Container hybrid deployment to the Edge
powered by Openshift & RHEL

Alessandro Arrichiello
Solution Architect
IoT Ambassador
ale@redhat.com

Luca Bigotta
Solution Architect
IoT Ambassador
luca.bigotta@redhat.com
RED HAT MISSION

To be the catalyst in communities of customers, contributors, and partners creating better technology the open source way
FROM COMMUNITIES TO ENTERPRISE
A RED HAT SUBSCRIPTION
Delivers Continuous Value Every Day

CUSTOMER PORTAL  KNOWLEDGE  SECURITY  CERTIFICATIONS

SUPPORT  LIFE CYCLE  ASSURANCE

access.redhat.com/subscription-value
What is IoT scenario?

we can normally heard about IoT on both:

- from **few sensors** scenarios ...
  - home automation, remote control (e.g. air conditioner, boiler ... domestic agriculture analytics)
What is IoT scenario?

we can normally heard about IoT on both:

● from few sensors scenarios ...
  ○ home automation, remote control (e.g. air conditioner, boiler ... domestic agriculture analytics)
● … to **big number of sensors** ...
  ○ predictive maintenance
What is IoT scenario?

we can normally heard about IoT on both:

- from few sensors scenarios ...
  - home automation, remote control (e.g. air conditioner, boiler ... domestic agriculture analytics)
- ... to big number of sensors ...
  - predictive maintenance
- ... until huge number of devices
  - smart cities, smart metering, telematics insurance

on growing number of sensor/devices corresponds growing of the complexity of the IT landscape to support the scenario:

- needs of device management & service management
- huge input traffics: needs to filter data, manage and store
- needs to correlate info from different devices to identify pattern in Real Time
ENTERPRISE IoT ARCHITECTURE
Driving datacenter function to the edge

- Business processing
- Reporting
- Long-term data analytics
- Data infrastructure
- Enterprise integration
- Software-defined storage

Communications/messaging
- Data pre-processing
- Real-time data analytics
- Real-time actions/rules
- Software-defined storage
- Security

- Communications/messaging
- Data acquisition
DIFFERENT TYPES OF IOT GATEWAY
On the Market

“Communications Gateway” - communication proxy only

“Smart Gateway” – localized data processing (e.g. Summarization, aggregation, transformation and routing ..)

“Intelligent Gateway” - localized decision and actions at the edge. It allow for real-time intelligence and business tools at the edge, adding business rules and complex event processing (CEP)
EMPOWERING DATA DRIVEN IOT
THE POWER OF DATA + INTELLIGENCE

DATA
Data emitted from sensors, control panels, actuators, human interfaces, etc.

INFORMATION
Data analyzed to drive tactical action

INTELLIGENCE
Actions driven from information

KNOWLEDGE
Information stored in DB and analyzed, yielding optimized tactical tools.

Field level data analysis

New data analysis optimizations

Information triggers pre-defined business rules

New rules created and pushed to business rules engine

Summarized information sent to back office for deep analysis

Controlled and augmented by domain experts
EXAMPLES OF TARGETED USE CASES
Remote factories, disconnected ferries, trains, oil stations
CUSTOMER NEEDS
How to handle containers deployment to the edge?
WHAT ARE CONTAINERS?
It Depends Who You Ask

- Application processes on a shared kernel
- Simpler, lighter, and denser than VMs
- Portable across different environments
- Package apps with all dependencies
- Deploy to any environment in seconds
- Easily accessed and shared
VIRTUAL MACHINES AND CONTAINERS

VIRTUAL MACHINES

VM isolates the hardware

CONTAINERS

Container isolates the process
VIRTUAL MACHINES AND CONTAINERS

Virtual Machine
- Application
- OS dependencies
- Operating System

Container
- Application
- OS dependencies
- Container Host

- VM Isolation
- Complete OS
- Static Compute
- Static Memory
- High Resource Usage

- Container Isolation - SELinux
- Shared Kernel
- Burstable Compute
- Burstable Memory
- Low Resource Usage
CONTAINERS DON’T RUN ON DOCKER
The Internet is WRONG :-)
EARLY CONCERNS WITH DOCKER

Enterprise Build and Runtime concerns

Since the early days users had concerns:

- Build requires a daemon
- Build requires a running container
- Build has secret handling issues
- Root/privileged concerns at runtime
- Regression for integration with container platforms (Kubernetes)
Docker, Red Hat et al. June 2015

Two Specifications

- **Runtime**
  - How to run a “filesystem bundle” that is unpacked on disk

- **Image Format**
  - How to create an OCI Image that contains sufficient information to launch the application on the target platform
APPLICATION PORTABILITY WITH CONTAINERS

