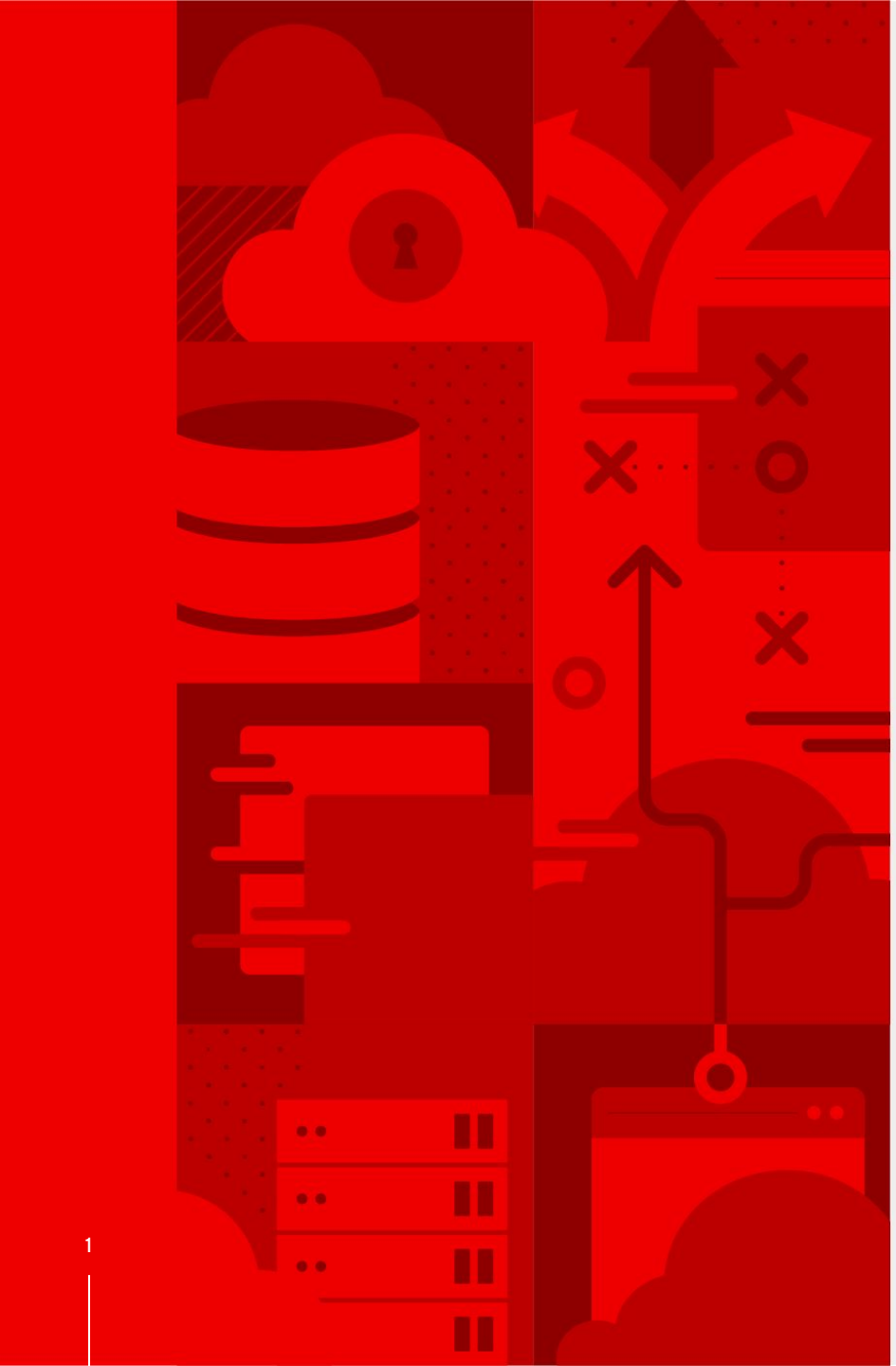
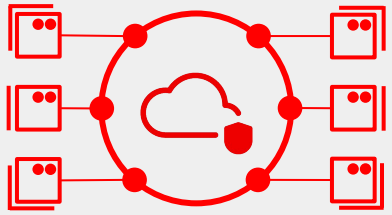


