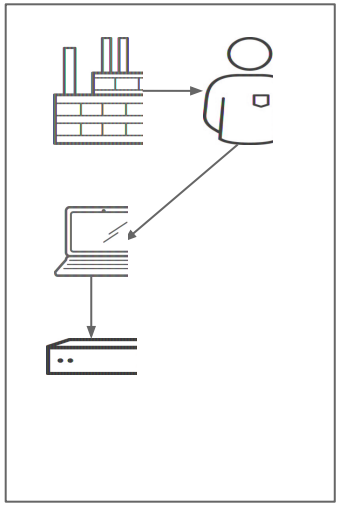
80's

GUI



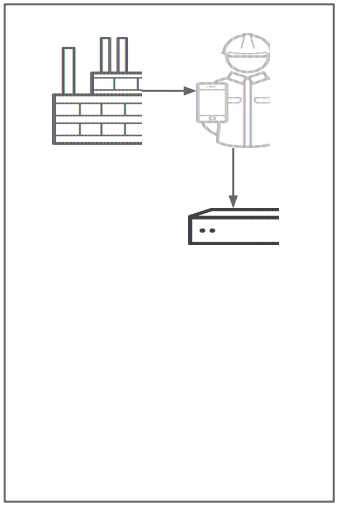
90's

Web



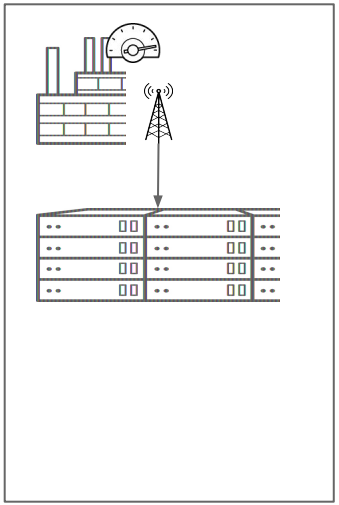
00's

Mobile



10's

Things



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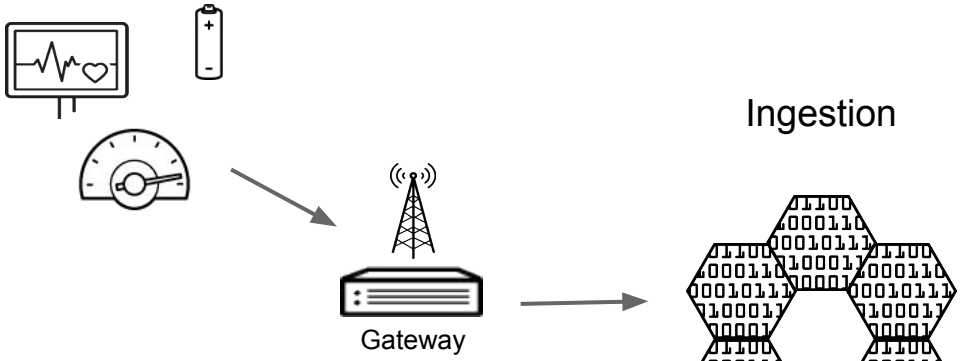
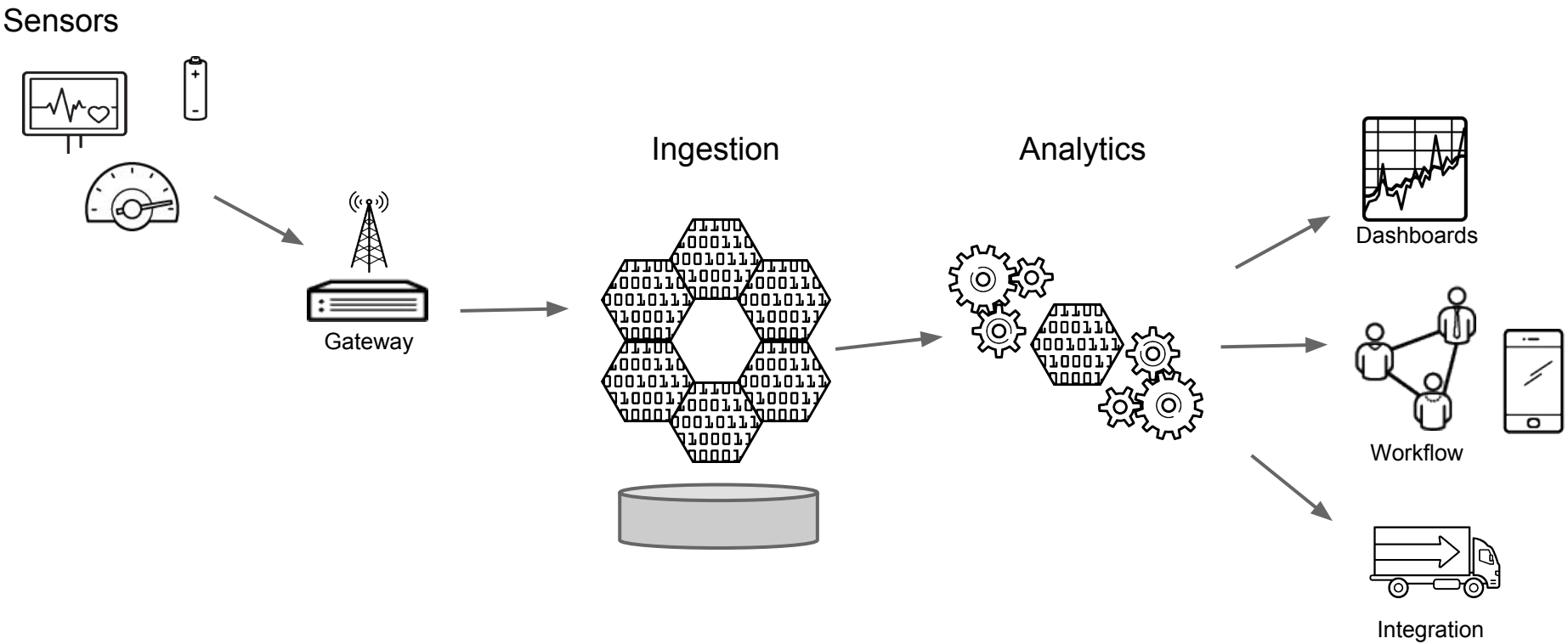
Sensors



