Fleet Health Monitoring with Yocto

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Yocto Project Summit, 2022.05

Fleet Health Monitoring with Yocto

Pets vs Cattle

Intro

Agenda

- Definition
- Architecture
  - General
  - Internet of Things
- Review some options
- POC Implementation (in Yocto)
- Torizon Architecture

About.me

- Embedded Linux Engineer
- 25+ years experience
- Solutions Architect for the Torizon Platform

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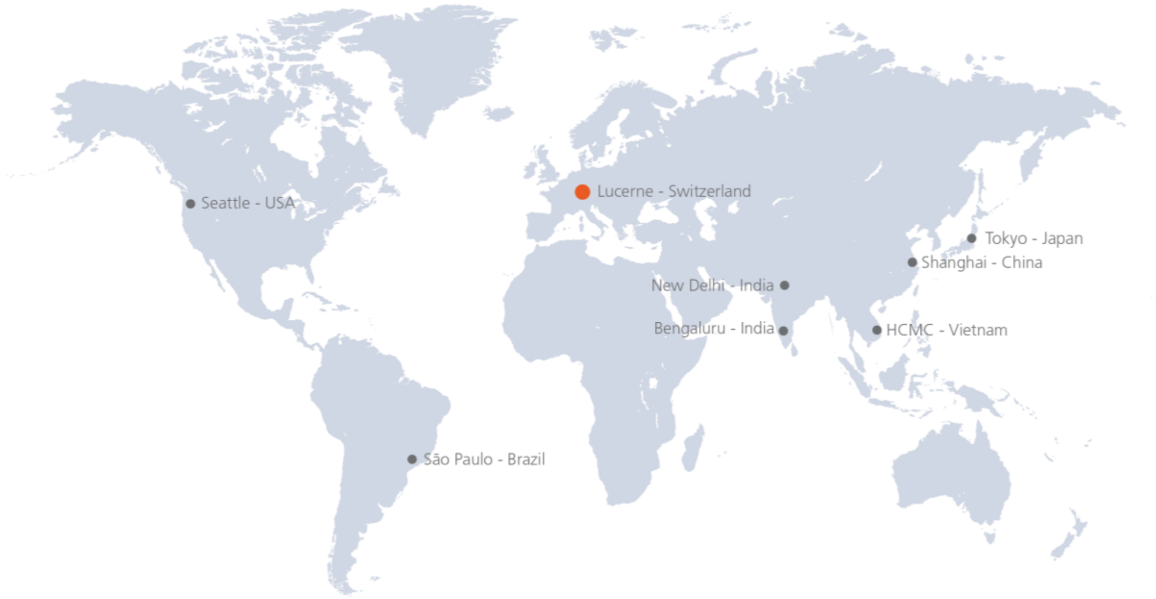
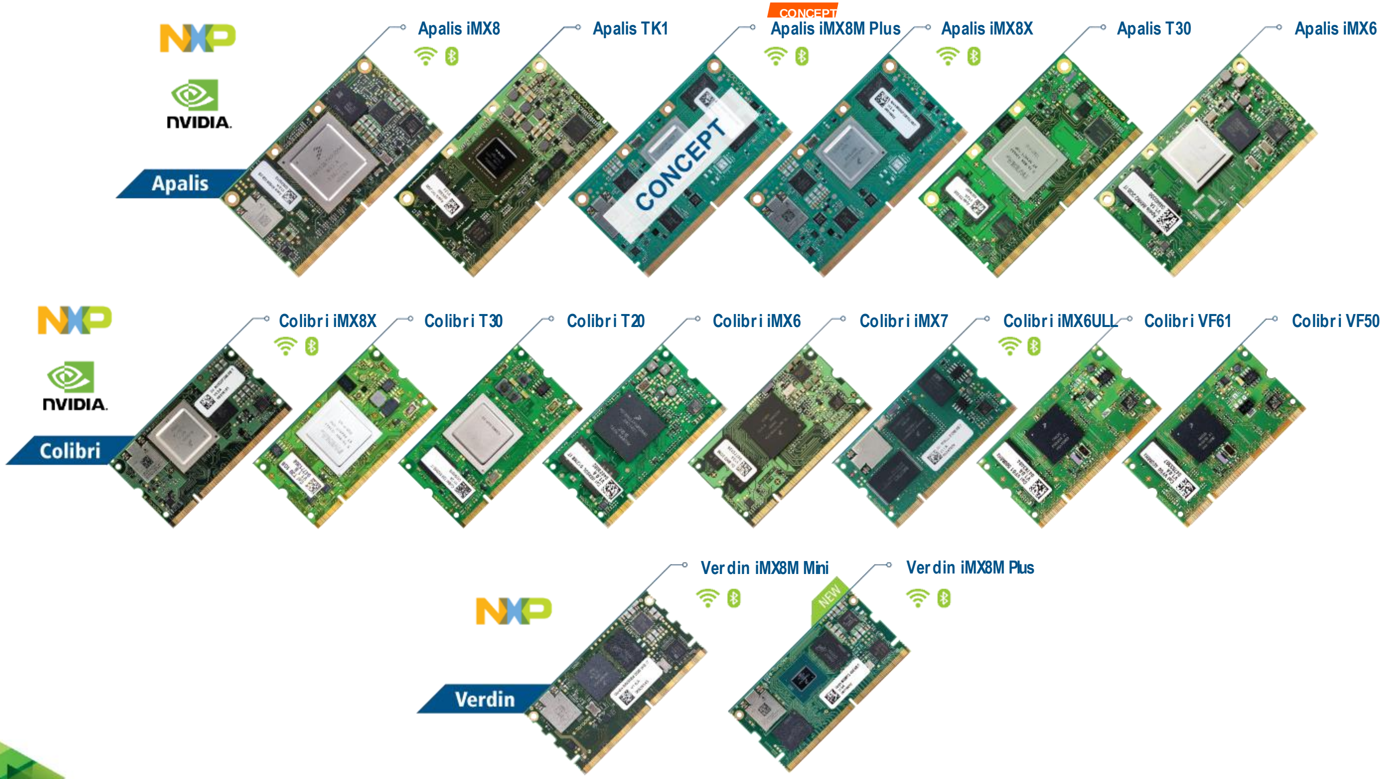
WHAT WE DO