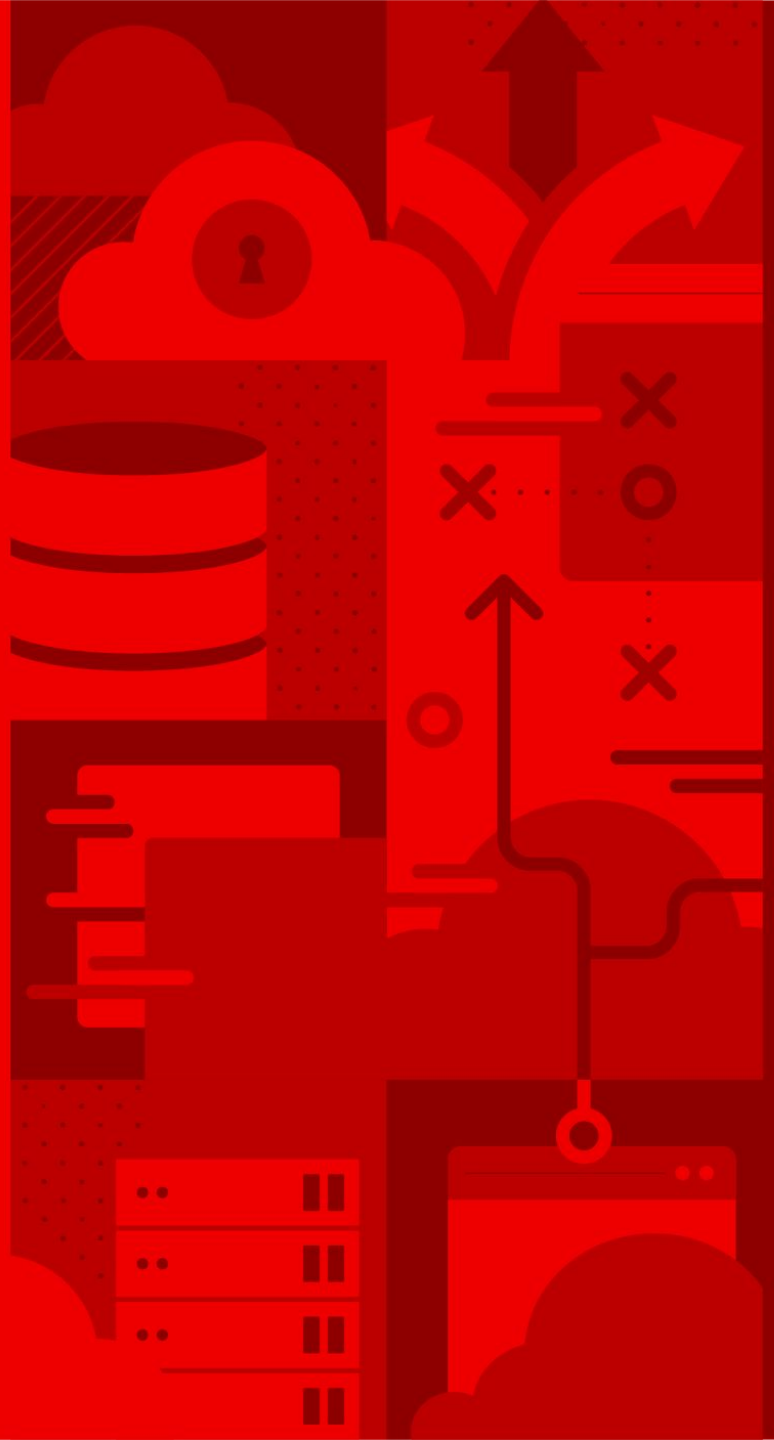


Industrial Edge IoT the Open Source Way

MANUfacturing Edge Lightweight Accelerator

<speaker>

Red Hat



Red Hat for Edge Computing

Brief Introduction

Red Hat

Edge Computing

MOTIVATION

NEW TECHNOLOGIES

BANDWIDTH & LATENCY

RESILIENCE

SECURITY & SOVEREIGNTY

COST SAVINGS

CHALLENGES

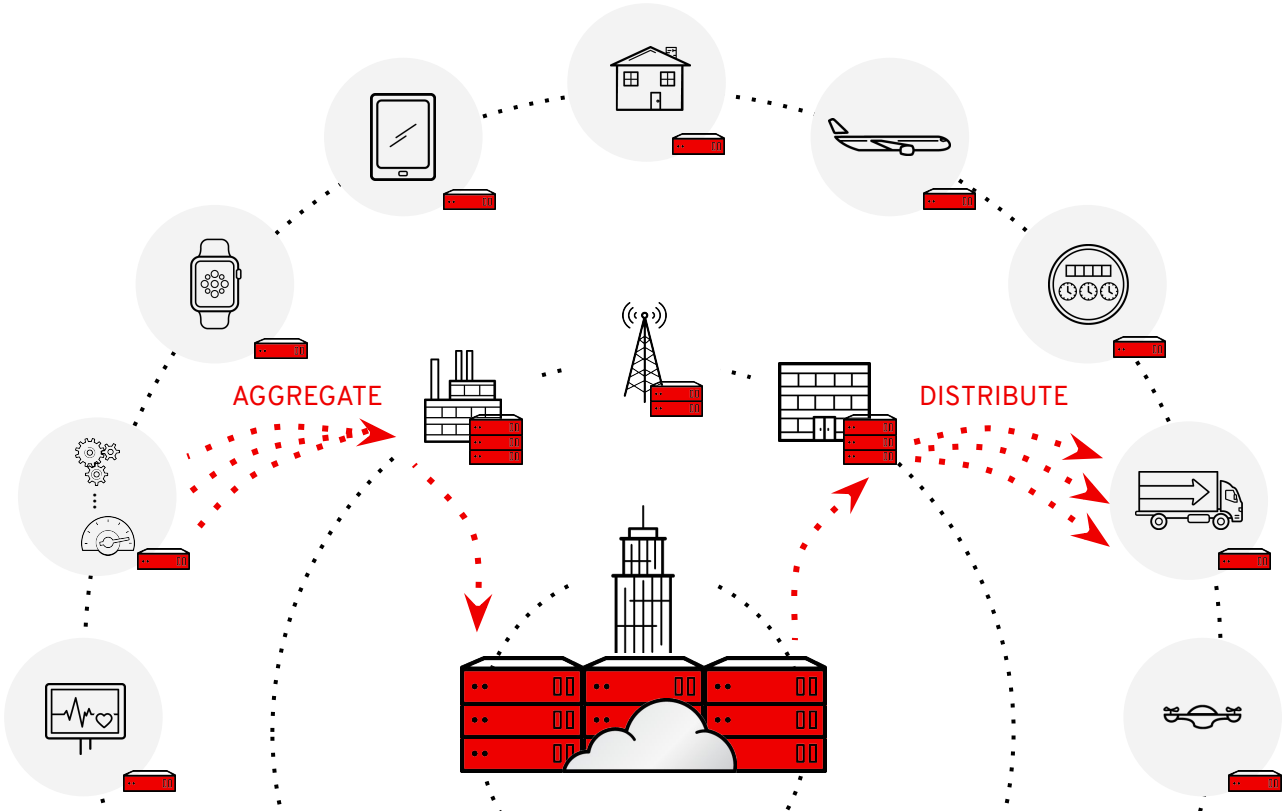
SCALE

INTEROPERABILITY

MANAGEMENT

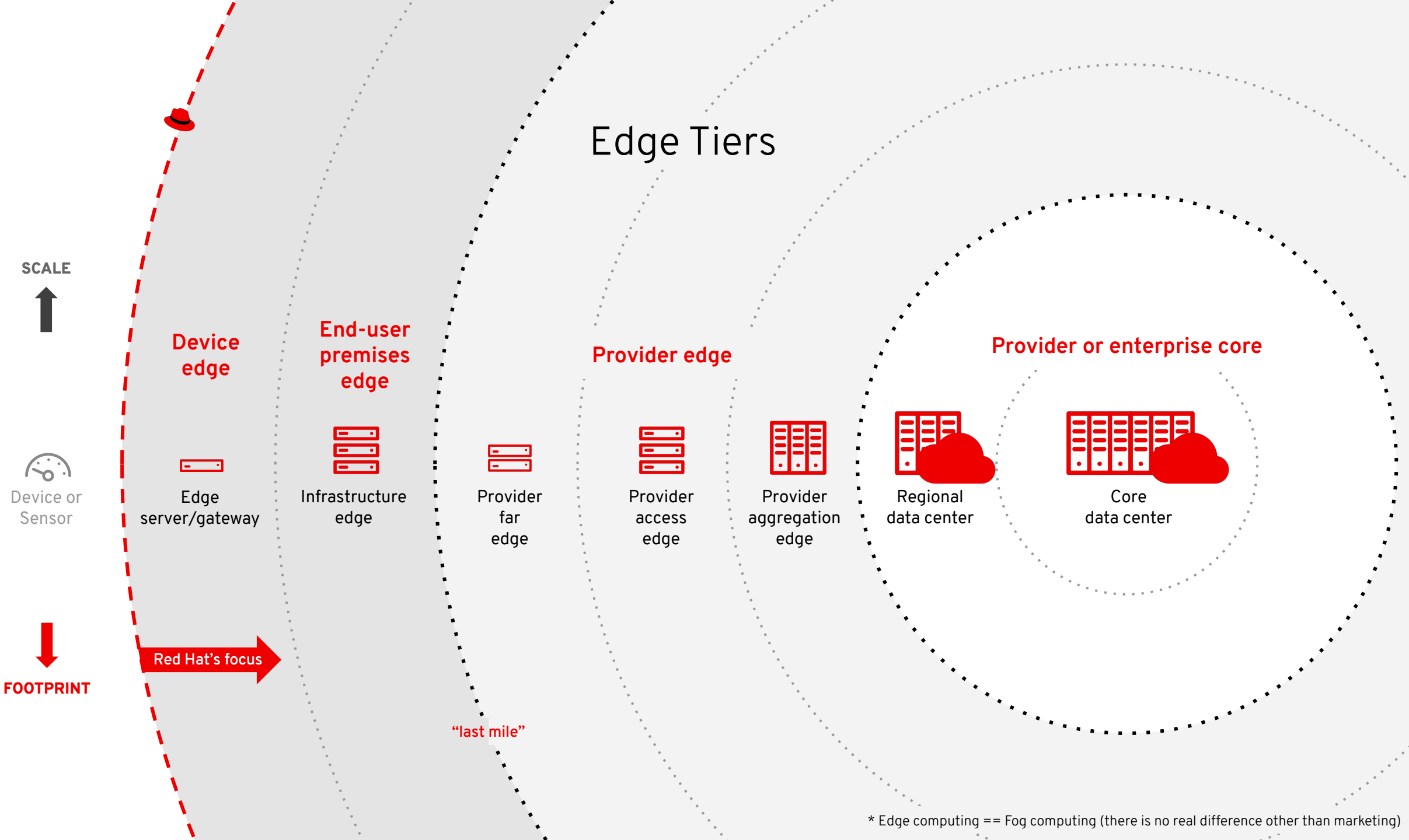
PEOPLE & EXPERTISE

OPERATIONAL COST



Red Hat

Edge Tiers



* Edge computing == Fog computing (there is no real difference other than marketing)

Factory Edge

Any workload, any footprint, **any location**

SCALE

FOOTPRINT

Device or Sensor

MES Integration
Predictive Maintenance
Quality Assurance
Augmented Reality
Autonomous Transport Systems

End-user premises edge

Edge server/gateway

Infrastructure edge

Different Stakeholders (OT vs. IT)
Special technology requirements
Long Depreciation Cycles
Firewalls

Provider edge

Provider far edge

Provider access edge

Provider aggregation edge

Provider or enterprise core

Regional data center

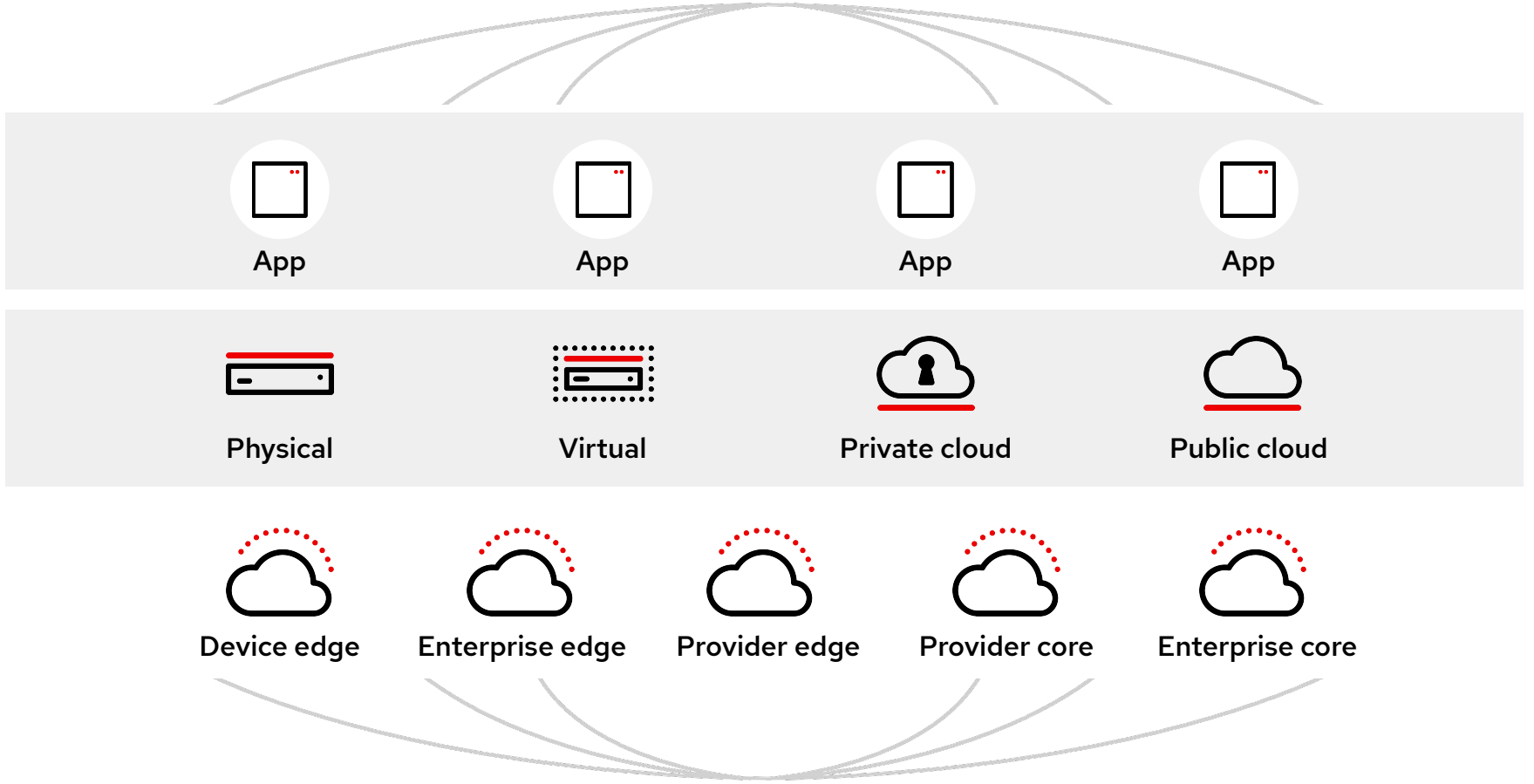
Core data center

"last mile"

* Edge computing == Fog computing (there is no real difference other than marketing)

Edge is part of our open hybrid cloud strategy

Any workload, any footprint, **any location**

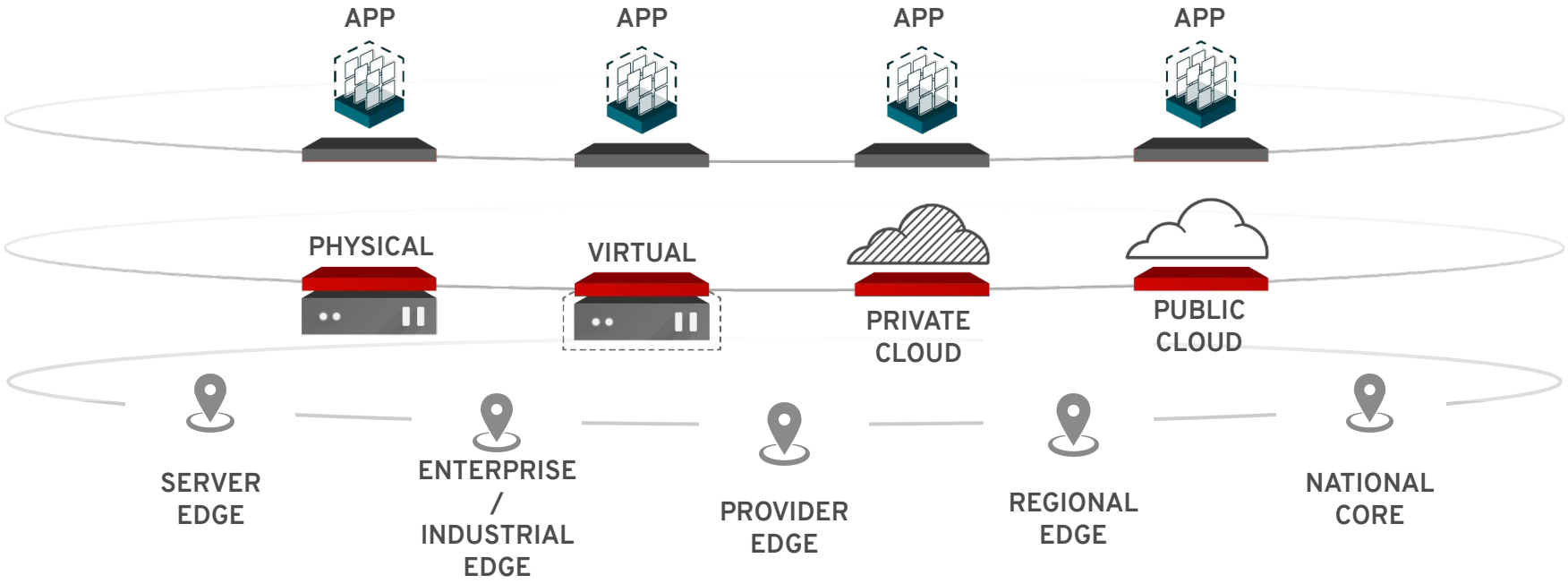


Red Hat

THE EDGE COMPUTING VISION

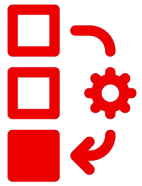
Extending the Open Hybrid Cloud Vision with Edge Computing

Any workload, any footprint, **any location**.



