INTEGRATING IOT DEVICES INTO THE CERN CONTROL AND MONITORING PLATFORM

WEPHA125

Abstract

The CERN Control and Monitoring Platform (C2MON) offers interesting features required in the industrial controls domain to support Internet of Things (IoT) scenarios. This paper aims to highlight the main advantages of a cloud deployment solution, in order to support large-scale embedded data acquisition and edge computing. Several IoT use cases will be explained, illustrated by real examples carried out in collaboration with the CERN Knowledge Transfer programme.

Scalability and reliability

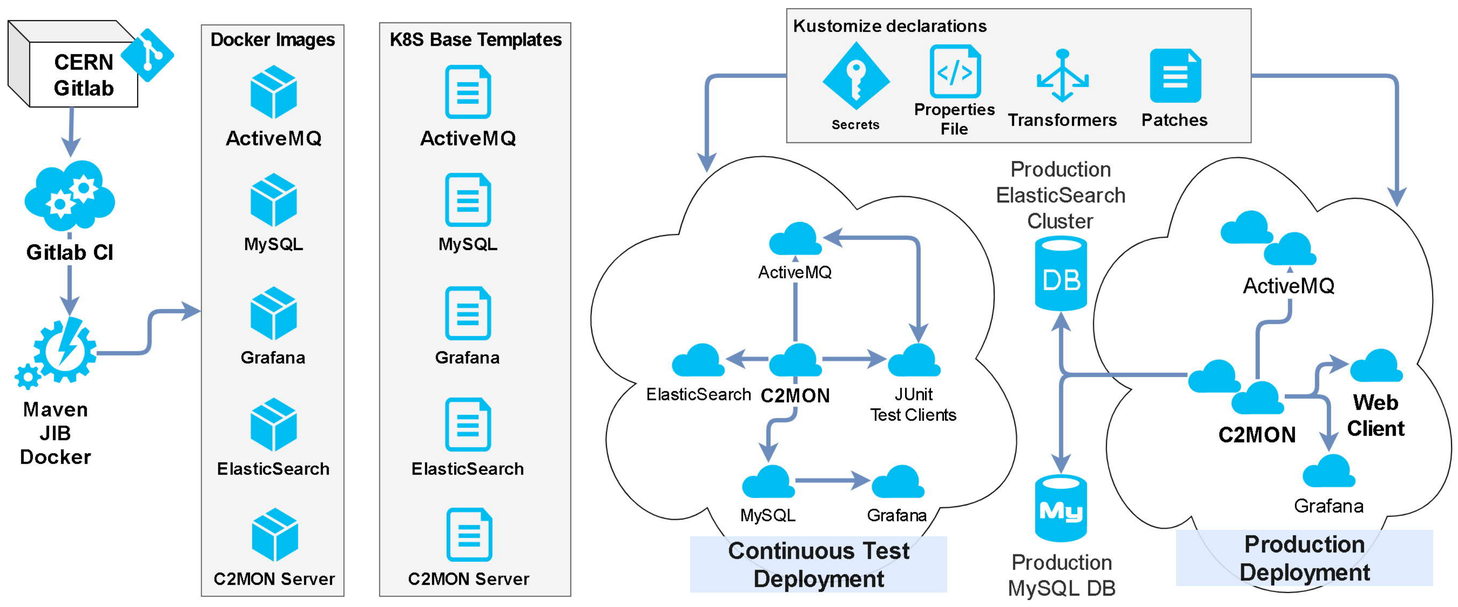
The CERN Control and Monitoring Platform (C2MON) is built upon a multiplicity of technologies that can make adoption difficult for third-party users despite its detailed documentation and open-source LGPL v3 licensing. Furthermore, C2MON employs pre-cloud technologies that are difficult to scale without prior configuration and care. Deploying C2MON on a standard cloud infrastructure would allow it to scale and support multiple deployment configuration scenarios for faster and more resource-efficient reliability and scalability testing.

Which tools ?

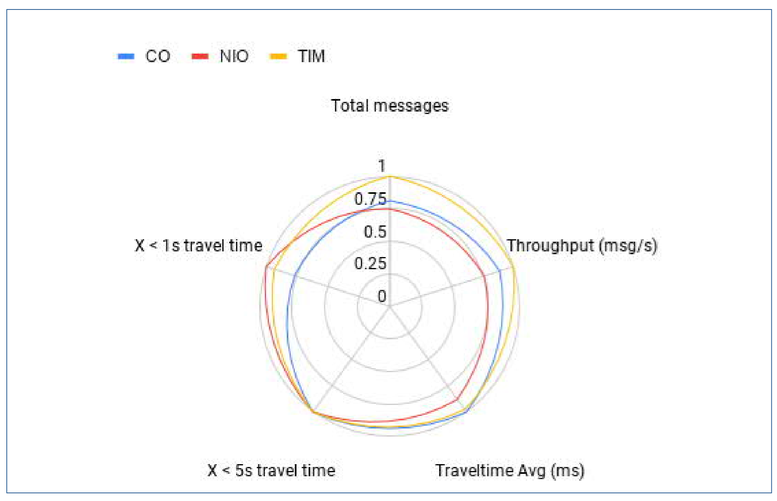
Kubernetes provides a clean and efficient abstraction for scaling concerns and orchestration but its deployment templates are mostly hard-coded.