Ingestion



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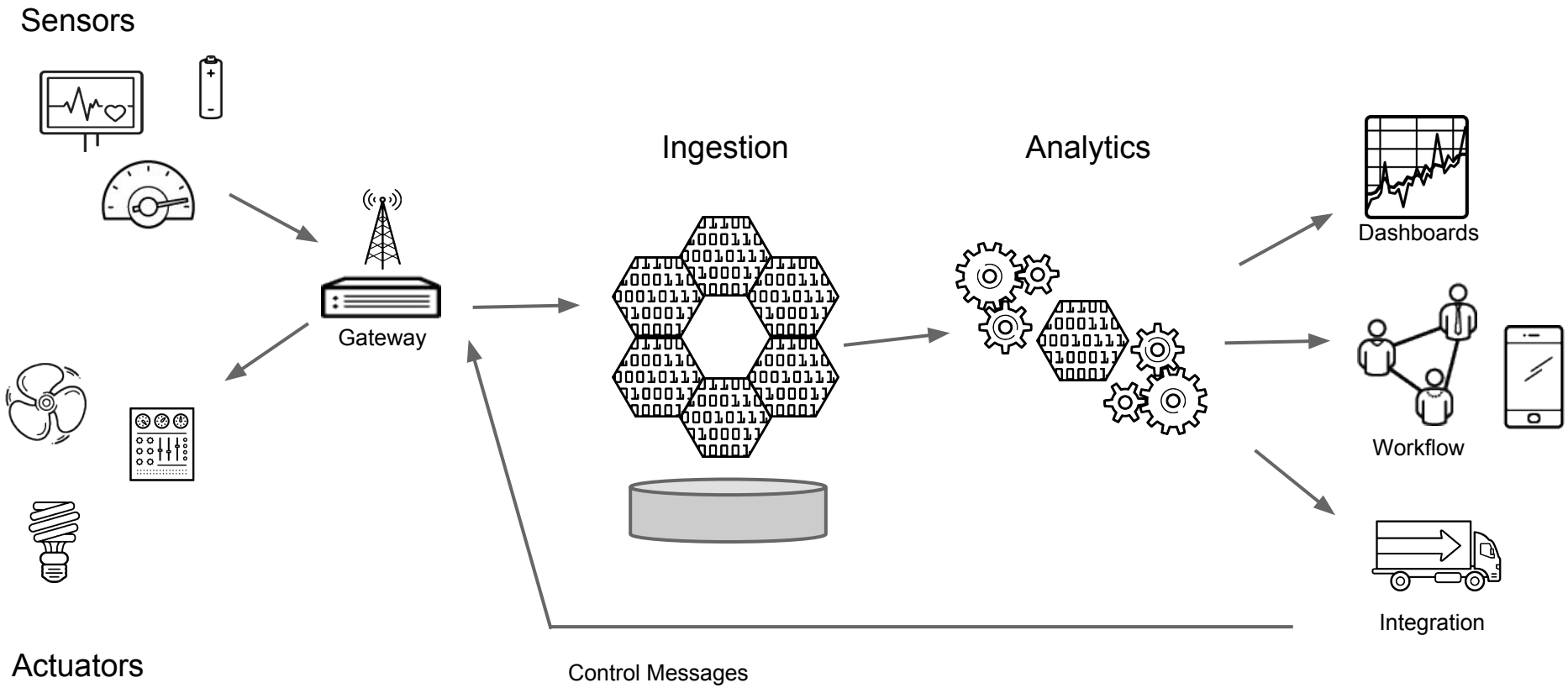

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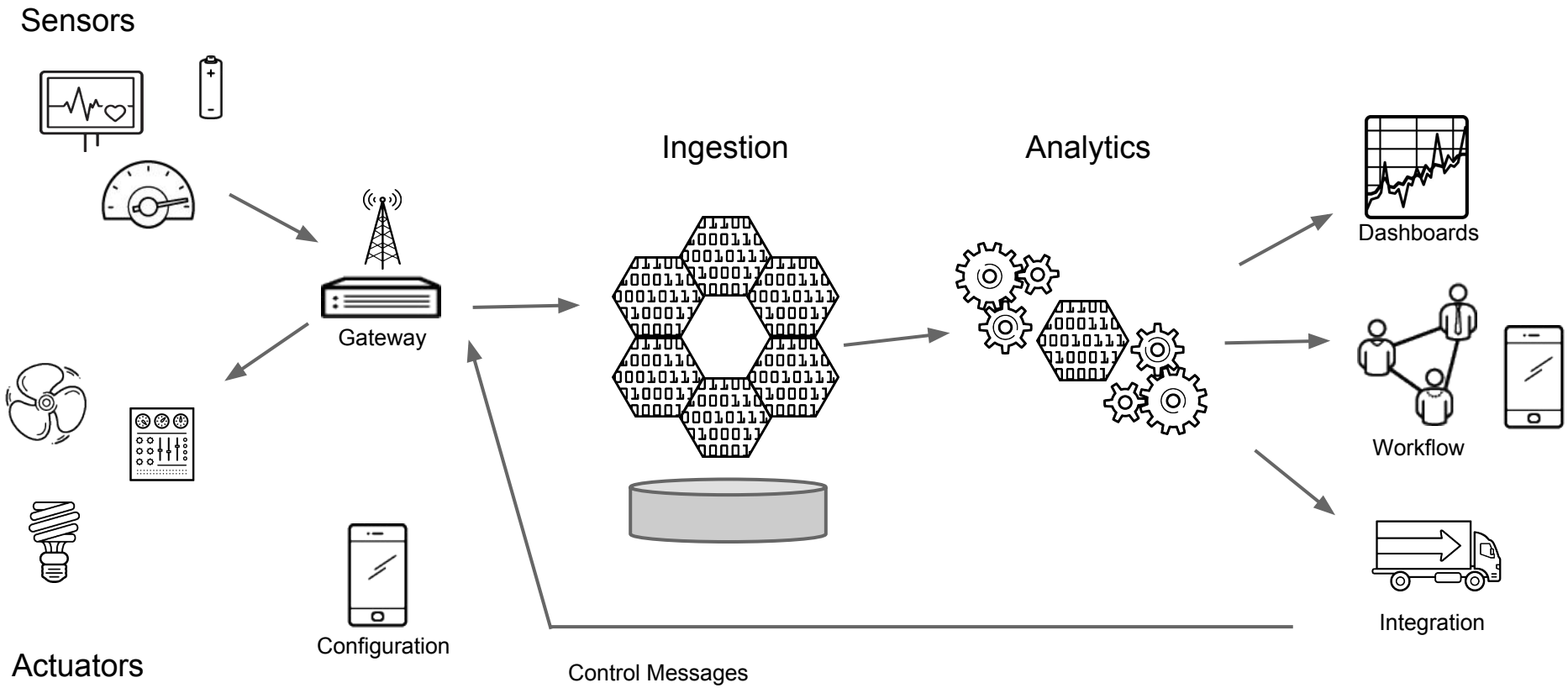