RHEL Containers + RHEL Host = Guaranteed Portability Across Any Infrastructure
FROM DEVELOPMENT TO THE EDGE

DEPLOY TO THE EDGE

BUILD & DEPLOY TO THE EDGE

APPLICATION

PLATFORM AS A SERVICE

NON-PROD | DEV | UAT | PROD

CONTAINER

CONTAINER

CONTAINER

Datacenter

Edge
USE CASE SCENARIO
From Datacenter to the Factory
FROM DEVELOPMENT TO EDGE DEPLOYMENTS
USE CASE SCENARIO
From Datacenter to the Factory
THE RED HAT STACK
Can support your edge deployments
OPENSHIFT IS KUBERNETES FOR THE ENTERPRISE

Security fixes
100s of defect and performance fixes
200+ validated integrations
Middleware integrations
(container images, storage, networking, cloud services, etc)
9 year enterprise lifecycle management
Certified Kubernetes
REFERENCE ARCHITECTURE
FOR ENTERPRISE KUBERNETES

Application Services
Middleware, Service Mesh, Functions, ISV

Cluster Services
Metrics, Chargeback, Registry, Logging

Developer Services
Dev Tools, Automated Builds, CI/CD, IDE

Automated Operations*

Kubernetes

Red Hat Enterprise Linux or Red Hat CoreOS

Best IT Ops Experience  CaaS  PaaS  Best Developer Experience

*coming soon

Best Developer Experience

redhat.
THE POWER OF THE OPENSHIFT ECOSYSTEM

RED HAT PORTFOLIO
Optimized for Containers

THIRD-PARTY ISV
Red Hat Container Catalog (100s certified)

CLOUD SERVICES
Open Service Broker

RED HAT ENTERPRISE LINUX ECOSYSTEM
Hardware, Virtualization, Cloud and Service Provider Certifications
Interactive Learning Scenarios provide you with a pre-configured OpenShift instance, accessible from your browser without any downloads or configuration.
HOW DO YOU HANDLE EDGE DEPLOYMENTS?
MULTIPLE EDGE DEPLOYMENTS SCENARIOS

**Corporate Node**
- **IoT HUB**
- **EDGE**

**Deployment Scenarios**
(Based on resource (CPU/Memory) and connectivity (Bandwidth/Latency) availability)

**SCENARIO 1**
- Low resource (Edge Gateway)
- Non reliable connectivity
  
**SCENARIO 2**
- High resource (Edge Server)
- Reliable connectivity
  
**SCENARIO 3**
- Available resource (Edge Server)
- High affidability connectivity

**Available capabilities**
- Data gathering
- Basic analytics remotely managed

- Data gathering
- Dynamic deployed containerized business applications

- Data gathering
- Dynamic deployed containerized business applications
- Centralized Management
CI/CD THROUGH DATACENTERS & GATEWAYS

- **GIT SERVER**
- **ARTIFACT REPOSITORY**

**EXISTING CI/CD PIPELINE**
- **IMAGE BUILD & DEPLOY**
- **PROMOTE TO UAT**
- **PROMOTE TO PROD**

**OPENSHIFT IMAGE REGISTRY**
- **QUAY**

**OPENSHIFT CLUSTER**
- **DEV**
- **UAT**
- **PROD**

**Edge Gateways**
- **RHEL 7.X CONTAINER**
- **OPENSHIFT NODE**

**IoT domain**

**Geo-Distributed Factories (plants)**

**Datacenter**

**Application domain**
SCALE IoT SOLUTION THROUGH CENTRALIZED AUTOMATION PROCESSES

Centralized Management for...

- Red Hat OpenShift
- Ansible Tower
- Red Hat Satellite

...Automatized processes to the edge

- Manage Application Deployment up to the edge
- Manage Operation System RHEL Deployment on HW at the edge

Gateway/Edge Server

Business Applications
WHAT ABOUT THE TECHNOLOGY?
Six Building Blocks

1. ENTERPRISE READY VIRTUALIZATION LAYER
2. CONTAINER BASED PLATFORM AS A SERVICE
3. AUTOMATION ENGINE ENTERPRISE FRAMEWORK
4. CRITICAL RELIABLE & MILITARY-GRADE SECURE OS
5. O.S. INSTALLATION & MANAGEMENT
6. IMAGE DISTRIBUTION

RED HAT® VIRTUALIZATION
RED HAT® OPENShift Container Platform
RED HAT® ANSIBLE® Automation
RED HAT® ENTERPRISE LINUX
RED HAT® SATELLITE
RED HAT® QUAY
DEMO TIME
INTELLIGENT GATEWAY ARCHITECTURE