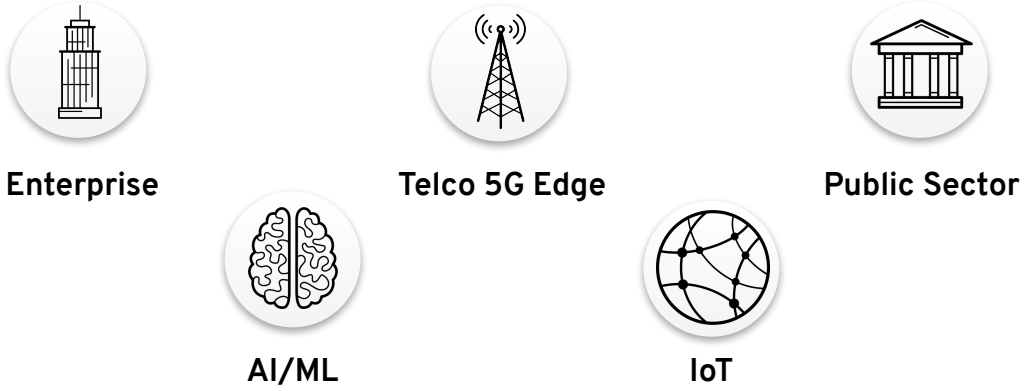
Red Hat

The edge computing opportunity in several industries

	Telecommunications	Manufacturing	Energy
			
Use cases	V/C-RAN Multi-access edge computing	Predictive maintenance Factory automation AR + remote export	Product optimization Process control Environment monitoring
Benefits	Better user experience Scale to meet demand Greater network flexibility Improved resilience	Reduced downtime Increased productivity Longer asset lifetime Improved factory safety	Reduced downtime Lower OpEx and CapEx Lower workforce risk Less environmental impact

Red Hat for Edge Computing

Who is doing Edge Computing?



Red Hat

Red Hat Strategy

Single, edge-enabled portfolio delivering consistency for development and operations

One story

Edge Computing

Market segments


Telco


Enterprise


Public sector

Various industries & workloads


IoT


Healthcare


Artificial intelligence /Machine learning

Products

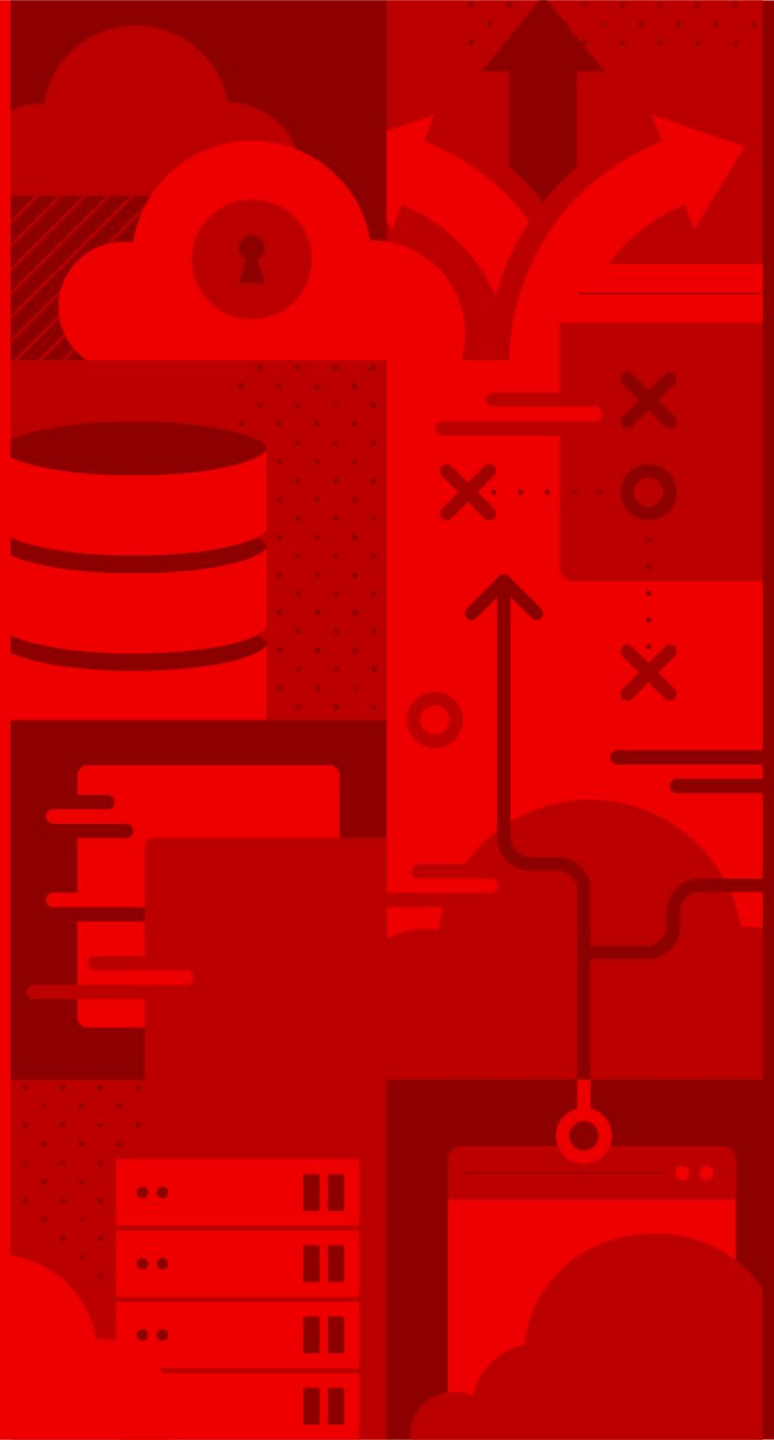
Red Hat OpenStack Platform

Red Hat Enterprise Linux

Red Hat Ceph Storage

\+ Others

Red Hat

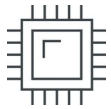


Industrial Edge Computing

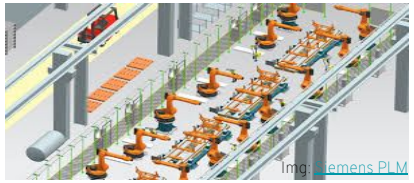
A path to accelerated agility

Red Hat

Industrial Edge



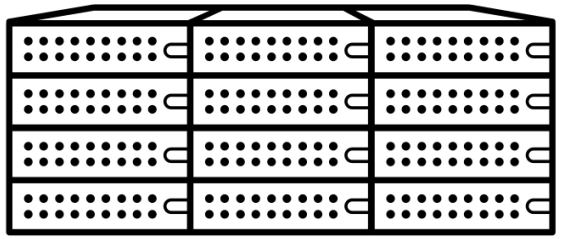
Device
Actuator, Sensor
PLC
~100.000



Line Server
Ruggedized Industry PC,
PLC, HMI, SCADA
~1000

Plant Data Center
Racks in IT room
SCADA, PPS, MES, PLM
~100

Regional Data Center
Country Specific
PPS, MES, PLM, ERP
~20-50



Headquarter Data Center

MES, PLM, ERP
~1-3

Operational Technology (OT)

Information Technology (IT)

EDGE

CORE

Red Hat

How does Industrial Edge differ from other Edge Computing use cases?

- Low Latency / Low Jitter / Near Realtime
- Disconnected / Offline situations
- High Throughput / Bandwidth
- Long-livety (5-15+ years)
- Separate Network Zones
- Software Deployment & Configuration from central DC (push vs. pull)
- Update & Patch Management cross Firewalls
- Non-HA applications need to be run highly available
- High availability (production downtime is a big no no)
  - Old Applications - Infrastructure HA
  - 3 Datacenters? Be glad if you have two separate rooms!

	Telco Edge	**Factory Edge**
Topology	Distributed Compute Node	Standalone Cluster
Control Plane	central	local
Impact of edge outage	minor (high probability of cell overlap)	major (car assembly line shutdown)
Upstream connectivity	fast and stable	slow and unstable
IaaS Provider probably	OpenStack	RHHI-V / RHHI.NEXT / OSP RT-KVM
PaaS Provider probably	OpenShift (Central)	OpenShift (Federated)
Tenancy	Single	Multi

How can I ...

Achieve real-time transparency as foundation for successful optimization, planning and control of production?

Optimize the roll-out of configuration across 100s of manufacturing plants?

Benefit from AI/ML to improve quality in production?

Leverage big data technology for traceability and analytics on the shopfloor ?

Speed up software development and release cycles for manufacturing operations management system?

What is needed?

Accelerate software driven production optimizations

- Develop new features, test, QA and simulate in a production-like environment
- Leverage container technology to improved quality and speed up releases
- Scale controlled and auditable release deployments to production

Declarative configuration management for multi-tier production lines

- Enable agile, controlled configuration and software rollouts
- Define and enforce desired state. Audit and log changes
- Efficient scale to hundreds production lines, support firewalled environments via pull model

Real-time transparency for successful optimization

- Real-time insights and actionable data
- Robust and fast data processing, analytics and visualization
- Scalable and reliable messaging. Open, industry standards protocols.

Leverage big data & ML technology for traceability and analytics

- Collect, normalized, visualize data to optimized production e.g. for predictive maintenance
- Enable data scientist to analyze production data
- Develop, test and deploy machine learning models to production

Factory Edge: Customer needs addressed

Coding, Simulation & deployment to production	Container based CI/CD from data center the edge
Declarative configuration management	End to end GitOps for distributed environments
Data processing from sensors to analytics	Open source middleware and AI/ML stacks
ML model training and deployment to production	Open Data Hub enabled CI/CD