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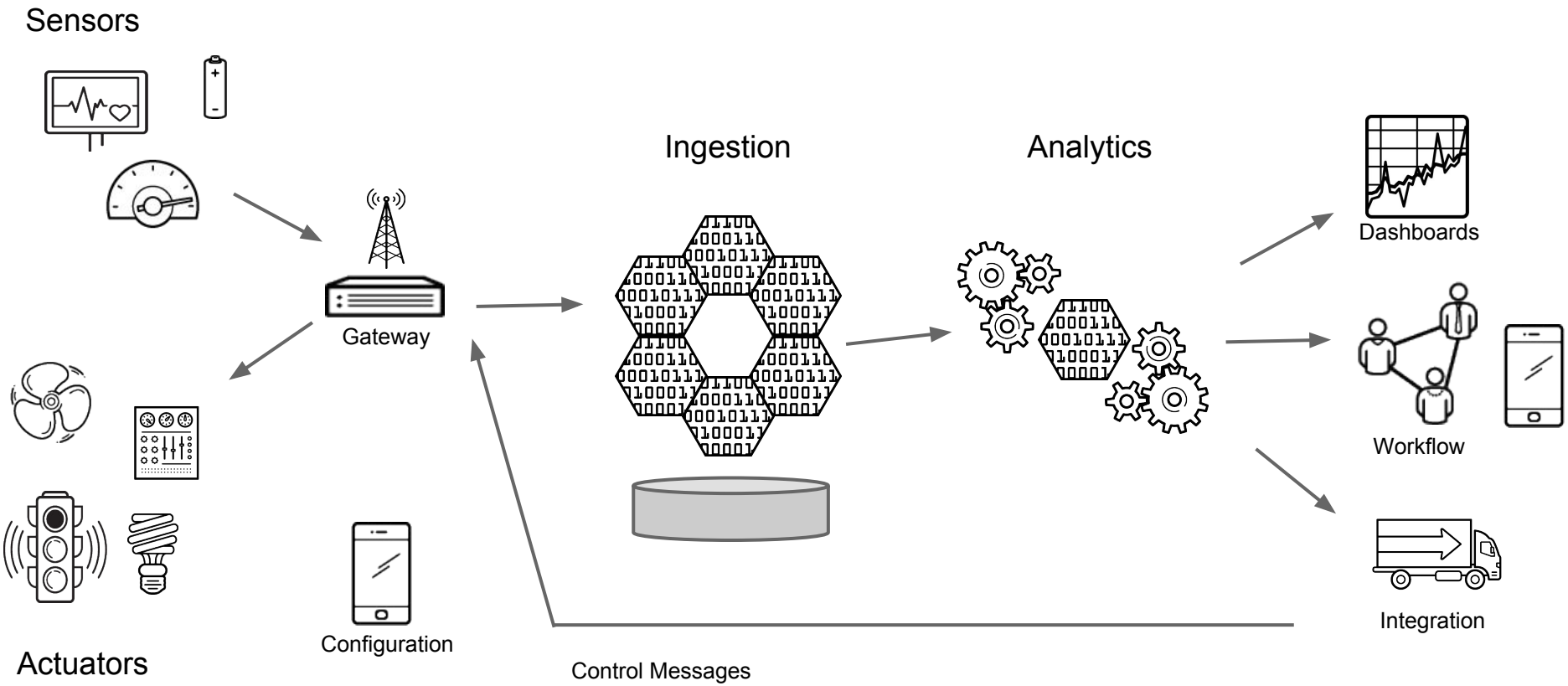

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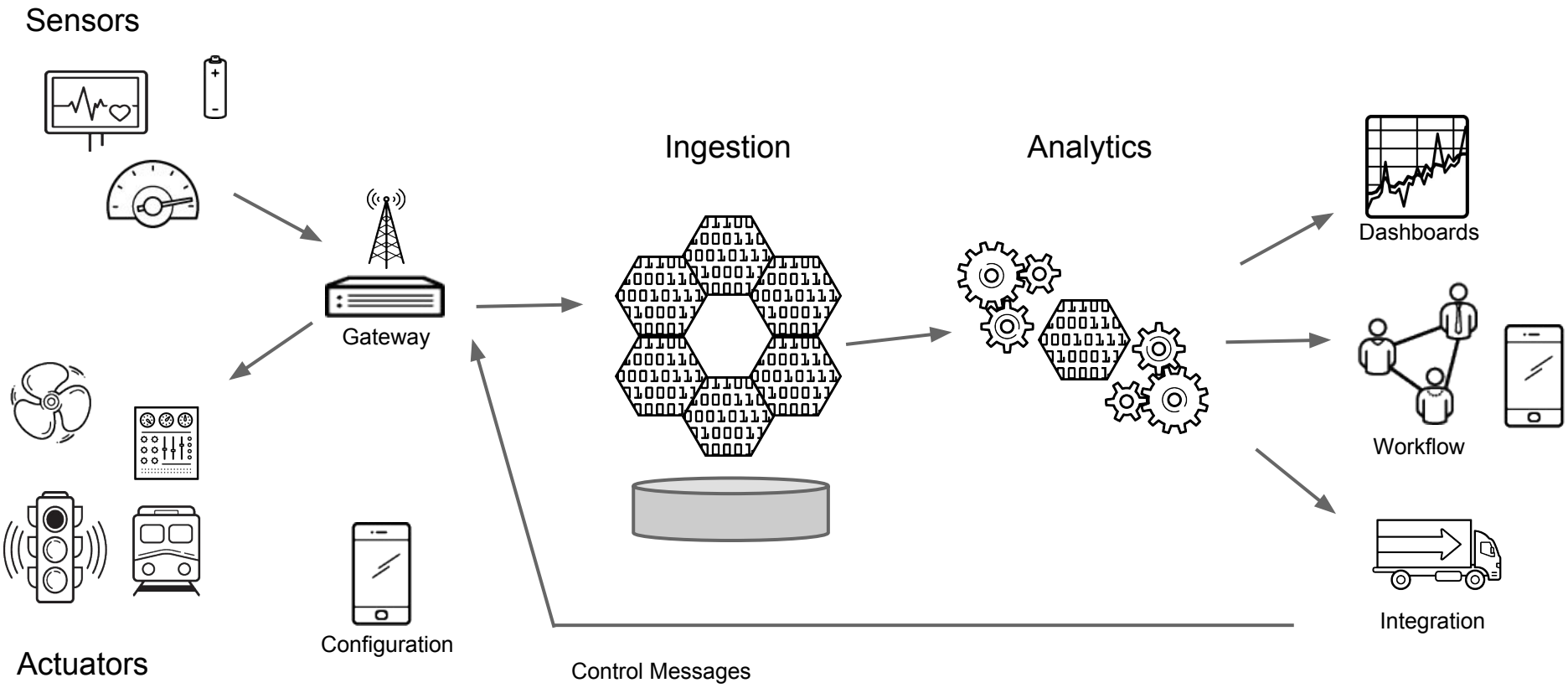