- **Make Embedded Computing Easy**
- **Reliable Arm® System on Modules**
- **Lowest Cost of Ownership**
- **Industry-leading Support**



RELIABLE AND EASY-TO-USE EMBEDDED SOLUTIONS FOR YOU

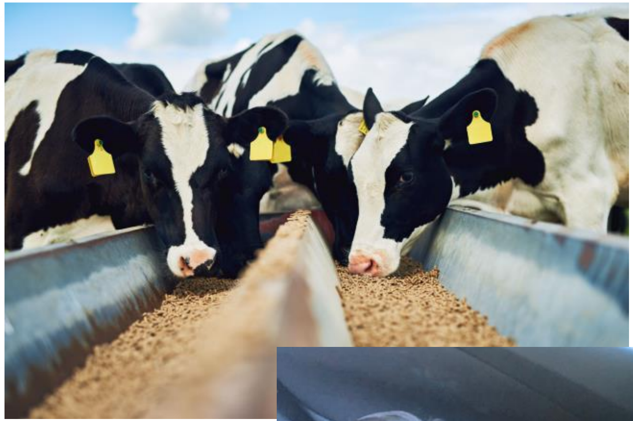
PRODUCT PORTFOLIO



Torizon™

Pets vs Cattle

- Coined by Randy Bias[1]
  - Originally from Enterprise Computing Space
- **In IoT:**
  - Pets – Weekend projects, home automation
  - Cattle – Large fleets of identical devices.
- **Fleet monitoring:**
  - Allows for structured access to health data for "cattle" devices.