Core
Data Center

Regional
Data Center

Factory
Infrastructure

Line Data
Server

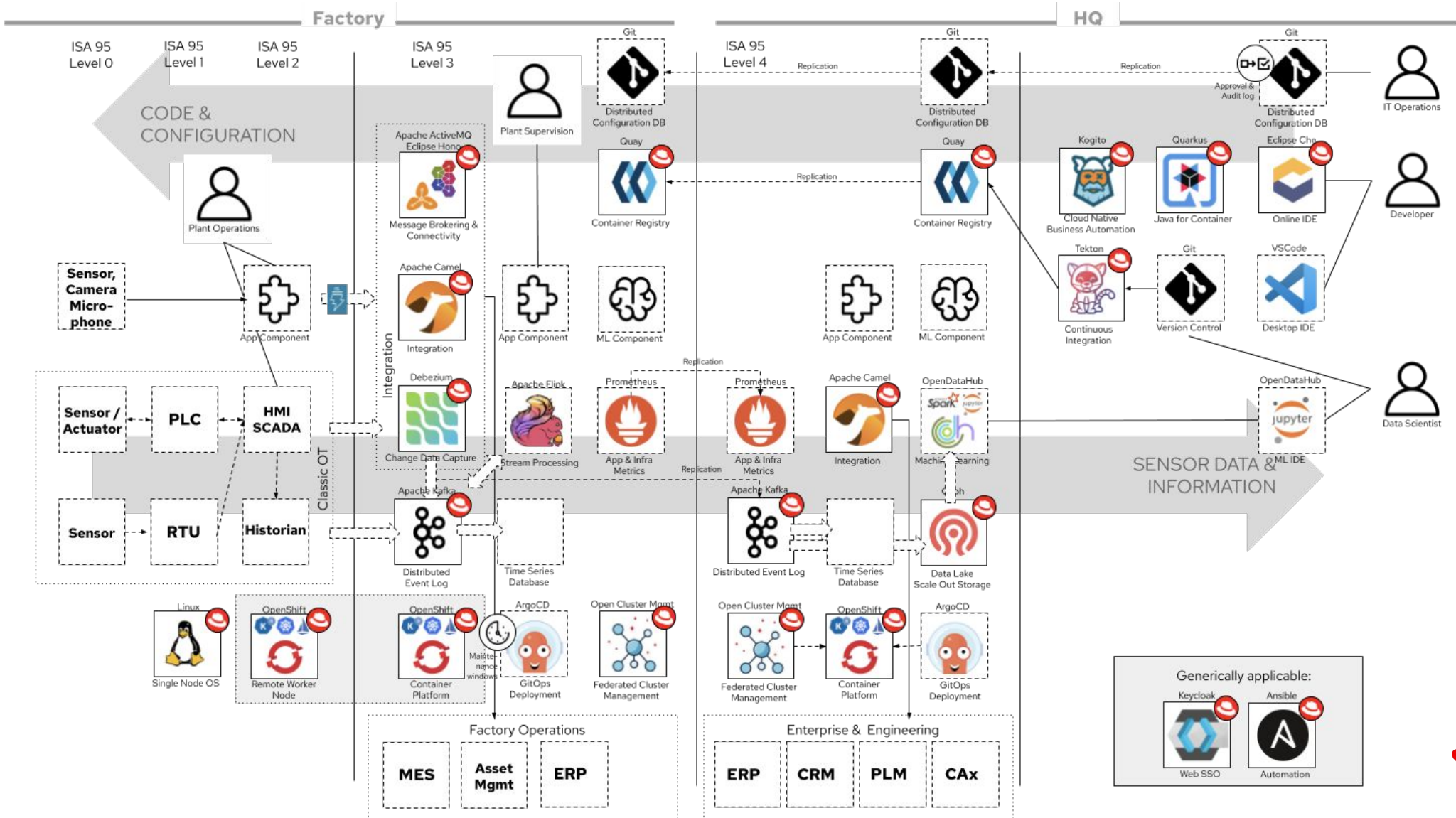
Devices,
Sensors, Robots

Enterprise Core

Factory Edge

Red Hat

Draft Red Hat Manufacturing Reference Architecture (WIP)



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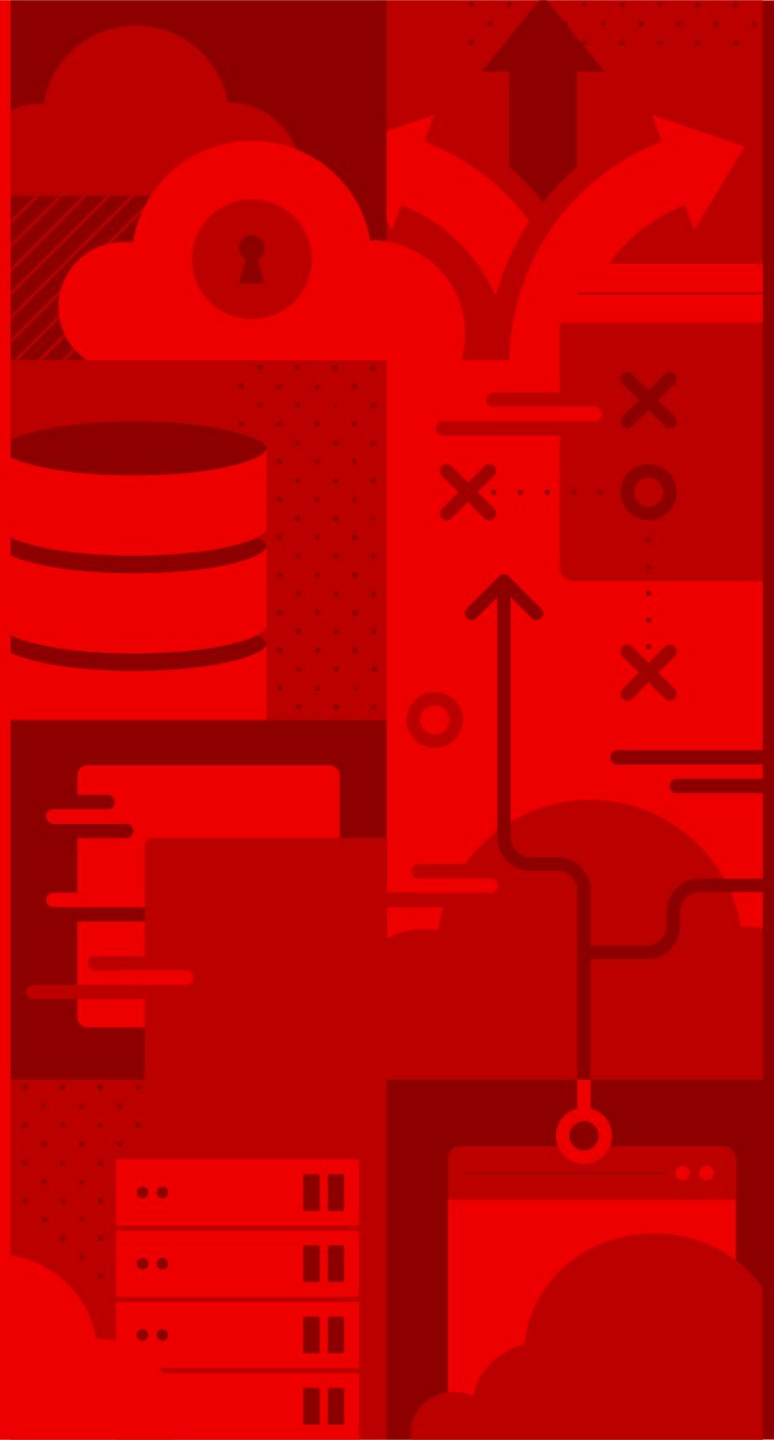


MANUela

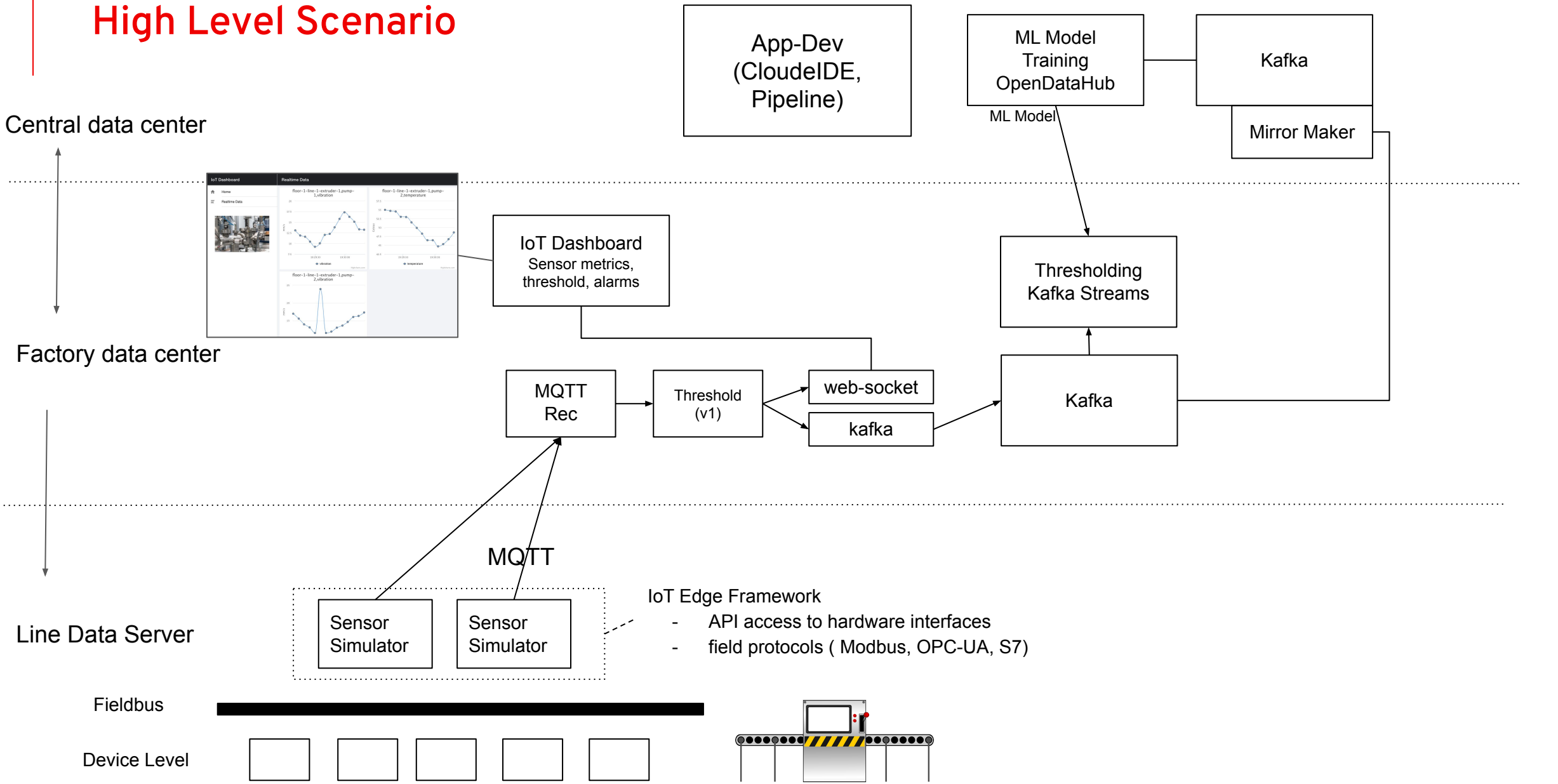
MANUfacturing
Edge
Lightweight
Accelerator

Red Hat

Goals of the Demo

- Demonstrate how the challenges mentioned before can be addressed
- Use Red Hat technology in an integrated way, with a context the customer feels “Yes, that’s me”
- Apply as much best practises as possible. This should work in the real world, not only demo world
- Provide a blueprint / reference architecture to start from
- Be modular, no need to show all aspects/parts, mix and match to what the current situation needs
- Be adaptive, to transport easily to other verticals (e.g. retail)
- Be flexible on demo setup - from single cluster laptop to 4 cluster distributed onprem and public cloud
- Learning vehicle for all people that contribute to the demo