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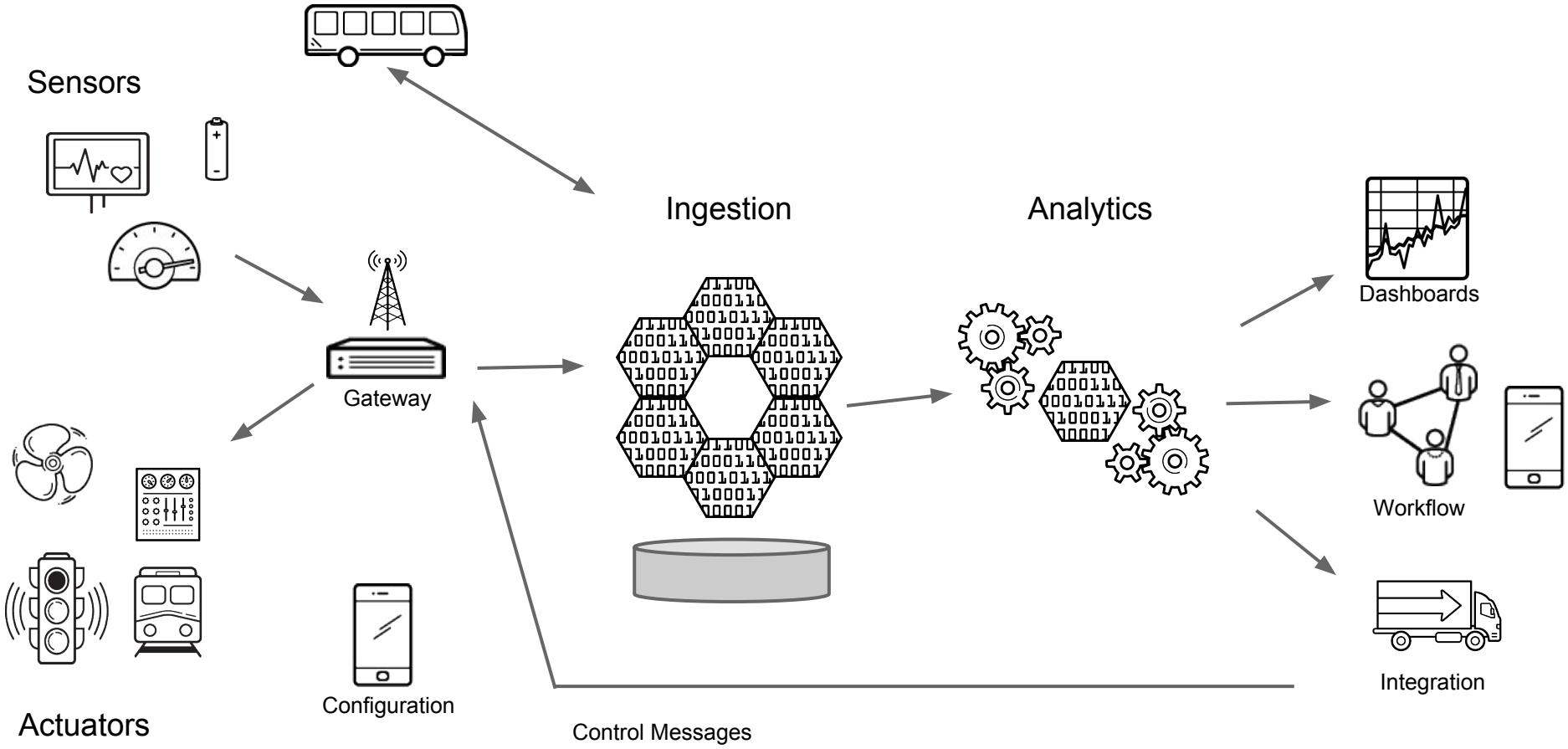

