containerd intro

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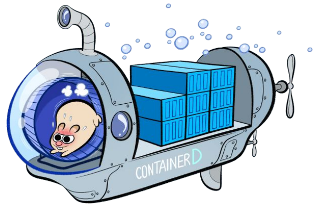
KubeCon EU

A Brief History



APRIL 2016 ······ Containerd "0.2" announced, Docker 1.11

Management/Supervisor for the OCI `runc` executor

Announce expansion of containerd OSS project ······ DECEMBER 2016

containerd

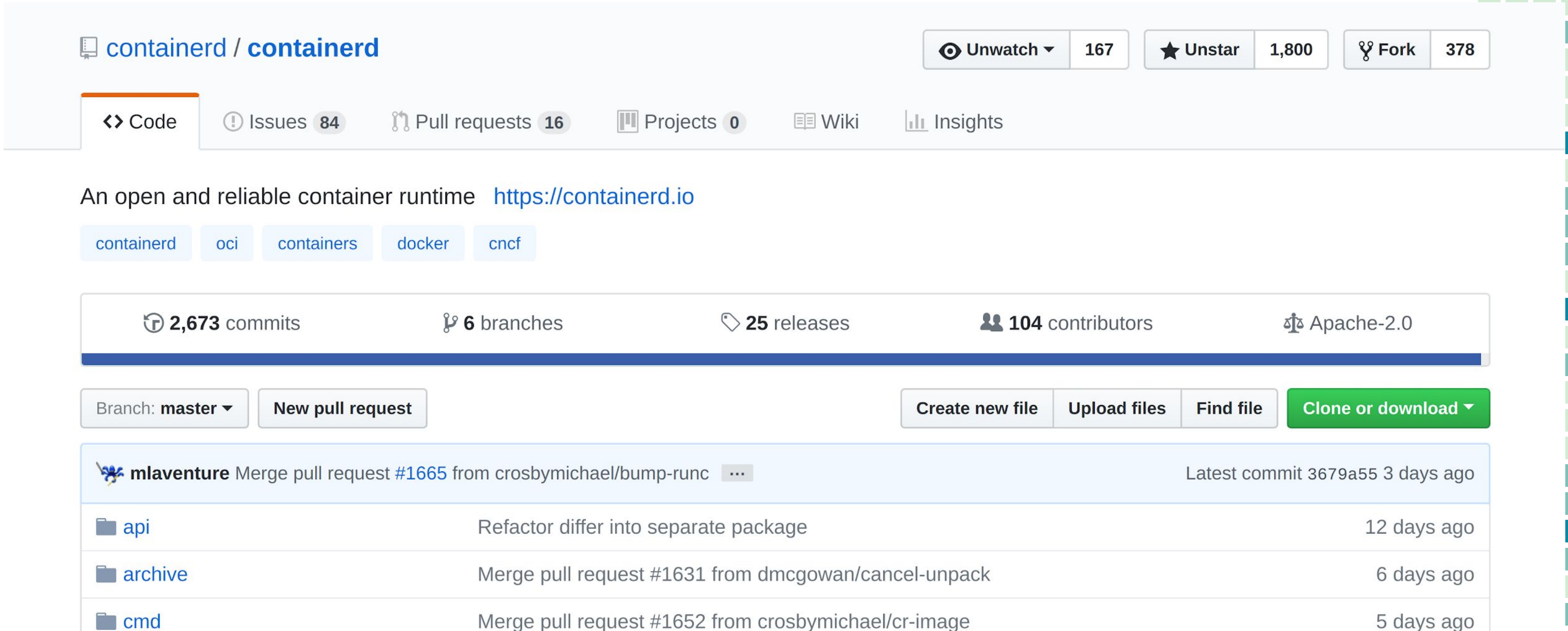
Containerd 1.0: A core container runtime project for the industry

MARCH 2017 ······ Containerd project contributed to CNCF

CLOUD NATIVE COMPUTING FOUNDATION

containerd

https://github.com/containerd/containerd



containerd / containerd

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Code | Issues 84 | Pull requests 16 | Projects 0 | Wiki | Insights