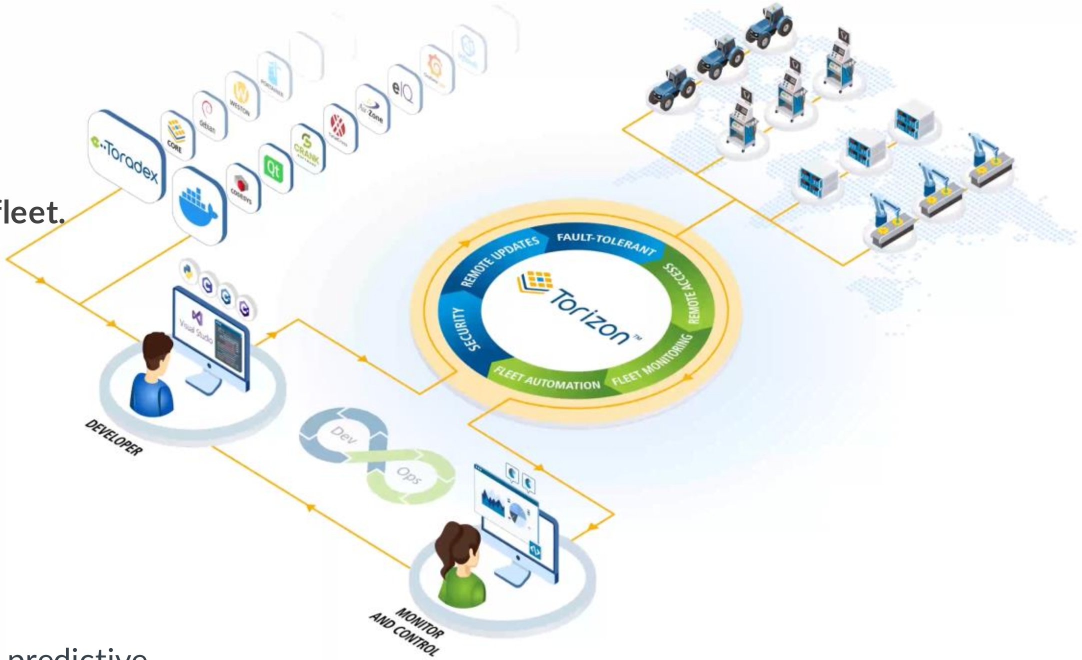


[1] http://cloudscaling.com/blog/cloud-computing/the-history-of-pets-vs-cattle/

Fleet Monitoring – Intro

Definition:

- Wikipedia[1]
- Periodic monitoring of data from all devices in your fleet.
- Gathering log information.
- Analyze and visualize the data.
- "Single pane of glass"



Out of scope:

- Remote access
- Remote control
- Use case dependent analytics/features (e.g., predictive maintenance, ML/AI)

[1] https://en.wikipedia.org/wiki/Fleet_management

Fleet Monitoring – What is important?

Device health:

- Device online/offline, uptime/downtime
- Status of core services
- Thermal measurements

Resource utilization:

- CPU
- Memory
- Flash
- Network

Device Configuration:

- OS/Kernel/Bootloader Versions
- Deployed containers/packages and versions
- Network connection details

Dashboard/fleet status at a glance.

Device status changes:

- Failed health check
- Failed update
- Failed processes/containers

Logs:

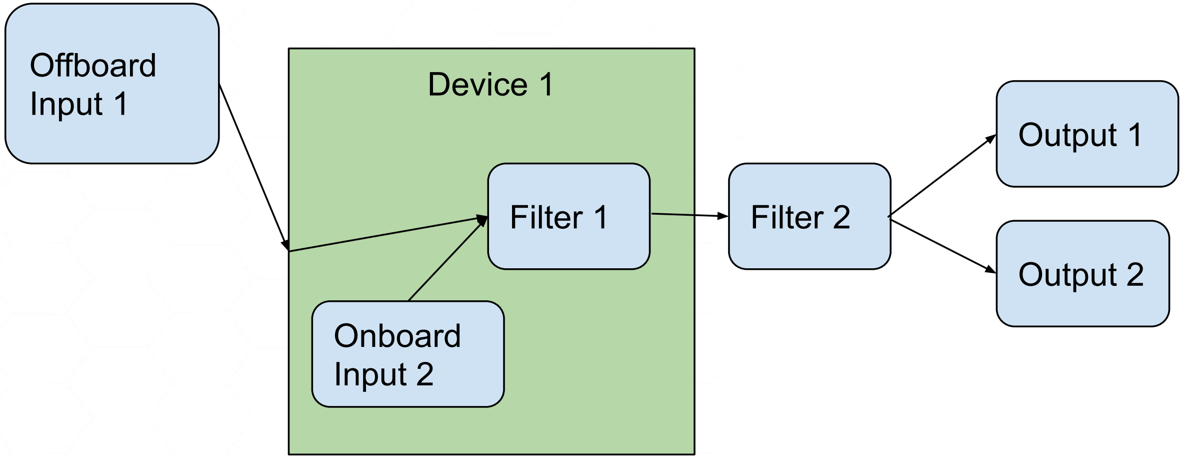
- Kernel logs
- Docker/Application logs
- Systemd logs

Non-functional requirements:

- OSS or not
- On-Prem vs Hosted
- Performance and resource requirements
- Modularity or integration with other services

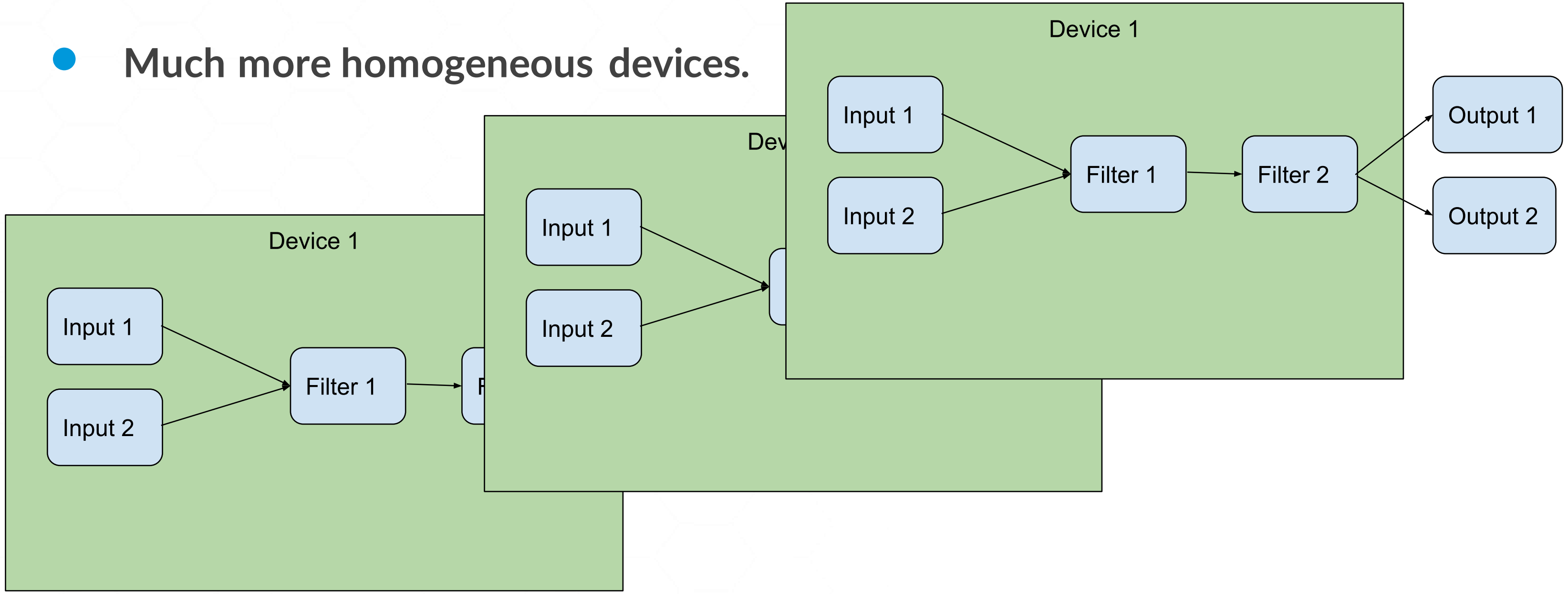
Fleet Monitoring General Architecture

- Inputs come from many sources (SNMP, local files, cloud APIs)
- Local filters allow for some processing of the data on device
- Multiple outputs can be used to send data to separate systems.