High Level Scenario



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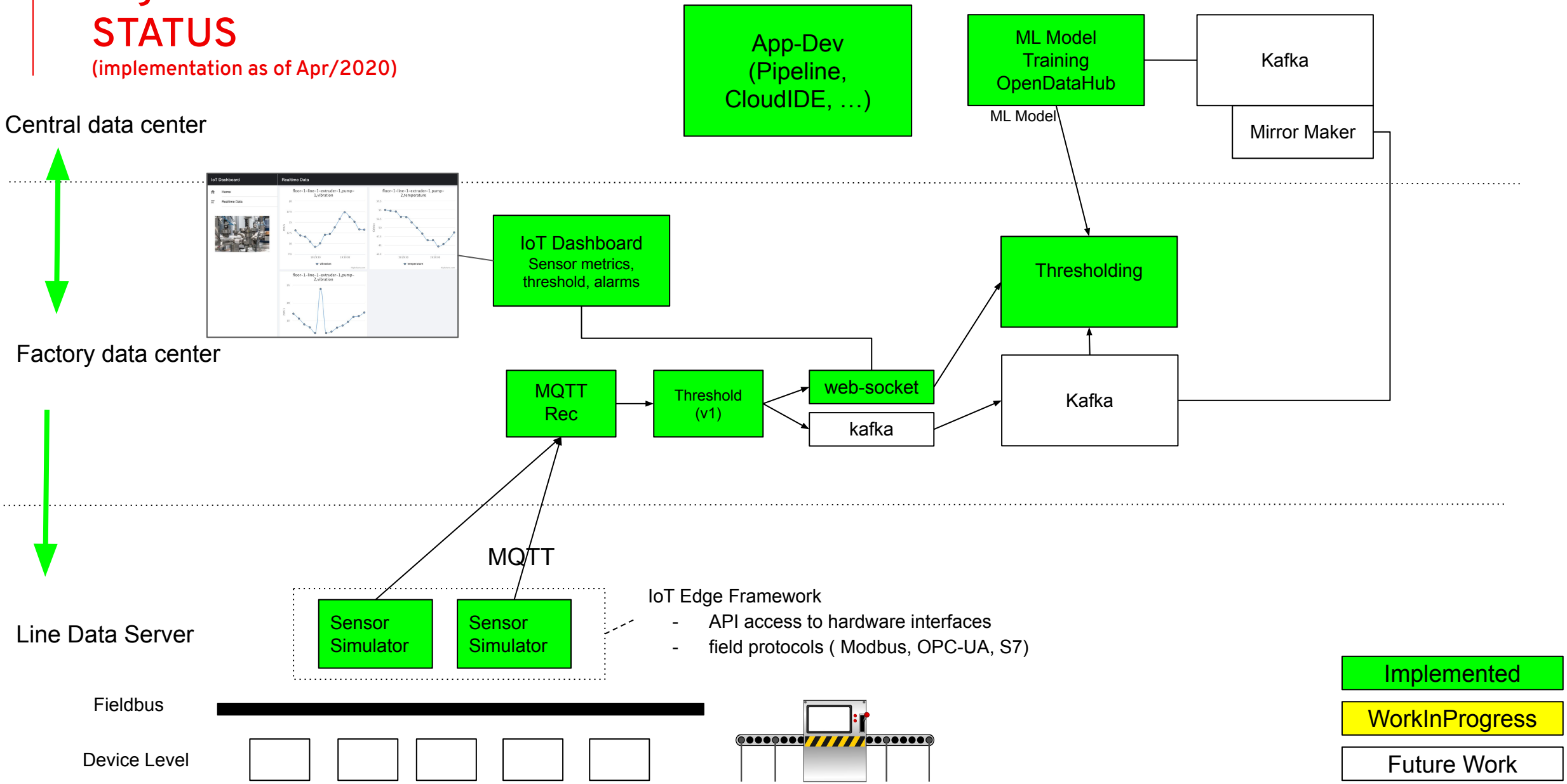
High Level Demo STATUS

(implementation as of Apr/2020)



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Red Hat Products Involved

THIS DEMO IS NOT ABOUT PRODUCTS

(there are lots of Red Hat products involved)

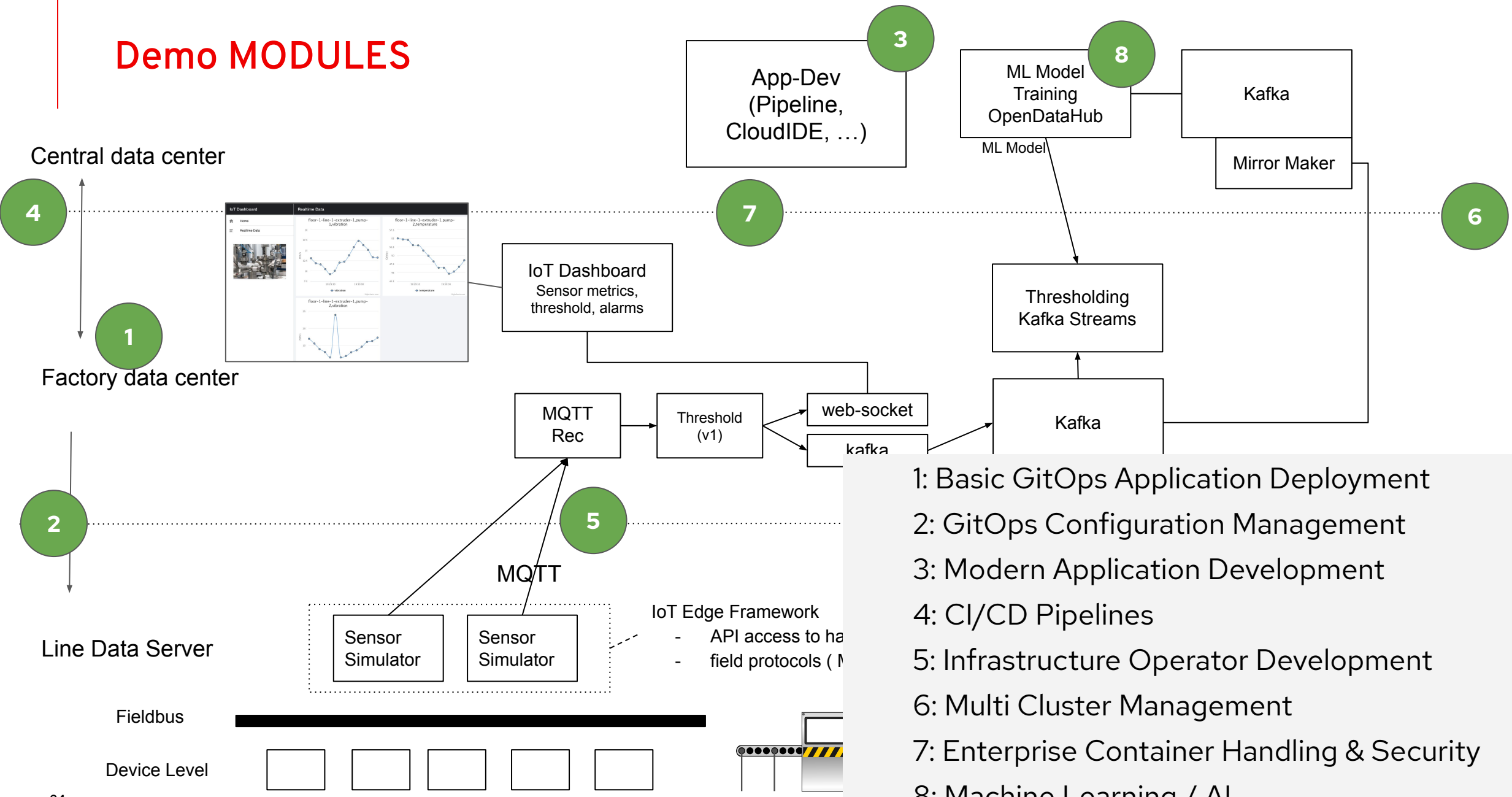
THIS IS A STORY TO TELL

Red Hat

Personas

App Dev System Architect	Defines High Level Architecture + Deployment Template
App Developer	Develops Manufacturing Application incl. Unit Tests
QA Engineer	Responsible for System Verification, Load Tests, ...
Deployer	Responsible to deploy an application instances to Edge locations
OT OPS Manager	Infrastructure Owner of the factory, owns LDS and Firewalls
Security	Reviews & Approves overall security architecture