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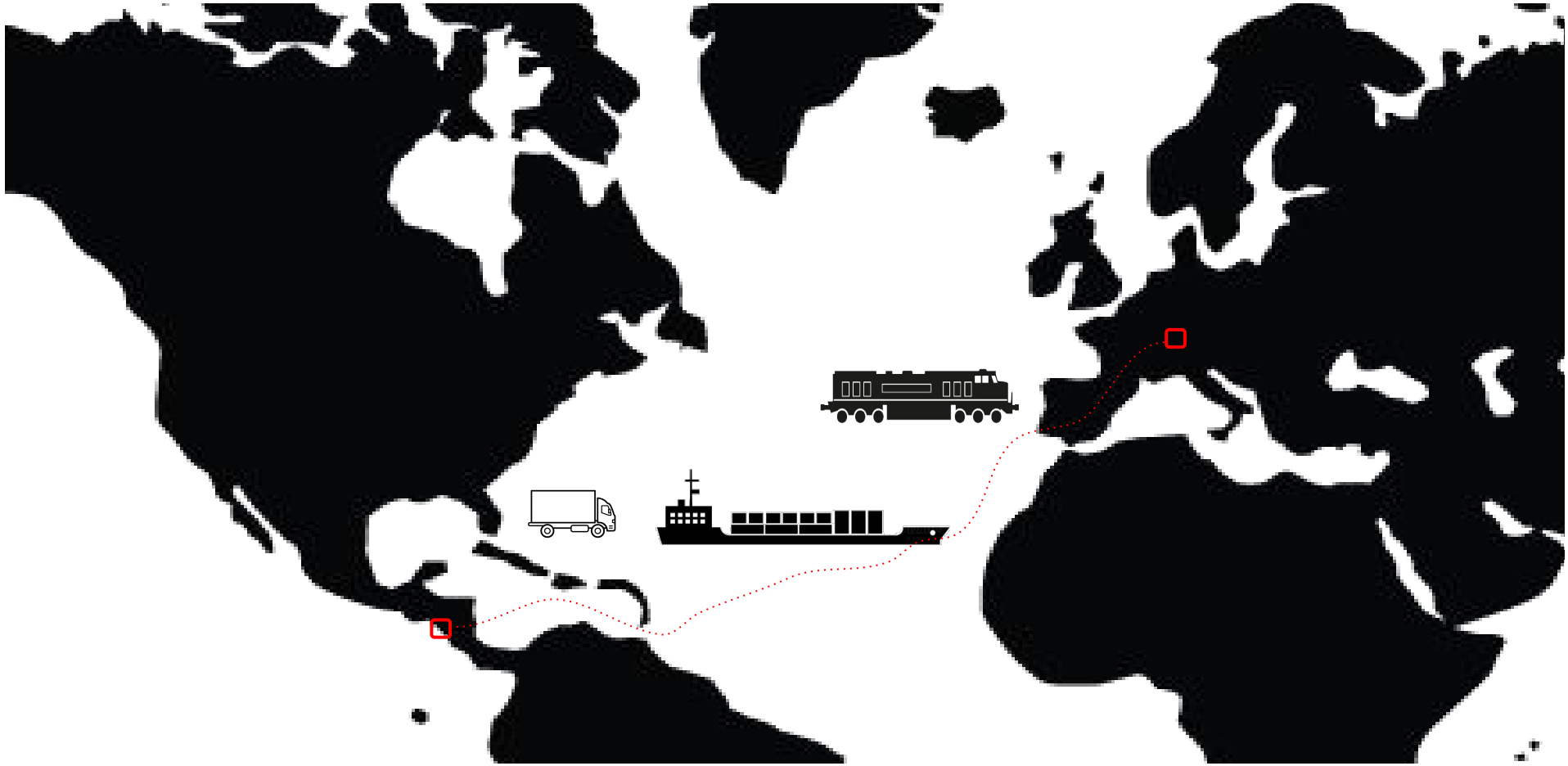
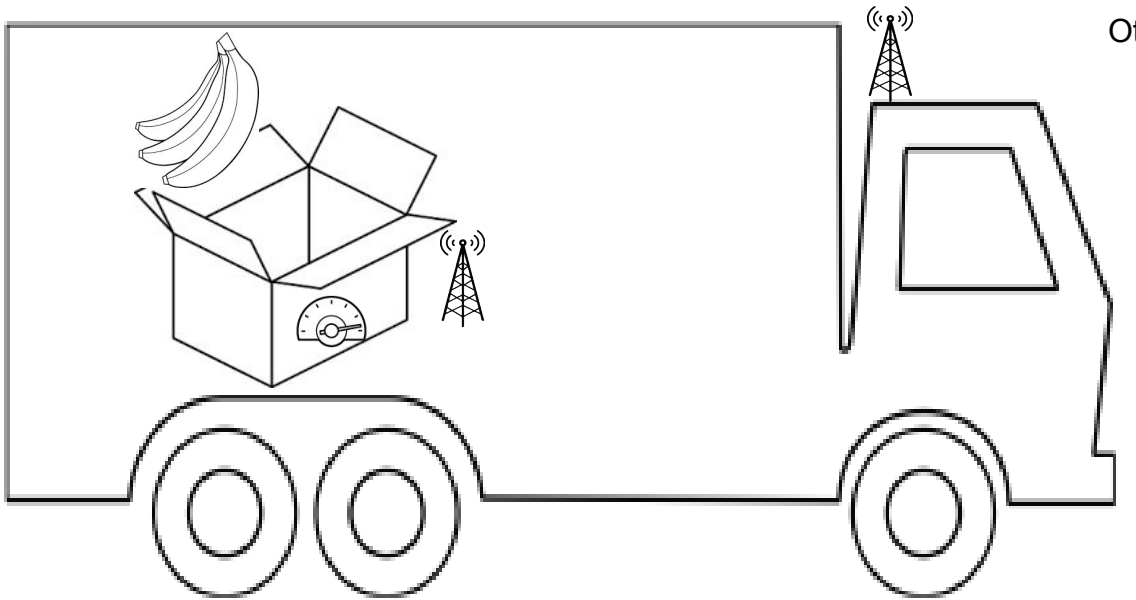
Bananas for Munich - https://tools.ietf.org/html/draft-seitz-ace-usecases-02#section-2.1.1



“The fruit vendor's quality management wants to assure the quality of their products and thus equips the banana boxes with sensors. The state of the goods is monitored consistently during shipment and ripening and abnormal sensor values are recorded. Additionally, the sensor values are used to control the climate within the cargo containers. Since a wrong sensor value leads to a wrong temperature and thus to spoiled goods, the integrity of the sensor data must be assured.”

My embellishment of the key business concerns:
Are my bananas over-ripe by the time they arrive at the store?
If so, at what point in the 6000 mile journey did they go out of specification?



Monitoring for :

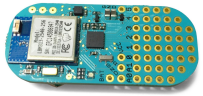
- Temperature
- Humidity
- Accelerometer
- GPS

Other Requirements:

- Container/vehicle climate control system
- Battery operated
- Inexpensive (one per crate/box)
- Ruggedized enough
- Bananas are mostly water - RF interference
- Truck->Ship->Train->Truck
- On Land Real-Time Monitoring (Cell-based)

Microcontrollers

Particle.io - Photon WiFi ($19)

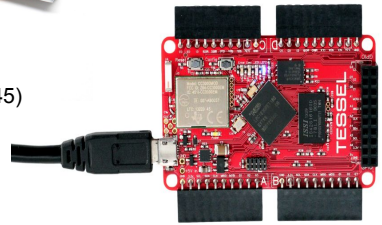


LightBlue Bean BLE ($29)

Electric Imp WiFi ($29)

MetaWear BLE ($45)

Tessel WiFi ($39)

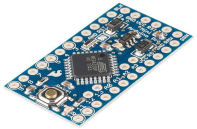


runs JavaScript

TI SensorTag BLE ($29)

ESP8266 ($4)
WiFi

Arduino Uno ($25)



Arduino Pro Mini ($10)

Embedded Linux

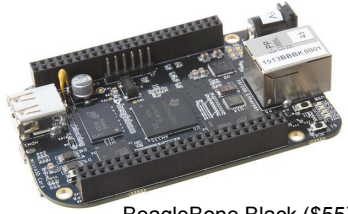
Intel Edison ($50)
includes WiFi and Bluetooth

Onion Omega ($25)
includes WiFi

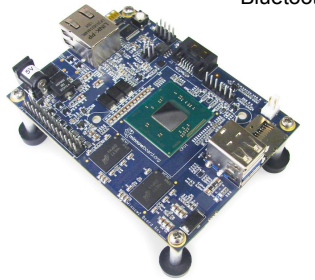
Arduino Yun ($75)
+ WiFi ($10)

Raspberry Pi 2 ($35)
+ WiFi ($10)
+ Bluetooth ($10)

C.H.I.P ($9)
includes WiFi,
Bluetooth



BeagleBone Black ($55)
+ WiFI ($10) + BLE ($10)



MinnowBoard Max ($145)

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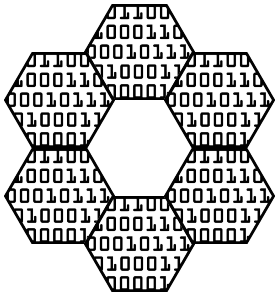