Fleet Monitoring IoT Architecture

- Inputs typically limited to just a few sources
- Much more homogeneous devices.



Discarded Options

Nagios XI

- Demo Server[1]
- Uses SNMP or custom agent
- Hybrid OSS/Commercial Licensing
- Yocto recipes exist

Elastic Stack

- ELK (ie Elastic Search, Logstash, Kibana)
- Many input plugins (snmp, syslog, azure_event_hubs, etc)
- On-prem or hosted
- Dual license Apache 2 License
- Large on-device footprint; "Beats" to reduce that.

Datadog

- IoT Monitoring[2]
- Closed Source/Proprietary License

Zabbix

- "Enterprise-class open source distributed monitoring solution"
- Fully OSS/GPLv2
- Paid support options
- Yocto recipes exist

Splunk

- "The Data-to-Everything(tm) Platform Powering Security, IT and DevOps"
- On-prem or hosted
- Commercial License with a feature-limited free option

[1] https://nagiosxi.demos.nagios.com/nagiosxi/index.php

[2] https://www.datadoghq.com/solutions/iot-monitoring/

Considered Options

Telegraf/InfluxDB

- On-prem or hosted
- Open Source (MIT)
- Written in Golang
- No external dependencies
- 110MB flash
- Yocto recipes exist

Fluentbit/Fluentd

- Open Source (Apache)
- Part of the Cloud Native Computing Foundation
- Fluentd:
  - Written in C and Rust
  - 1000+ input and output plugins
  - Depends on rubygems
  - ~40MB flash
- FluentBit
  - Written in C
  - ~70 input and output plugins
  - No external dependencies
  - ~3MB flash/~650KB RAM
- Yocto recipes exist

Torizon Architecture

- Fluentbit – client agent
- Custom output plugin that generates JSON data to be delivered to our cloud.
- Developed an in-band data channel as part of our standard device-to-cloud transport.
- Current metrics are generic values such as CPU and Memory loading.
- Time-series data only at present.