Demo MODULES



1: Basic GitOps Application Deployment

2: GitOps Configuration Management

3: Modern Application Development

4: CI/CD Pipelines

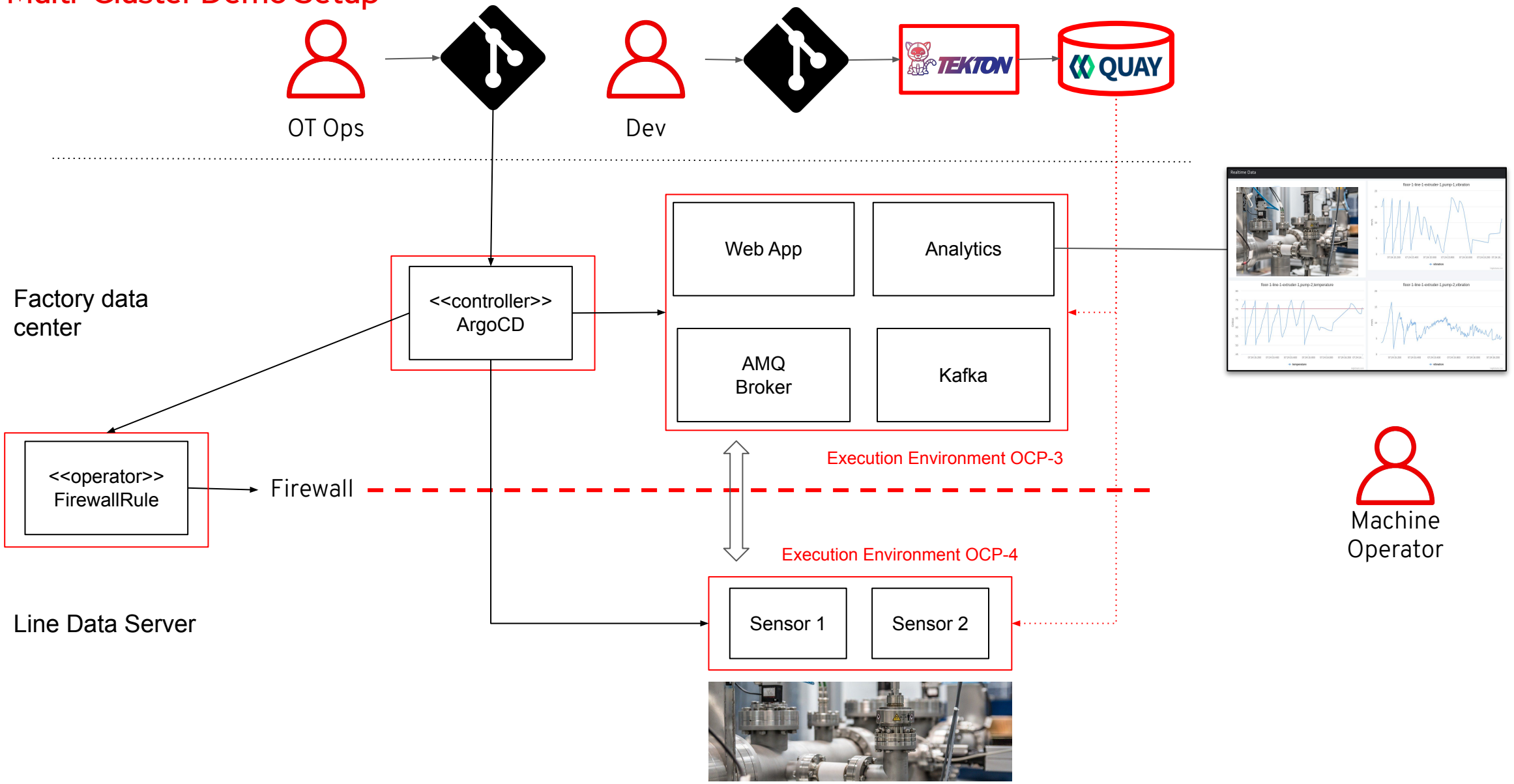
5: Infrastructure Operator Development

6: Multi Cluster Management

7: Enterprise Container Handling & Security

8: Machine Learning / AI

Multi-Cluster Demo Setup



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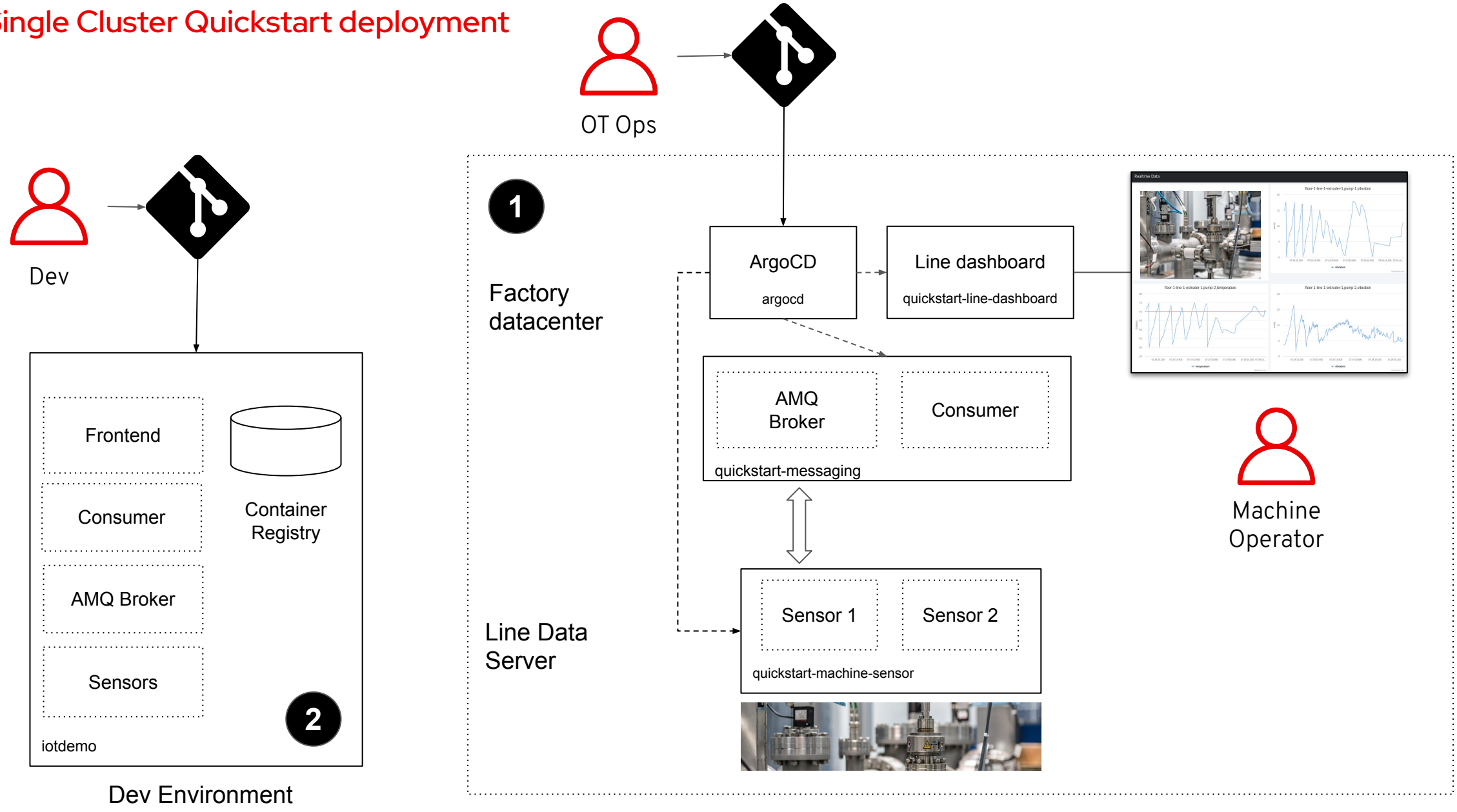
Single Cluster Quickstart deployment



https://github.com/sa-mw-dach/manuela/blob/master/docs/QUICKSTART.md

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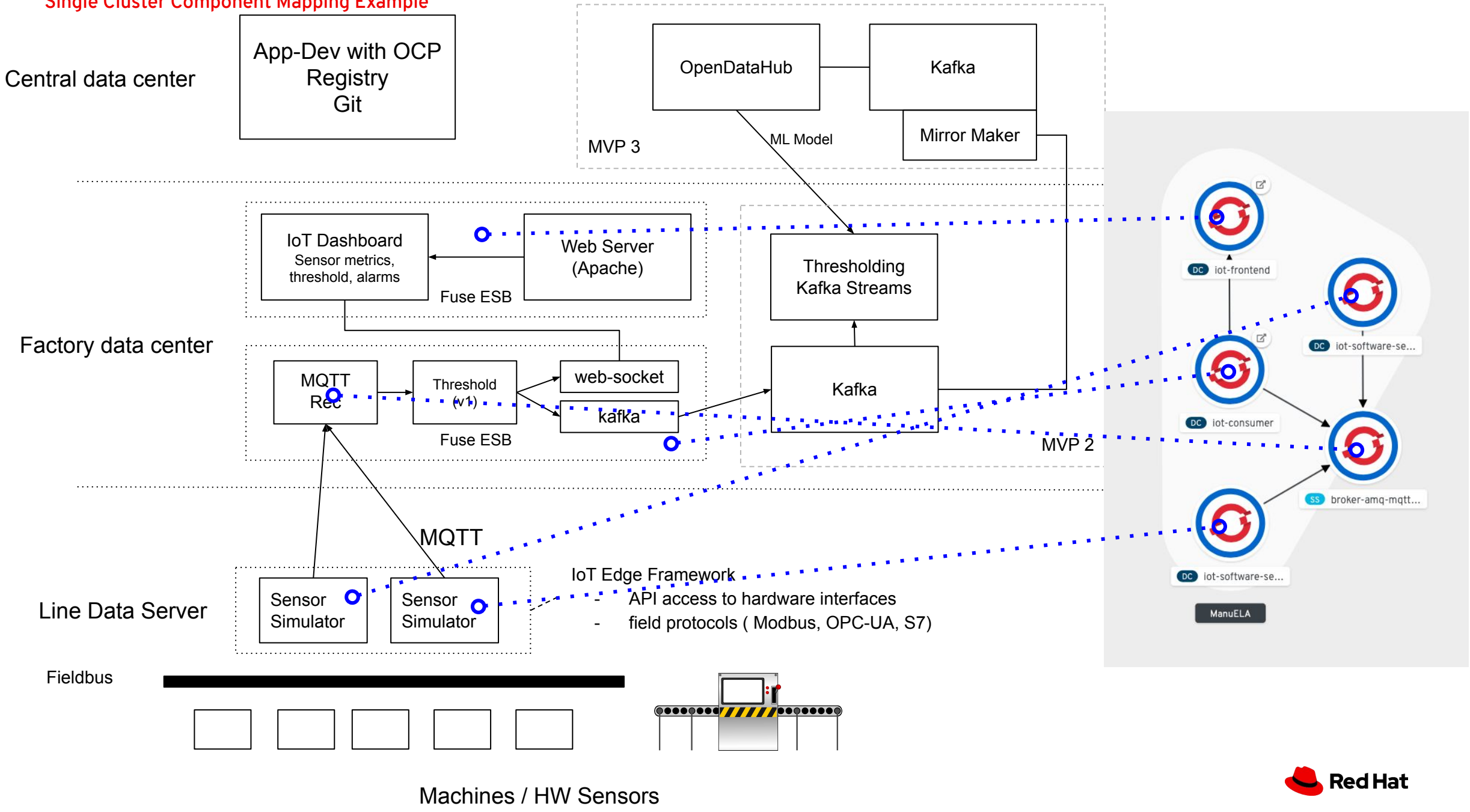
Single Cluster Component Mapping Example



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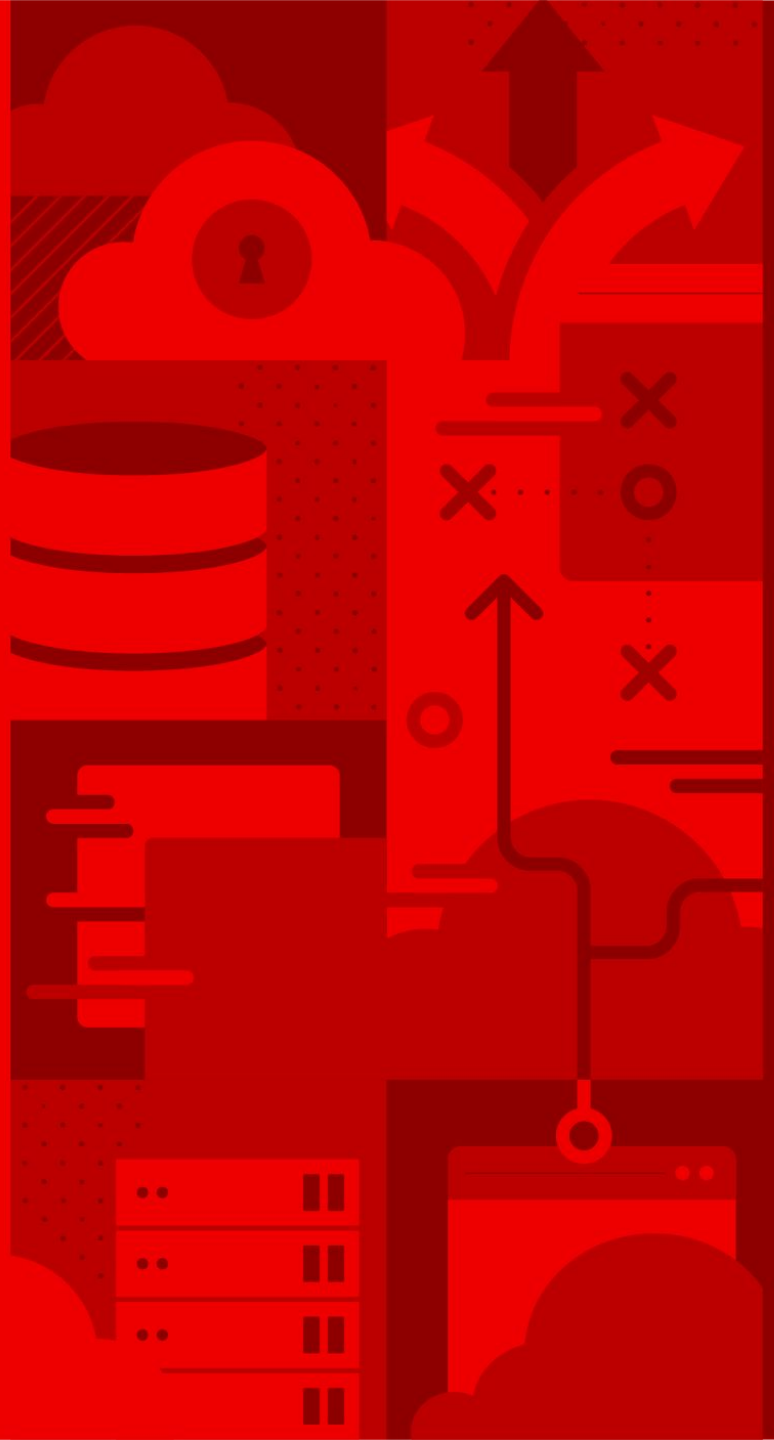