Ingestion

Apache ActiveMQ & Apache Camel

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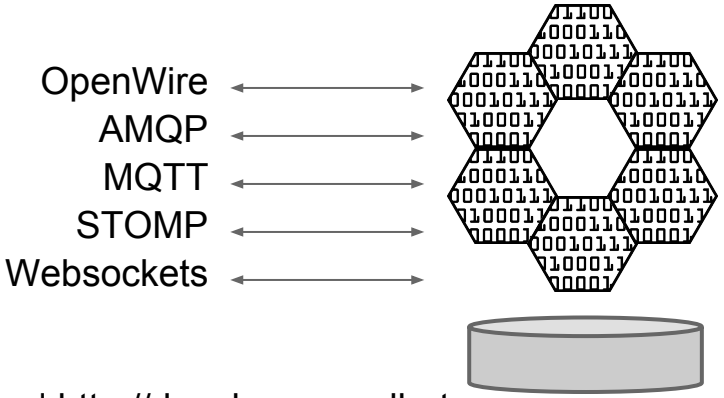
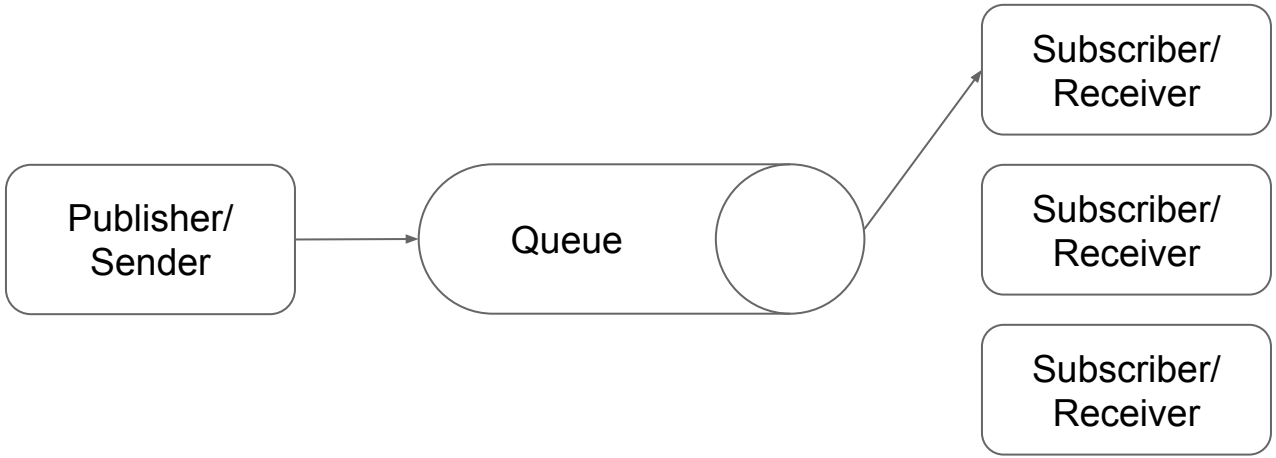
Apache ActiveMQ

- Top Level Apache Software Foundation project
- Client support for Java, C++, C#, Ruby, Python, Perl, JavaScript
- Protocols: OpenWire, Stomp, AMQP, MQTT
- Embeddable into your Spring and/or Camel apps
- Point-to-Point and Pub/Sub Messaging

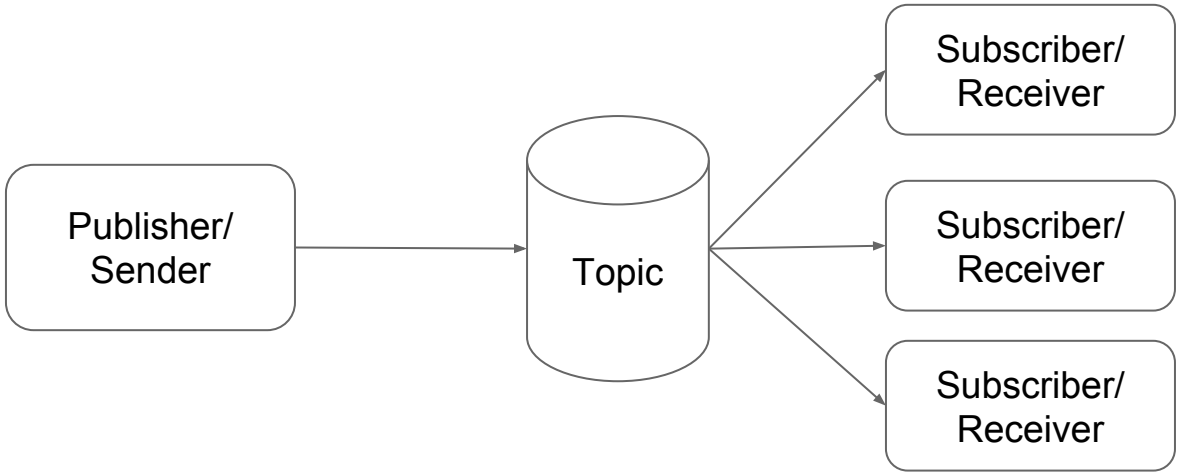


Point to Point (Queue)



Only one receiver of a specific message

Pub Sub (Topic)



All subscribers receive the message

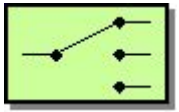
Apache Camel

Apache Camel is an open source Java framework that focuses on making integration easier and more accessible to developers.

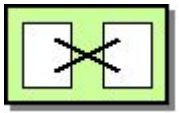
- concrete implementations of Enterprise Integration Patterns (EIPs)
- connectivity to a great variety of transports and APIs
- easy to use Domain Specific Languages (DSLs) to wire EIPs and transports together
- Embeddable in your JVM-based application

Components: MQTT, JMS, File, HTTP, AMQP, SMTP, POP3, HL7, HipChat
http://camel.apache.org/components.html

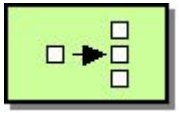
Enterprise Integration Patterns



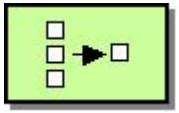
Router



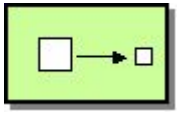
Translator



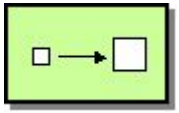
Splitter



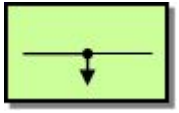
Aggregator



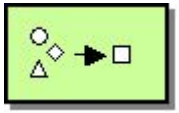
Filter



Enricher



Wire Tap



Normalizer

http://camel.apache.org/enterprise-integration-patterns.html

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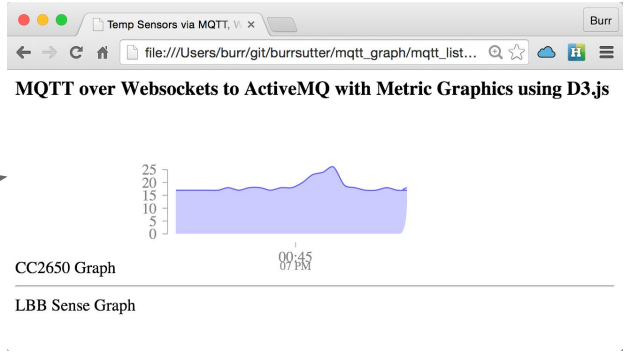
Camel Demo