An open and reliable container runtime https://containerd.io

containerd | oci | containers | docker | cncf

2,673 commits | 6 branches | 25 releases | 104 contributors | Apache-2.0

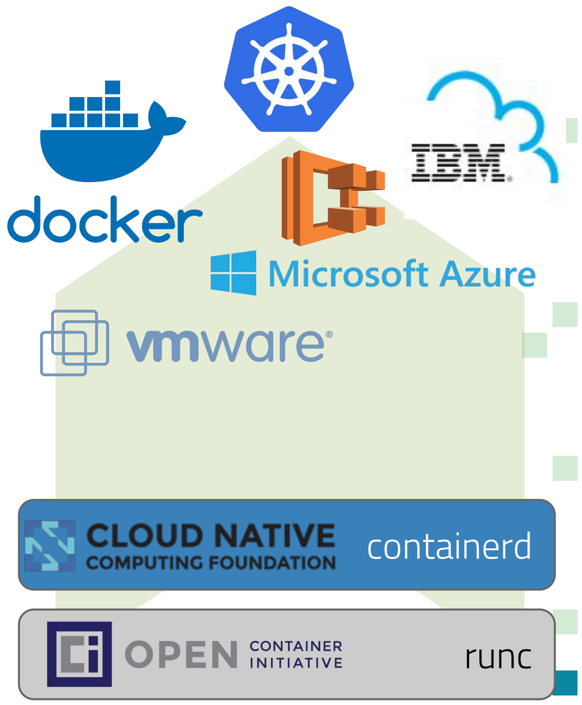
Branch: master | New pull request | Create new file | Upload files | Find file | Clone or download

mlaventure Merge pull request #1665 from crosbymichael/bump-runc ... Latest commit 3679a55 3 days ago

api	Refactor differ into separate package	12 days ago
archive	Merge pull request #1631 from dmcgowan/cancel-unpack	6 days ago
cmd	Merge pull request #1652 from crosbymichael/cr-image	5 days ago

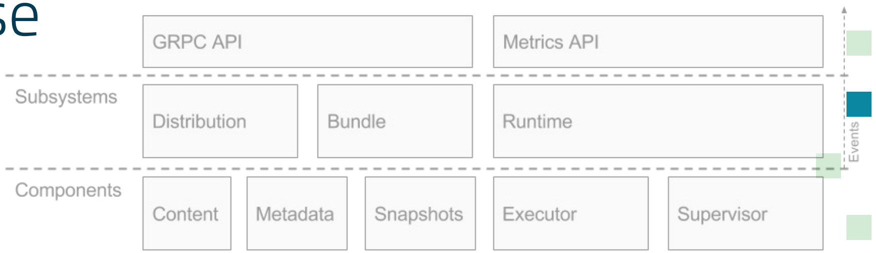
Why Containerd 1.0?

- Continue projects **spun out** from monolithic Docker engine
- Expected use **beyond** Docker engine (Kubernetes CRI)
- Donation to **foundation** for broad industry collaboration
  - Similar to runc/libcontainer and the OCI



Technical Goals/Intentions

- Clean **gRPC-based** API + client library
- Full **OCI** support (runtime and image spec)
- **Stability** and **performance** with tight, well-defined core of container function
- **Decoupled** systems (image, filesystem, runtime) for pluggability, reuse