MANUela Demo

Modules / Flows

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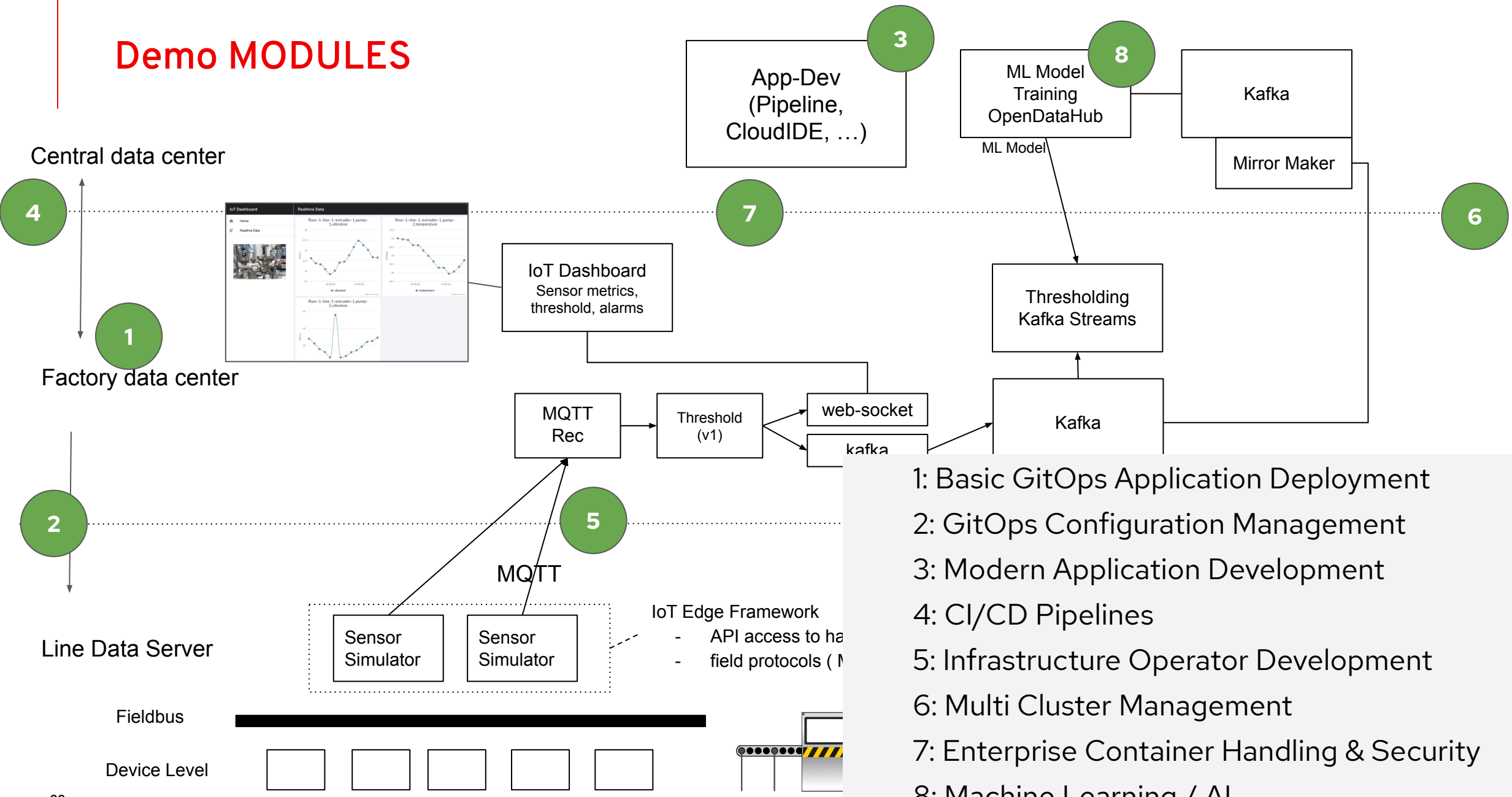
Demo MODULES



1: Basic GitOps Application Deployment

2: GitOps Configuration Management

3: Modern Application Development

4: CI/CD Pipelines

5: Infrastructure Operator Development

6: Multi Cluster Management

7: Enterprise Container Handling & Security

8: Machine Learning / AI

#1 - Basic GitOps Deployment

Demo Flow

- Application Instance is not deployed
- Deployer reviews environment incl. Firewall
- Deployer reviews application template
- Deployer prepares application instance configuration & deployment information & OT Ops Manager reviews it
- Deployer deploys application components to their respective execution environments
- Application is instantiated without direct interaction with the target cluster(s)
- Firewall rules have been added where necessary

Benefits

- Application Instance configuration can be reviewed before instantiation (OT Ops Manager)
- Instance Configuration can reference specific commits which are frozen in time.
- Deployment without access to runtime environment, can be behind firewall (Deployer, Security, OT Ops Manager)

#2 - GitOps Configuration Change

Demo Flow

- Application Instance is deployed
- OT Ops Manager identifies the need for a config change
- Deployer adjusts configuration in GitOps repo
- Application is reconfigured without direct interaction with the target cluster(s)
- Configuration Change can be reviewed in Git(Hub) history

Benefits

- Git revision history makes transparent who caused which change (OT Ops Manager)
- GitHub (or other) workflow can even do multi-stage approvals (OT Ops Manager)
- Config Change without access to runtime environment, can be behind firewall (Deployer, Security, OT Ops Manager)

#3 - Code Change with Cloud IDE

Demo Flow

- Application Instance is deployed
- A bug is being detected: unnecessary Fahrenheit->Celsius Conversion leading to wrong values and false alarms
- Developer reproduces the bug in her Cloud IDE Development Environment and creates a fix (by simply commenting out the unnecessary conversion).
- New Code is pushed to git

Benefits

- Fast setup of development environment (minutes instead of days)
- Easy Development using Cloud IDE
- Secured Development Environment (no developer laptop can be lost)

#4 - Continuous Integration Pipeline

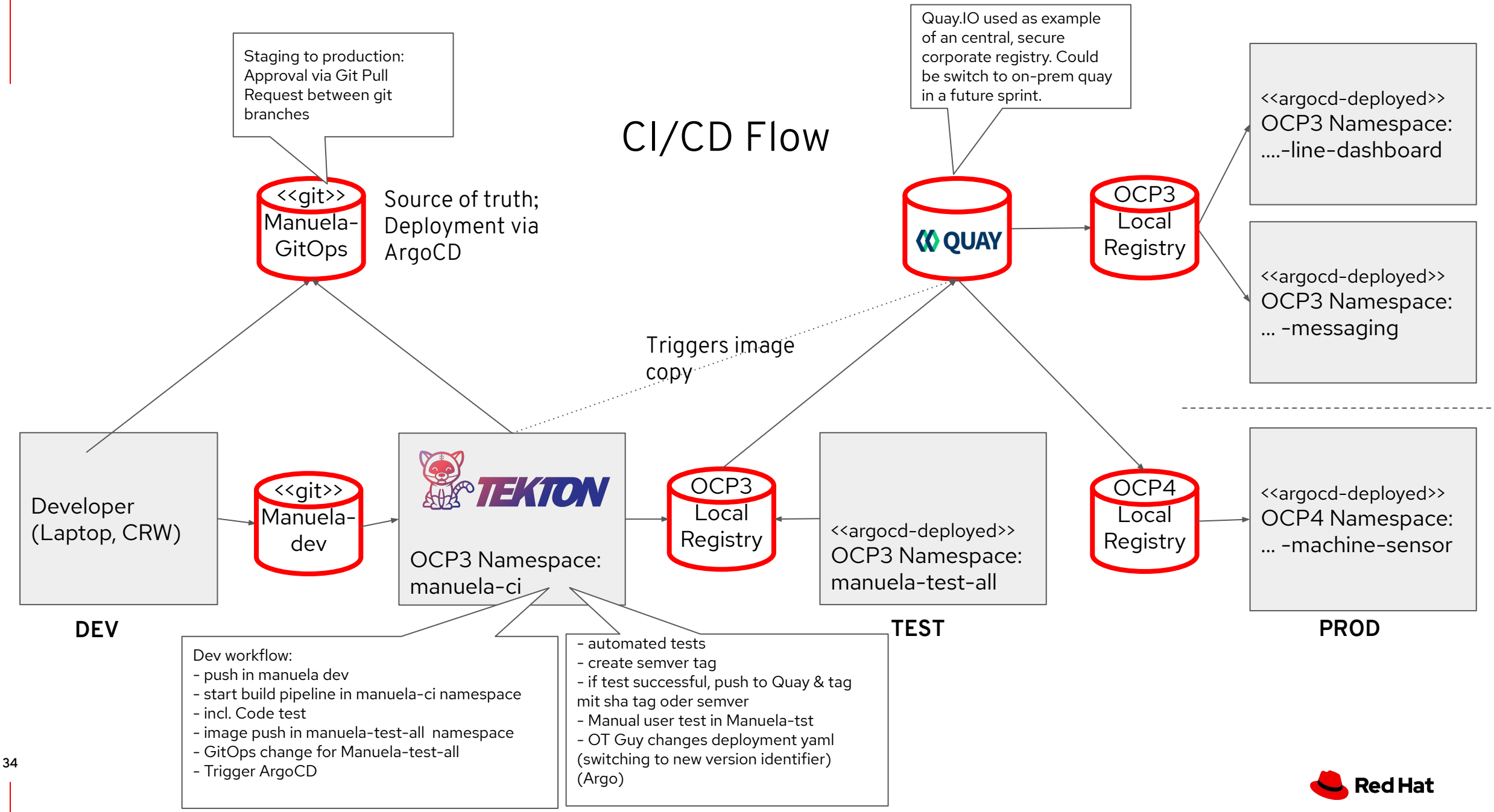
Demo Flow

- CI Pipeline based on Tekton is triggered to build a new version of the affected component. New Container image is deployed and tested in the central datacenter.
- Once all tests are completed, new version is made available in enterprise registry. OT Ops manager is notified via a pull request.
- OT Ops Manager can decide to deploy new version to his edge cluster by merging the pull request.
- CD via GitOps ensures deployment (see next Demo Module)

Benefits

- Secure Enterprise Container Registry allowing for Security Scans
- State of the Art, Kubernetes Native CI tooling
- Full version control with semantic versioning (so the ops guy can easily blame development)
- Full control for the OPS people, which version is running where.
- Edge Clusters fully operational even disconnected thanks to local registry

CI/CD Flow



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#5 - Infrastructure Operator Development

Demo Flow

- Create new ansible-operator from scratch via operator-sdk
- Adjust generated project contents:
  - Build to include requisite modules
  - deployment info to include access secrets to external firewall
  - Ansible code to mirror custom resource data in firewall rules
- Deploy operator to cluster & Test it
- Alternatively: Review existing operator code

Benefits

- Manage IT infrastructure via declarative kubernetes model
- Quick and efficient operator development through code generation and ansible automation
- Leverage the rich ansible ecosystem, modules are available to manage almost any IT infrastructure element

#6 - Multi Cluster Management

Demo Flow

- Show cloud.redhat.com - cluster manager
  - Overview of all clusters
  - Review Update Status
  - Drill down to view cluster details