MQTT

Apache Camel

MQTT

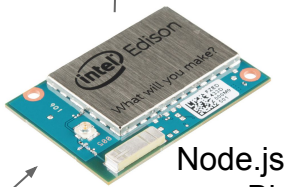
Apache ActiveMQ (Fuse A-MQ)

MQTT over WebSockets to browser

MQTT over WiFi

MQTT over WiFi

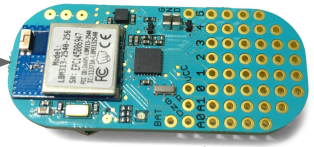
TI SensorTag - Bluetooth 4.0



Node.js polls SensorTag over Bluetooth, publishes MQTT over WiFi

Node.js subscriber, if HOT writes Bluetooth scratch data

LightBlue Bean - C code



Servo

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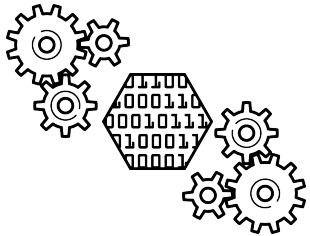

Analytics

Apache Spark

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Apache Spark

- Fast: In-memory, runs up to 100x faster than Hadoop Map-Reduce
- Write applications in Java, Scala, Python, R
- Batch & Spark Streaming
- Spark SQL - SQL & HQL (Hive)
- MLlib - machine learning
- GraphX

Apache Spark (continued)

- HDFS, S3, Cassandra, Infinispan…
- Cluster: Standalone, YARN, Mesos
- Simple word count example:

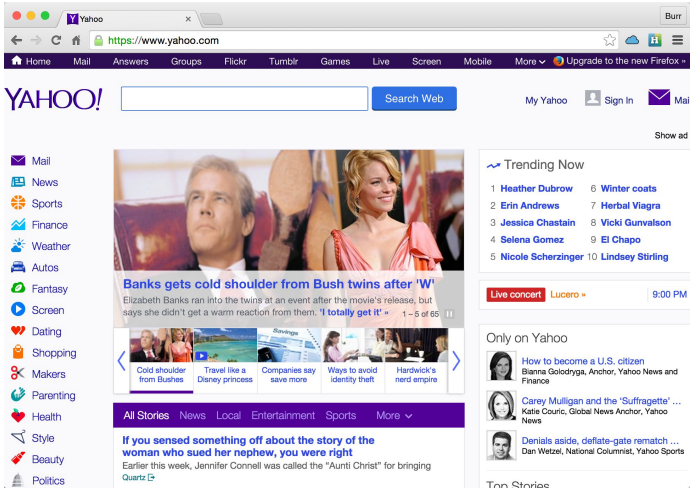
```
# start the Spark shell (scala REPL)
$SPARK_HOME/bin/spark-shell

val f = sc.textFile("data/dracula.txt")
val blood = f.filter(line => line.contains("blood"))
blood.count()
blood.first()
```

Apache Spark in the Wild

Yahoo

- News Personalization
- Spark ML: 120 lines of Scala
- Replaced 15,000 lines of C++



http://www.datanami.com/2014/03/06/apache_spark_3_real-world_use_cases/

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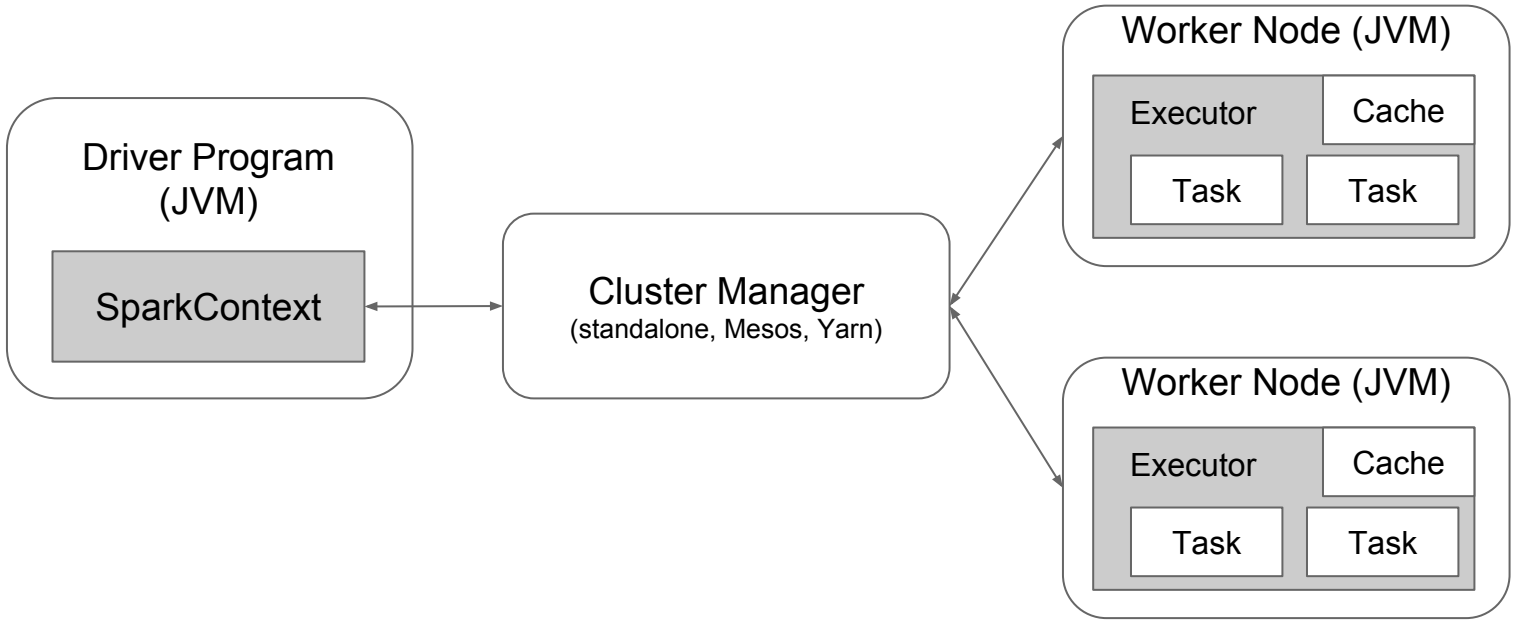
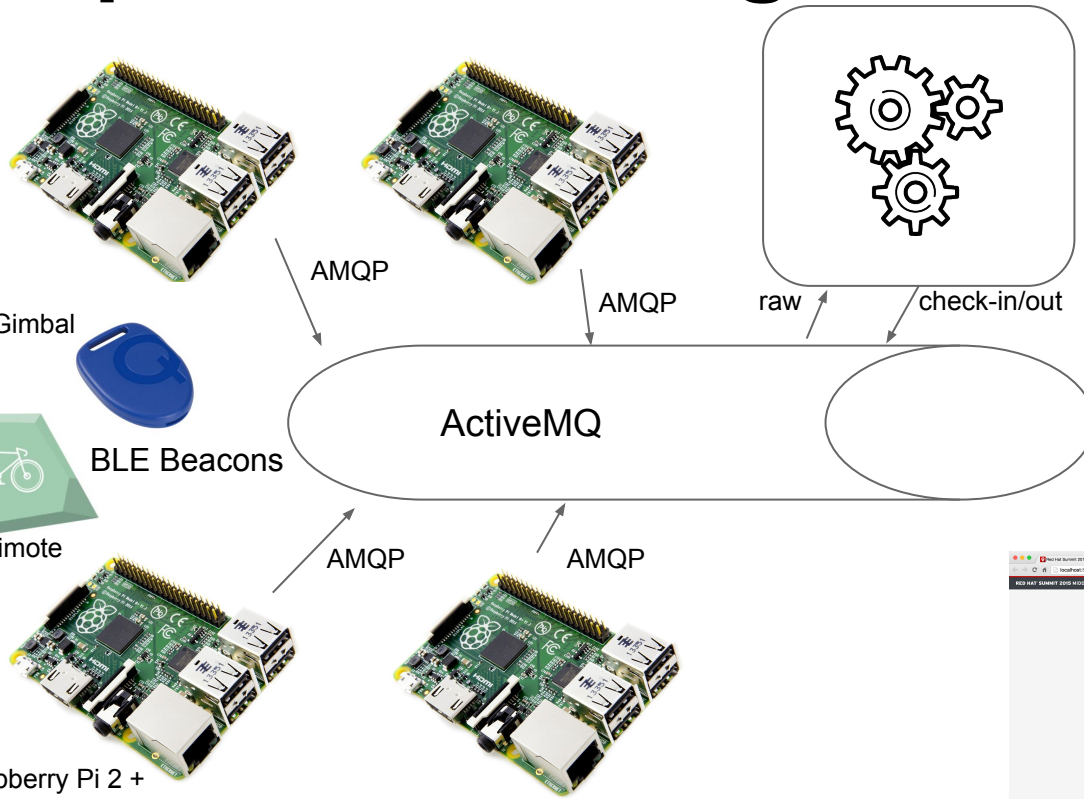
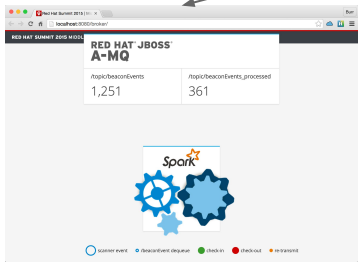
Spark runtime architecture