INTELLIGENT GATEWAY

Red Hat Enterprise Linux®

Data capture

Temperature
Speed
Vibration
Location

Sensors and actuators

Fast data

Aggregation
Transformation
Summarization
Routing

Red Hat JBoss BRMS
(Rules-based actions)

Red Hat JBoss Fuse
Red Hat JBoss A-MQ
(Work stream)

2a
2b
3
4
5

Slow data

Mobile
Database
Management
Applications
Cloud

Datacenter
Demo firstly developed for Red Hat Summit 2016 (https://github.com/redhat-iot/Virtual_IoT_Gateway)

- Build the Intelligent IoT Gateway with open source software in a few simple steps
- Main components of the Gateway are:
  - Red Hat Enterprise Linux to provide Enterprise class foundation
  - Red Hat Fuse to transform sensor data and route it to end points
  - Red Hat Decision Manager to enable real-time decision making at the edge
  - Red Hat AMQ to arbitrate sensor data
- Red Hat Fuse integrate sensor app and a business rules service
- Sensor app sends temperature data using MQTT to the Red Hat AMQ broker, these messages will be forwarded to the earlier services
- Finally the business rules will trigger desired action when the sensor value reaches a threshold
INTELLIGENT IoT GATEWAY: CONTAINERIZED

Demo refactoring for OpenShift deployment

Software-Sensor

Broker-AMQ

Business-Rules

OpenJDK

RED HAT® AMQ

RED HAT® DECISION MANAGER

Routing-Service

RED HAT® FUSE

https://github.com/alezzandro/iotgw_mainproject
DEMO’s CONTAINERS DEPLOYMENT TOPOLOGY
Multiple Openshift projects simulating DC and HUB

Development

Testing

HUB

Datacenter

Geo-Distributed Factories (plants)

- AMQ CONTAINER
- SW-SENSOR CONTAINER
- ROUTING-SVC CONTAINER
- BUSINESS-RULES CONTAINER

- AMQ CONTAINER
- SW-SENSOR CONTAINER
- ROUTING-SVC CONTAINER
- BUSINESS-RULES CONTAINER

- AMQ CONTAINER
- SW-SENSOR CONTAINER
- ROUTING-SVC CONTAINER
- BUSINESS-RULES CONTAINER

EDGE GATEWAYS

SW-SENSOR CONTAINER
ROUTING-SVC CONTAINER
BUSINESS-RULES CONTAINER
RED HAT ENTERPRISE LINUX

OPENSHIFT
by Red Hat
Deploy the container just built through OpenShift

**OPENSHIFT ANSIBLE PLAYBOOK BUNDLE**

APB container runs deploy.yaml playbook to provision container on Edge Gateway

```
oc run postgresql-apb bind $vars
```

```
ansible-playbook deploy.yaml $vars
```
CI/CD THROUGH DATACENTERS & GATEWAYS

https://github.com/alezzandro/iotgw_mainproject
MULTIPLE EDGE DEPLOYMENTS SCENARIOS

**Deployment Scenarios**
(Based on resource (CPU/Memory) and connectivity (Bandwidth/Latency) availability)

**SCENARIO 1**
Low resource (Edge Gateway)
Non reliable connectivity
- Data gathering
- Basic analytics remotely managed

**SCENARIO 2**
High resource (Edge Server)
Reliable connectivity
- Data gathering
- Dynamic deployed containerized business applications

**SCENARIO 3**
Available resource (Edge Server)
High affidability connectivity
- Data gathering
- Dynamic deployed containerized business applications
- Centralized Management
Eclipse IoT is an open source community aimed at building and promoting open source software, open standards & open collaboration models needed to create an Open Internet of Things
25+ open source projects under Eclipse IoT

Red Hat contribute on:

- **Kura** at gateway level is an OT middleware (Red Hat & Eurotech; based on ESF source code donated to community by Eurotech)
- **Kapua** project at cloud platform (Red Hat & Eurotech, based on Everyware Cloud source code donated to community by Eurotech)
- **Hono** enables connecting large numbers of IoT devices to a platform, based on **EnMasse** (the coming Messaging as a Service on OpenShift) (Red Hat & Bosch)
Develop using Red Hat's most valuable products

Your membership unlocks Red Hat products and technical training on enterprise cloud application development.

JOIN RED HAT DEVELOPER  LEARN MORE
Thanks!

Questions?
Follow the agenda, the speakers & vote the sessions!