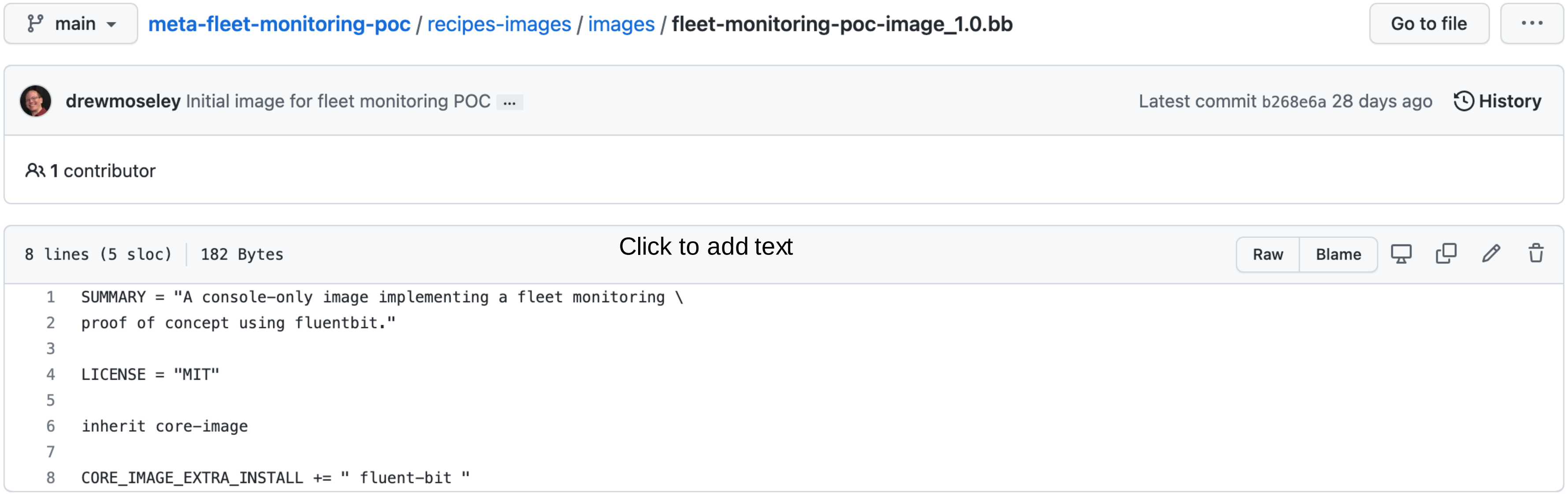
Torizon Architecture part 2

- Individual device monitoring and fleet-wide aggregation supported.
- Custom metrics can be added using variables or Fluent bit plugins, via standard config file
- On-device filters can be used to send data to a separate destination (i.e. Kibana).
- Server API will eventually allow users to query data directly from Torizon.

Proof of Concept

- Implemented a custom DISTRO and IMAGE in a public git repo.
- Adds fluentbit and basic configuration.
- Delivers data to ElasticSearch
- Can be visualized in Kibana.