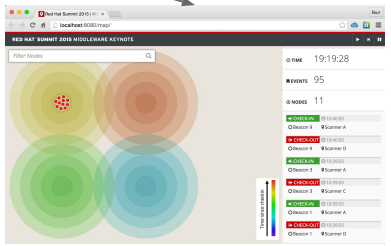


Spark Streaming Demo



Spark receives raw events and calculates check-in, check-out and retransmit events





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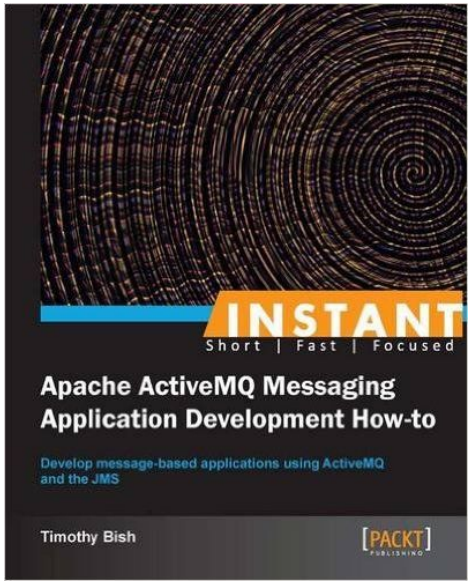

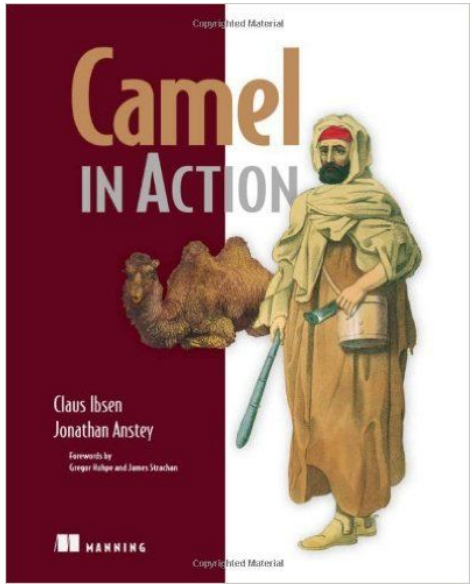

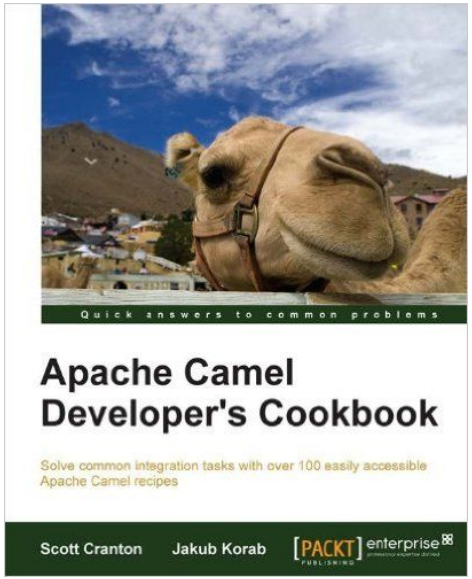

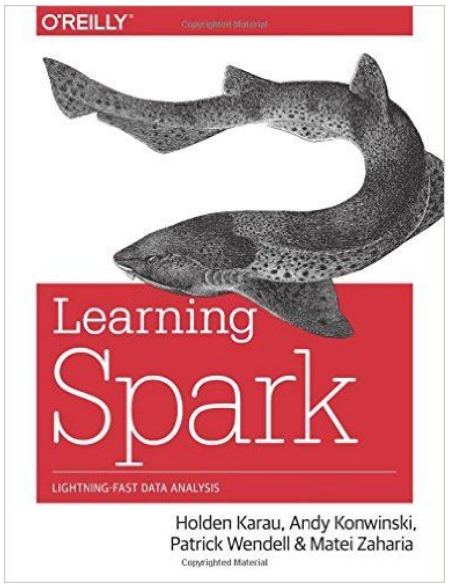

Red Hat IoT Project: https://github.com/rhiot/rhiot

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