Kustomize solves this, as it can tailor and combine a common set of Kubernetes templates for multiple scenarios, injecting configuration and writing scaling directives in a much more efficient and reproducible manner than traditional cluster management tools such as Ansible, due to the fact that the deployment environment is completely factored out and dissociated from hardware and operating system concerns.

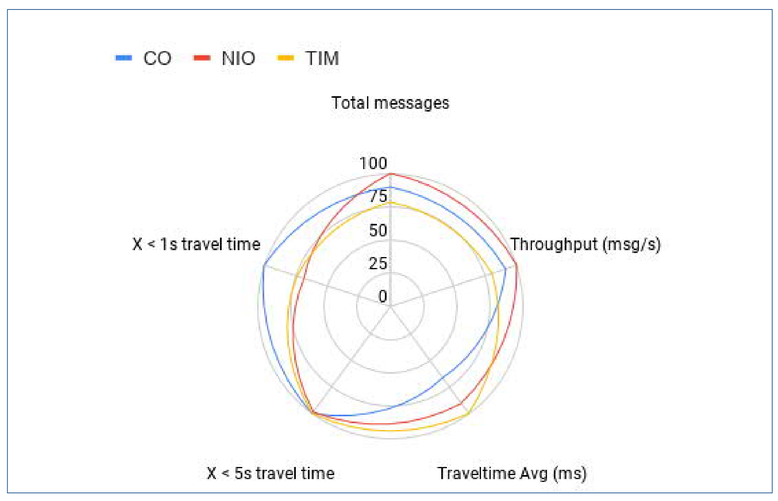
The C2MON Kubernetes deployment has been modularized, and additional configuration options, such as resource properties files can be added in those directories and they are automatically converted into Kubernetes ConfigMaps and Secrets



C2MON Deployment workflow over Kubernetes infrastructure.



Performance of different ActiveMQ configurations during idle state. Scaled to best performance on each axis.



Performance of different ActiveMQ configurations during significant system load. Scaled to best performance on each axis.

What results ?

Java Messaging Server functionality (as provided by ActiveMQ in the C2MON stack) is a critical layer that must be carefully tuned and scrutinized to ensure optimum configuration for its intended usage.

Reproducing failure situations encountered in production is arduous, and sometimes impossible.

By simulating load, but also failures through Chaos Engineering, we can safely improve production configurations.

As an example, three configurations were compared and findings proposed for production release.

Full details of the configuration are available in the annexes of the paper.

Early adoption of C2MON outside CERN

The CERN Knowledge Transfer (KT) team has the mandate to disseminate and productize CERN technology so it can benefit society at large beyond high-energy physics research. CERN KT provides a legal and financial framework for third-party companies to adopt CERN technologies for maximum mutual benefit; as part of the CERN KT portfolio, this applies to C2MON, as illustrated in the two following case studies.

Fresh Produce Logistics Monitoring with C2MON

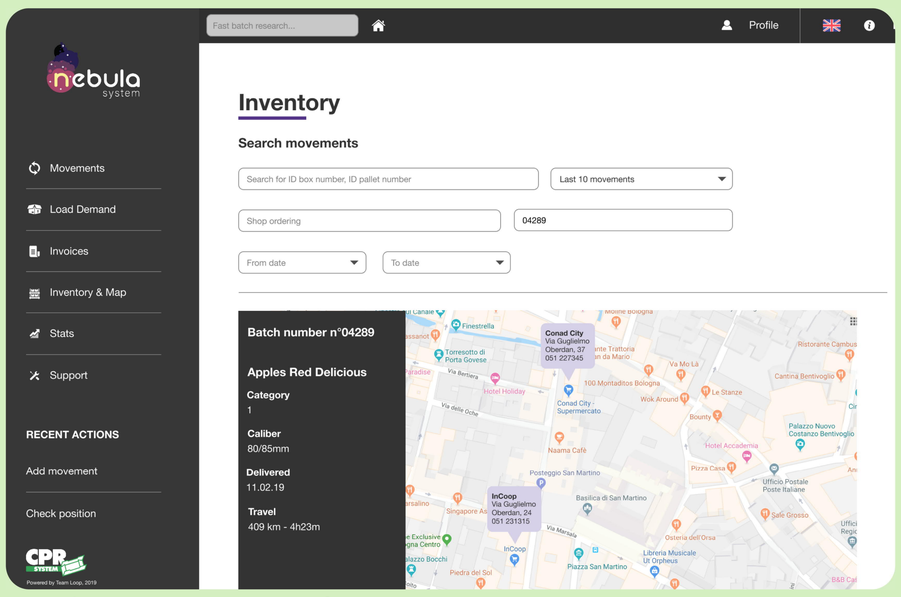
As part of the CERN Challenge Based Innovation, a team of six university students sponsored by the Italian sustainable grocery packaging producer CPR Systems, developed a working tracking service for fresh produce transport crates, using RFID and on board sensors. The tracking service, based on C2MON technology and design principles, enables follow-up of the location, travel time and storage conditions of fruits and vegetables transiting through the transport system. Such detailed information is essential to CPR Systems and goods producers, and also a strong selling point for consumers that can see on the shelf all relevant information concerning the goods they are buying.

The team interviewed all actors in the supply chain.

Transport crates to be fitted with RFID tags and on-board sensors.

Intelligent food stalls display collected information aggregated in the tracking system.

Images courtesy of Team Loop / AlmaCube



Tracking system user interface prototype.

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ICALEPCS 2019