Requirements

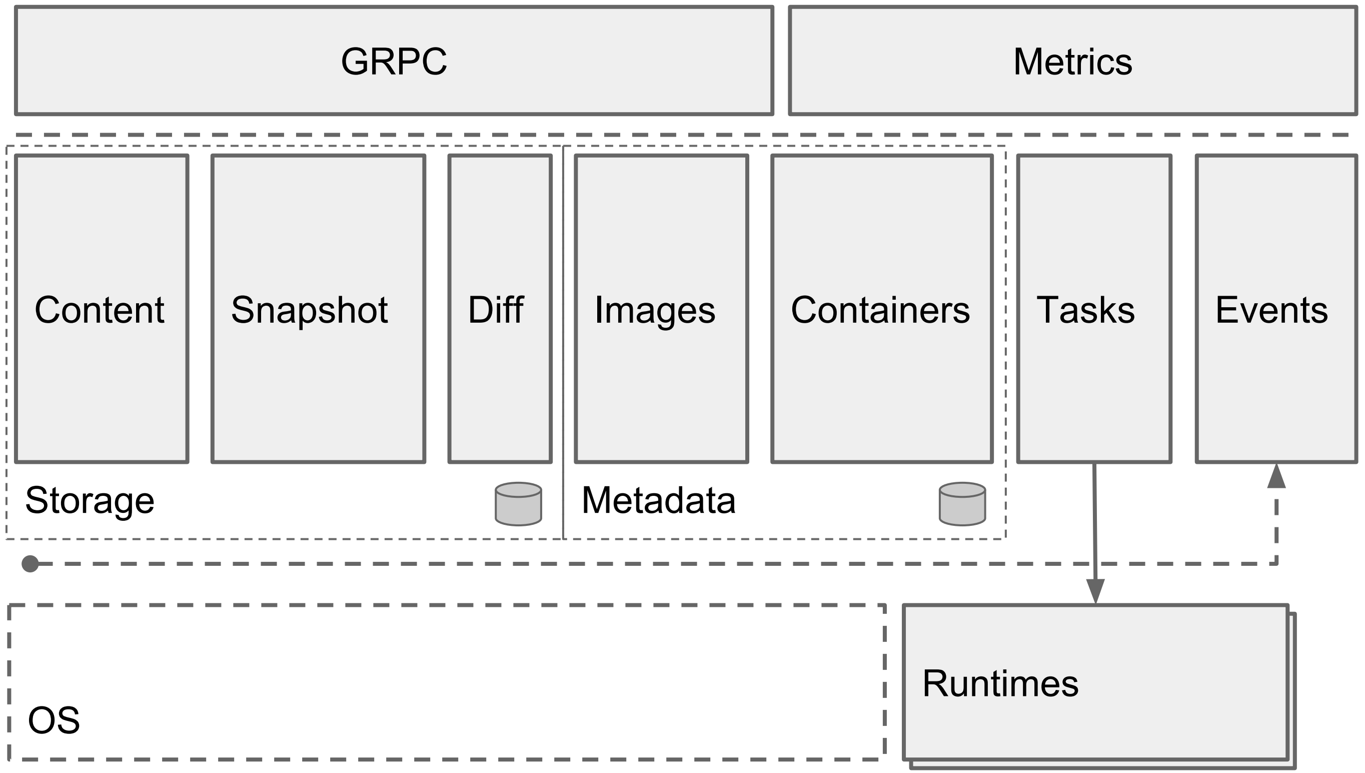
- **A la carte**: use only what is required
- Runtime **agility**: fits into different platforms
  - Pass-through container configuration (direct OCI)
- **Decoupled**
- Use **known-good** technology
  - OCI container runtime and images
  - gRPC for API
  - Prometheus for Metrics

