Proposal for GSoC 2018

Integrate Containerd with Katacontainers

About Me

- Name: Jian Liu
- Email: anthonyliu@zju.edu.cn
- Phone: +86 13018970075
- GitHub: ZeroMagic
- Education:
  - 2017.9 ~ present: Software Engineering Master Candidate in Zhejiang University, China.
- Related Experience:
  - Half-year Cloud Platform Project development experience, as a software engineer intern in Hangzhou Harmonycloud Technology Ltd.
  - Participate in the project "Real-workload Benchmark for Kubernetes" which is developed jointly by Zhejiang University SEL laboratory and Alibaba Cloud container team.

About Project

- Project Name: Integrate Containerd with Katacontainers
- Project Description: Integrate Containerd with Katacontainers

Proposal

Background

Containerd is an industry-standard container runtime with an emphasis on simplicity, robustness and portability. It can manage the complete container lifecycle of its host system: image transfer and storage, container execution and supervision, low-level storage and network attachments, etc.

Kata Containers is an open source project and community working to build a standard implementation of lightweight Virtual Machines (VMs) that feel and perform like containers, but provide the workload isolation and security advantages of VMs.

There are more and more companies and developers that tend to adopt Kubernetes in their production environment. Nowadays, they can use runc, runv and other runtimes. But these containers can't balance performance and security. So this project will provide users with a well performance and secure container.

Goal and Non-Goals

The goals of the project during official coding period
- A containerd-kata project.
- Bridge mode of CNI support for Kata.
- A demo of Kubernetes + containerd + Kata with several test cases.
- Node e2e conformance test.

The non-goals include
- Support all kinds of CNI plugins other than bridge mode.
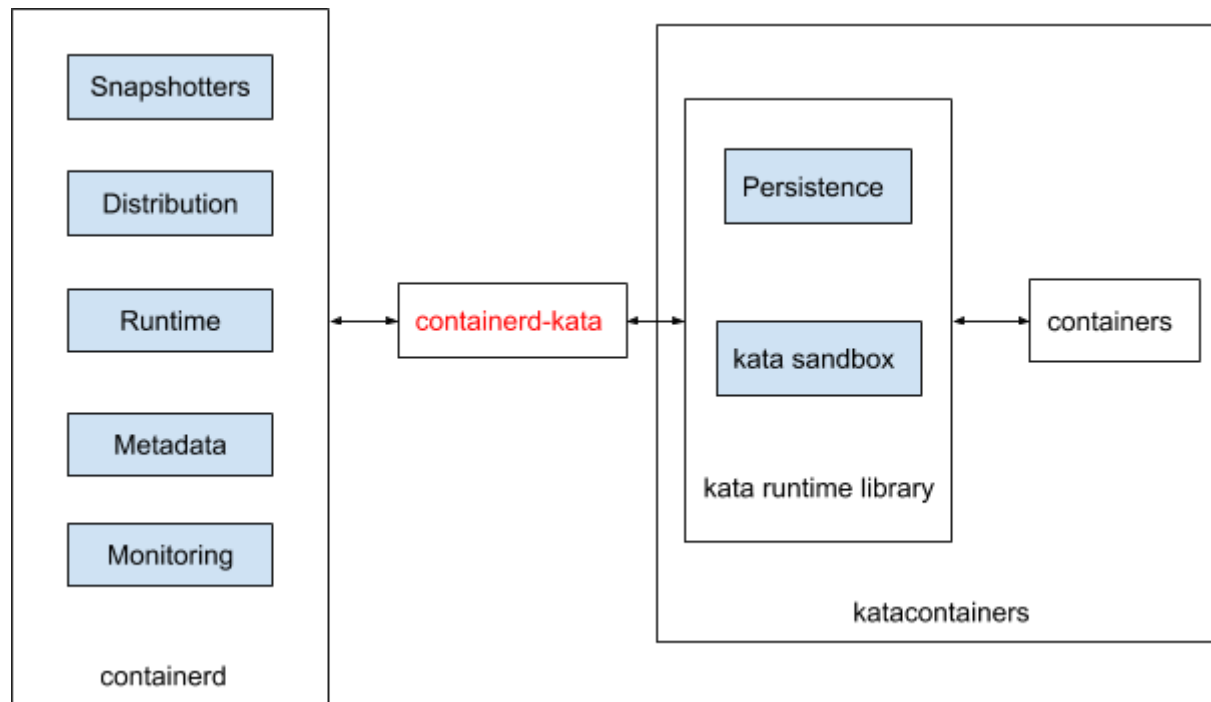- Implement Docker+containerd+Kata.