- Does not require Torizon.

Proof of Concept – Image Recipe


main
meta-fleet-monitoring-poc / recipes-images / images / fleet-monitoring-poc-image_1.0.bb
Go to file
drewmoseley Initial image for fleet monitoring POC ...
Latest commit b268e6a 28 days ago
History
1 contributor
8 lines (5 sloc) | 182 Bytes
Raw
Blame

Click to add text

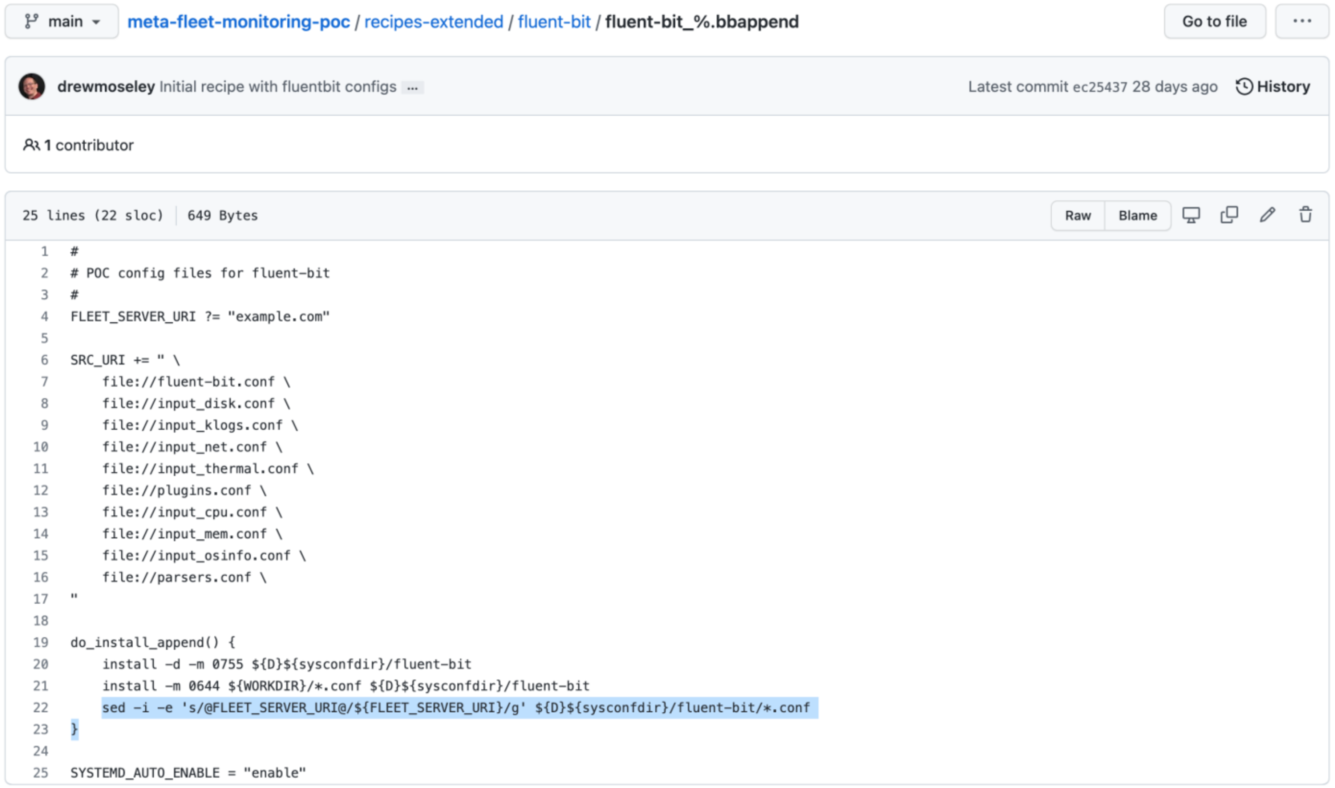
```
SUMMARY = "A console-only image implementing a fleet monitoring \
proof of concept using fluentbit."

LICENSE = "MIT"

inherit core-image

CORE_IMAGE_EXTRA_INSTALL += " fluent-bit "
```