Use cases

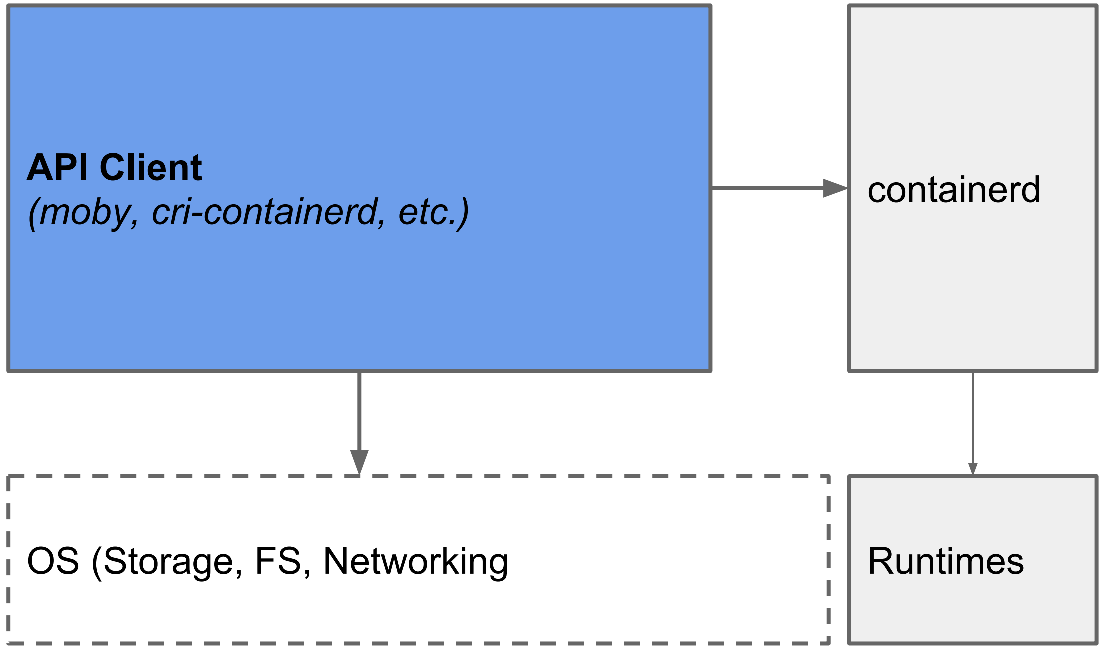
- Container API Implementations
- Building Images
- Container OS

- **EXAMPLES**
- Docker/Moby
- Kubernetes CRI
- alibaba/pouch
- SwarmKit (experimental)
- LinuxKit
- BuildKit
- IBM Cloud

Architecture



Architecture



Containerd: Rich Go API

Getting Started

https://github.com/containerd/containerd/blob/master/docs/getting-started.md

GoDoc

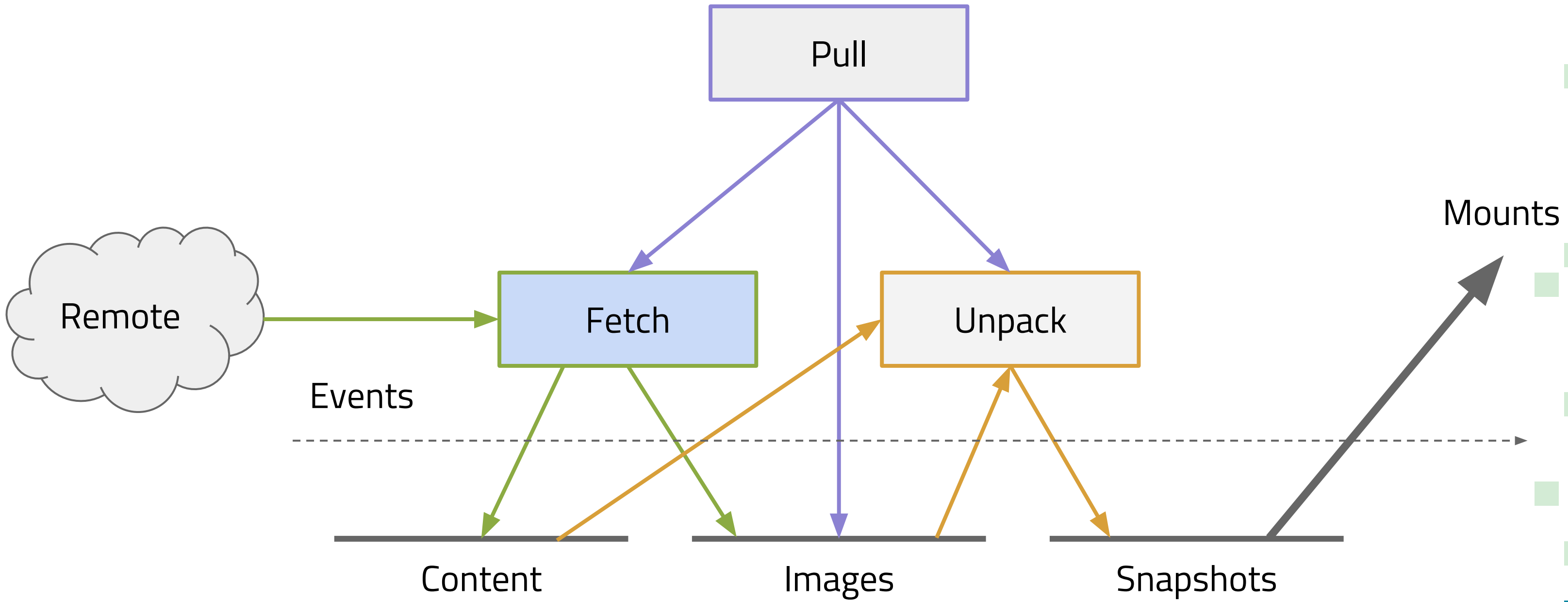
https://godoc.org/github.com/containerd/containerd