Benefits

- Stay in control of hundreds of k8s clusters
- SaaS service - no additional operations required

#7 - Enterprise Container Handling and Security

Demo Flow

- Show Slide#32 and elaborate on the role of the image registry
- Show quay.io and the manuela repo there
- Highlight container security scanning in quay
- Show an image stream in the “remote” cluster (e.g. for line-dashboard)
- Elaborate on how it pulls through the images to ensure availability even when disconnected (“Reference Policy: local”)

Benefits

- Enable geo- / cross cluster - replication of images
- Secure the container supply chain
- Enhanced image availability for disconnected ops

#8 - Machine Learning / AI

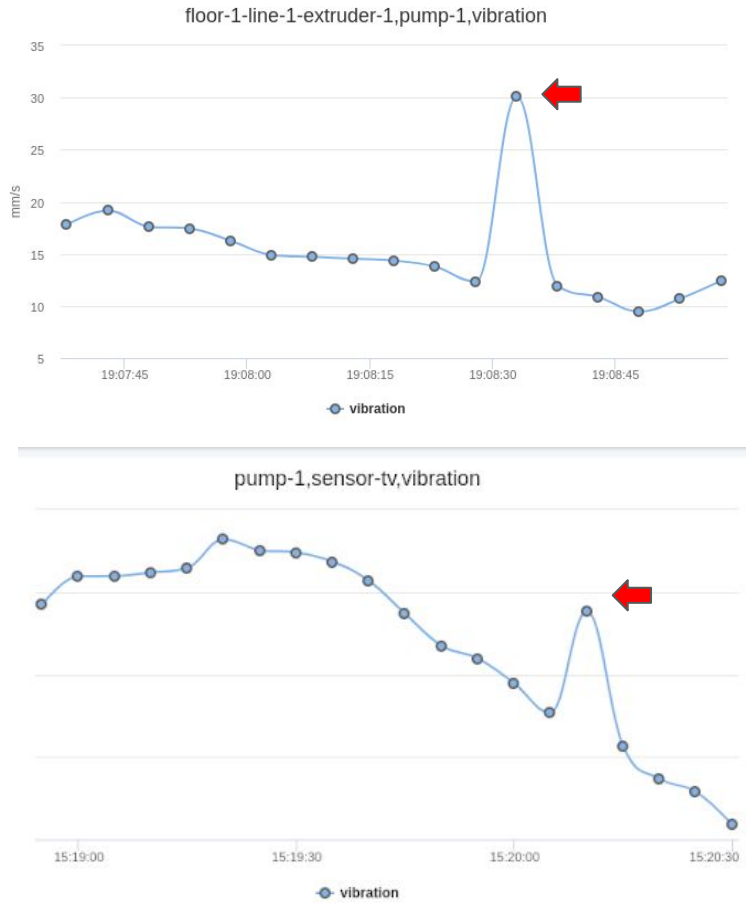
Demo Flow

- Data Scientist is chartered to build ML model for detection vibration anomalies to avoid unplanned outages.
- ML Model is developed in a Jupyter notebook using Open Data Hub.
- The ML model is baked into a container and served with Seldon
- The consumer component calls the Seldon web service and creates alerts when the ML model detection an anomaly

Benefits

- Open Data Hub is a OpenShift powered Data Scientist workbench
- Fully integrated CI/CD and GitOps approach for ML models

Vibration anomalies



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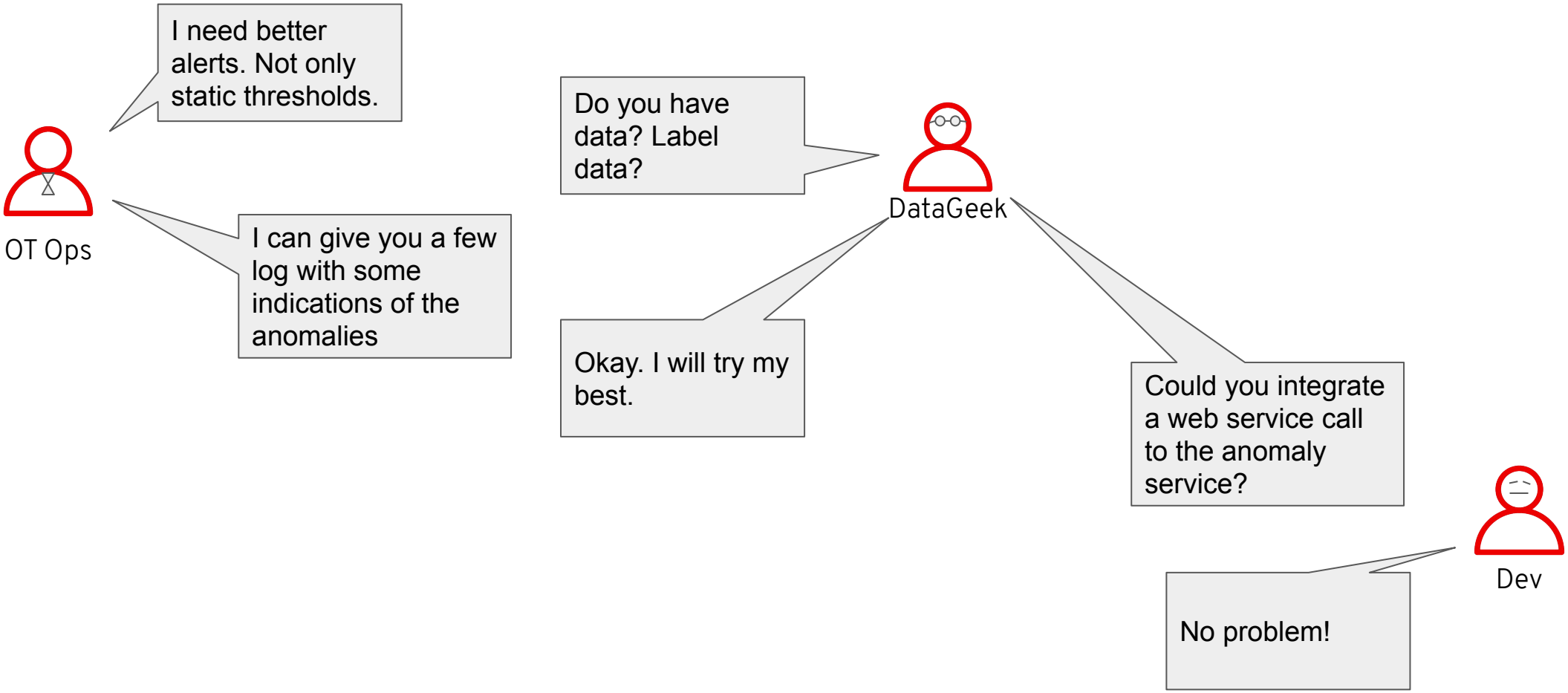
Story



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#8 - Machine Learning / AI

ML Demo flow

Data Scientist gets raw data and build a ML model for anomaly detection

1

DataGeek

Jupyter Notebook (OpenDataHub)

Data wrangling, ML model creation

Labeled Data

Tekton pipelines creates a Seldon container with the ML model for serving the model as web-service.

The consumer component calls the Seldon WS for checking if an anomaly exists.

2

TEKTON

Frontend

Anomaly Detection

Consumer

AMQ Broker

Sensors

manuela-tst-all

Container Registry

Integration & test

Seldon container with ML model is published to Quay

QUAY

3

Factory datacenter

ArgoCD

argocd

Line dashboard

quickstart-line-dashboard

Anomaly alerts

AMQ Broker

Consumer

Anomaly Detection (ODH)

quickstart-messaging

Model serving in production

Line Data Server

Sensor 1

Sensor 2

quickstart-machine-sensor

Red Hat

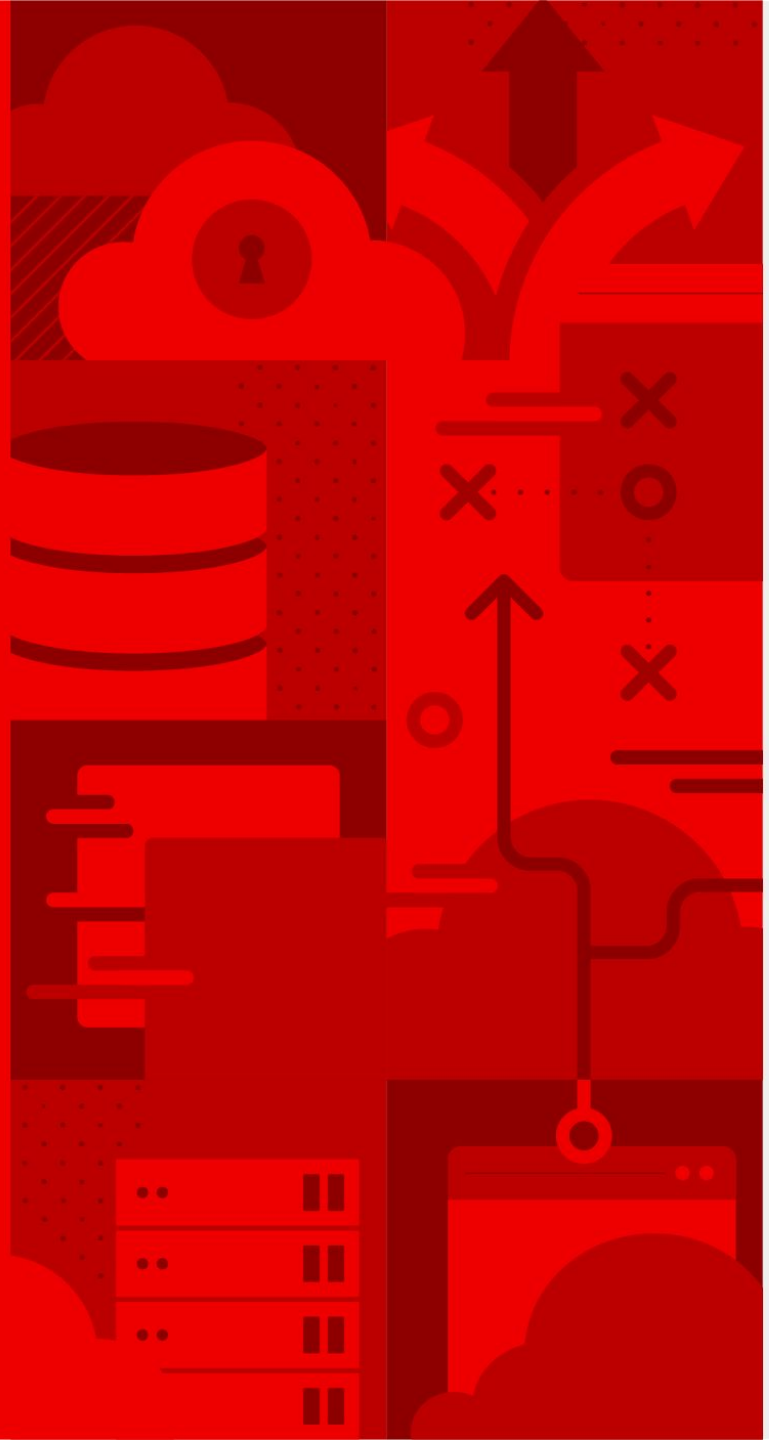
#9 - ???

Demo Flow

-
- ...

Benefits

-
- ...



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