Design

Synopsis

The project aims at creating a **containerd-kata** runtime plugin for containerd to integrate it with katacontainers. Because containerd is constructed with plugins and contains many native plugins when built and is able to load dynamically loaded go plugins, we decide to implement the project as a plugin.
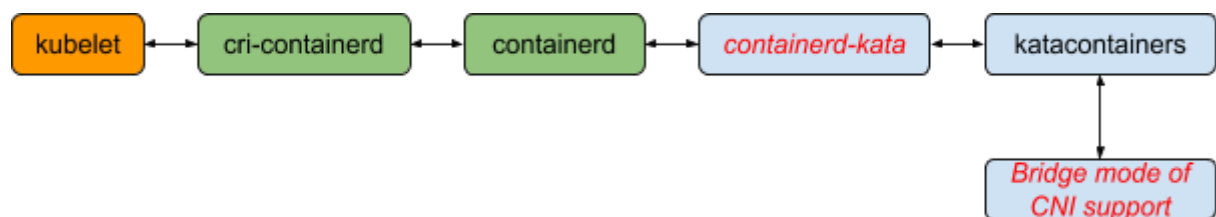
The workflow of containerd-kata

This is the core logic execution flow of containerd-kata. First and foremost, we need to implement the containerd runtime interfaces so that containerd can call kata runtime. Secondly, we need to call into kata runtime library to operate the kata sandbox and containers. In Kata, kata sandbox is also called pod sandbox which is a lightweight Virtual Machines. Every pod sandbox can include several containers. This is like the concept "Pod" in Kubernetes. In order to create a container, we need to create a pod previously with a PodConfig. As a container is always linked to a pod, the entire container API always takes a pod ID as its first argument. And then, the container will be created in the pod which we create before. In addition, we need to use the kata agent which manage the lifecycle of Katacontainers lifecycle and hold all the processes, exit-code and IO.

Image Management

Here we need to manage the images of Katacontainers. We will implement the image features including listing images, pulling images, removing images, showing images status and auditing images.

Containerd crash resistance

When we use containerd to start Katacontainers, the metadata of Katacontainers will be saved into metadata plugin of containerd. Then containerd happens to crash, kata sandbox is still existing. We restart containerd, and it can leverage kata runtime library to acquire the previous metadata. Then it will reconnect to katacontainers.

Bridge mode of CNI support for Kata

CNI plugin is essentially an executable file. The execution of CNI is generally to obtain configuration from container management system and configuration file. Then the information is transferred to CNI plugin as environment variables and standard input. Next, run CNI plugin to complete the specific container network configuration. Eventually, the configuration result is returned by the flag output.

In consideration of the difference between Katacontainer construction and other OCI containers, we need to join the pod network to customize a container network solution for Kata.

Schedule

Date	Work
April 30th - May 6th	Deeply understand katacontainers, containerd, cri-containerd / Detail design
May 7th - 13th	Implement basic framework of containerd-kata
May 14th - 20th	Implement image management
May 21st - 27th	Implement kata sandbox management
May 28th - June 3rd	Implement container management
June 4th - 10th	Implement container management
June 11th -17th	Test, debug and review / Write a document of evaluation
June 18th - 24th	Implement reconnection kata sandbox
June 25th - July 1st	Implement CRI part of containerd-kata
July 2nd - 8th	Implement CNI support
July 9th - 15th	Implement a demo of Kubernetes + containerd + Kata / Write a document of evaluation
July 16th - 22nd	Implement a demo of Kubernetes + containerd + Kata
July 23rd - 29th	Node e2e conformance test
July 30th - August 5th	Test, debug and review
August 6th - 12th	Write a summary throughout the project and a document of evaluation

Extra Information

Working Time

I will be based in Hangzhou, China during the summer. Therefore, I will work in GMT +8 timezone. During official coding period, I will spend at least 40 hours a week for the work, and there is no conflict in terms of time.

Reason for Participation

Since the first day I started programming, I have wanted to be a great developer and to challenge my programming capabilities in different aspects. When I found GSoC, I was very excited. I think GSoC is awesome. It can provide me a chance to make contributions to open source projects with mentors from great developers all over the world. This program can not only help students to improve skills and participate the community, but also promote the development of the open source community. I extremely enjoy learning and spending time on Kubernetes and container technology. After GSoC, I am willing to keep contributing to Katacontainers, Containerd and other projects in CNCF.