Proof of Concept – fluentbit config


main
meta-fleet-monitoring-poc / recipes-extended / fluent-bit / fluent-bit_%.bbappend
Go to file
drewmoseley Initial recipe with fluentbit configs
Latest commit ec25437 28 days ago
History
1 contributor
25 lines (22 sloc) 649 Bytes
Raw
Blame

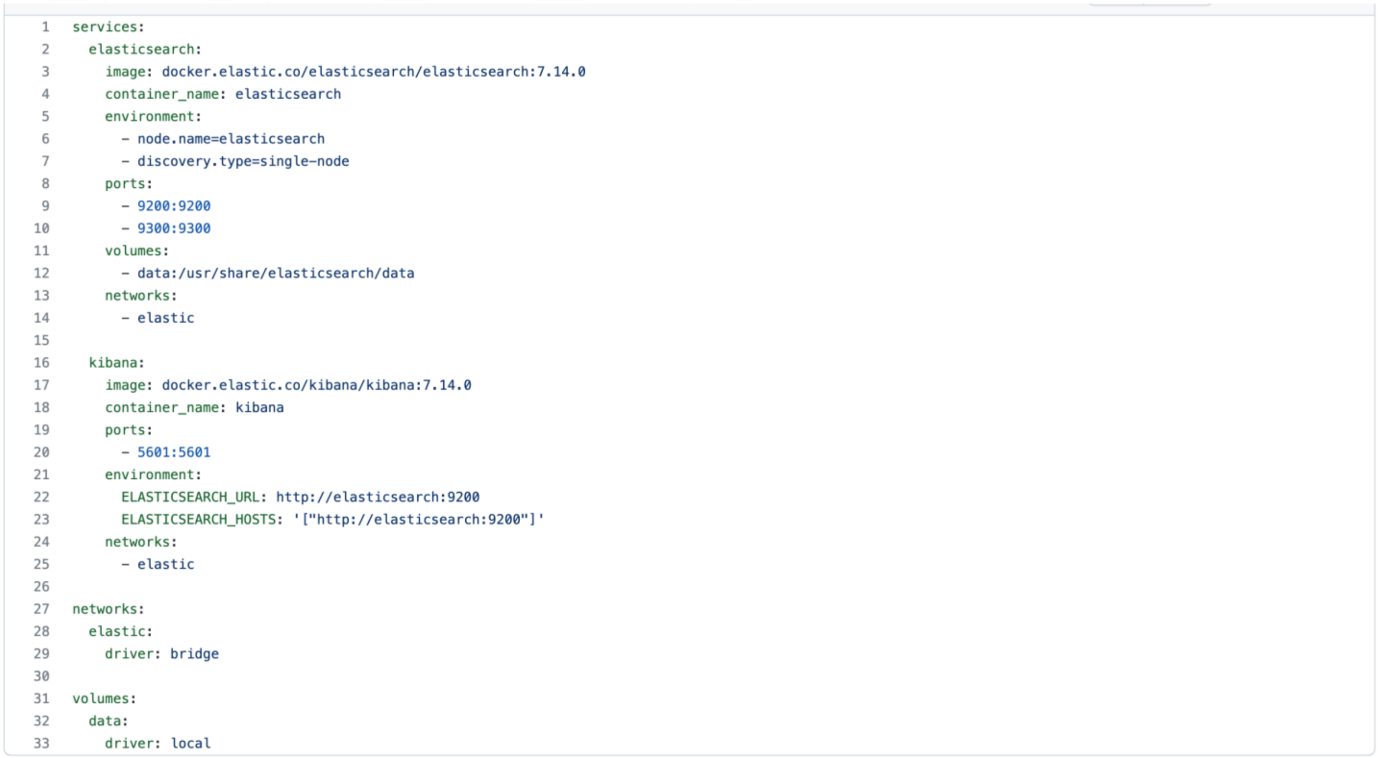
```
#
# POC config files for fluent-bit
#
FLEET_SERVER_URI ?= "example.com"

SRC_URI += " \
    file://fluent-bit.conf \
    file://input_disk.conf \
    file://input_klogs.conf \
    file://input_net.conf \
    file://input_thermal.conf \
    file://plugins.conf \
    file://input_cpu.conf \
    file://input_mem.conf \
    file://input_osinfo.conf \
    file://parsers.conf \
"

do_install_append() {
    install -d -m 0755 ${D}${sysconfdir}/fluent-bit
    install -m 0644 ${WORKDIR}/*.conf ${D}${sysconfdir}/fluent-bit
    sed -i -e 's/@FLEET_SERVER_URI@/${FLEET_SERVER_URI}/g' ${D}${sysconfdir}/fluent-bit/*.conf
}

SYSTEMD_AUTO_ENABLE = "enable"
```

Proof of Concept – server config



```yaml
services:
  elasticsearch:
    image: docker.elastic.co/elasticsearch/elasticsearch:7.14.0
    container_name: elasticsearch
    environment:
      - node.name=elasticsearch
      - discovery.type=single-node
    ports:
      - 9200:9200
      - 9300:9300
    volumes:
      - data:/usr/share/elasticsearch/data
    networks:
      - elastic

  kibana:
    image: docker.elastic.co/kibana/kibana:7.14.0
    container_name: kibana
    ports:
      - 5601:5601
    environment:
      ELASTICSEARCH_URL: http://elasticsearch:9200
      ELASTICSEARCH_HOSTS: '["http://elasticsearch:9200"]'
    networks:
      - elastic

networks:
  elastic:
    driver: bridge

volumes:
  data:
    driver: local
```

Proof of Concept – howto

Device Setup

```
$ git clone https://github.com/drewmoseley/meta-fleet-monitoring-poc.git \
            layers/meta-fleet-monitoring-poc
$ bitbake-layers add-layer layers/meta-fleet-monitoring-poc
$ echo 'FLEET_SERVER_URI = "<IP-ADDRESS-OF-SERVER>" >> conf/local.conf
$ bitbake fleet-monitoring-poc-image
```

Server Setup

```
$ cd layers/meta-fleet-monitoring-poc/misc
$ docker-compose –f fleet-monitoring-server-docker-compose.yml up -d
```

Demo Time

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