Pulling an Image

What do runtimes need?

Pulling an Image

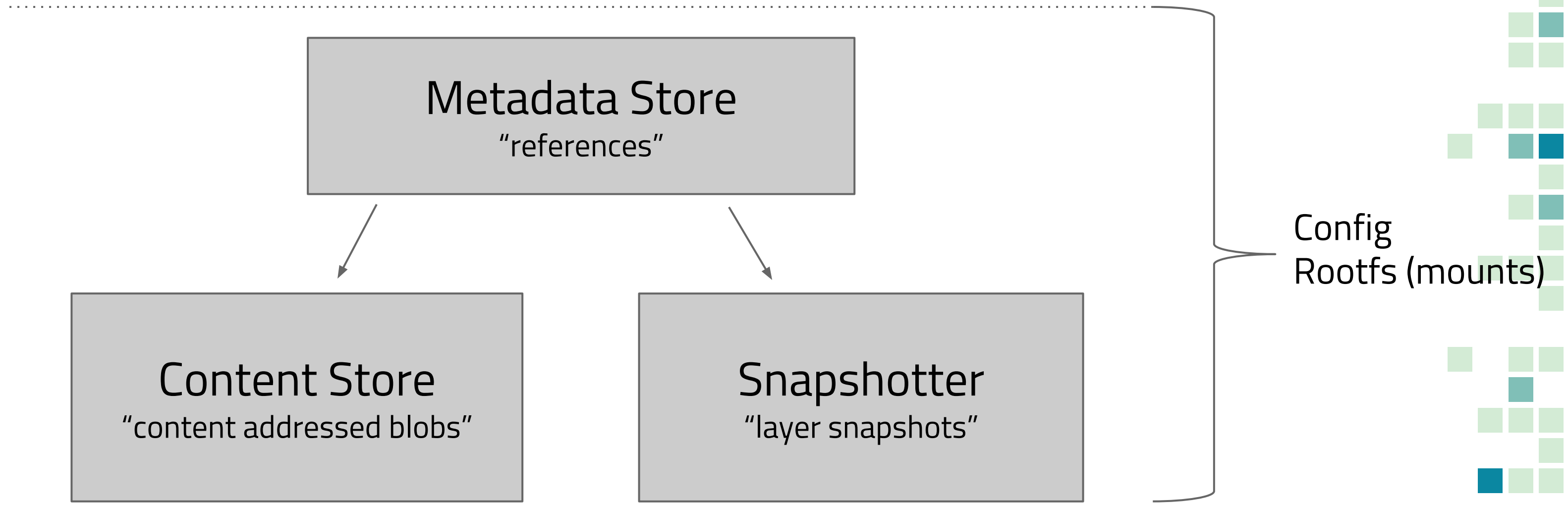
Data Flow



Snapshotters

How do you build a container root filesystem?

containerd Storage Architecture



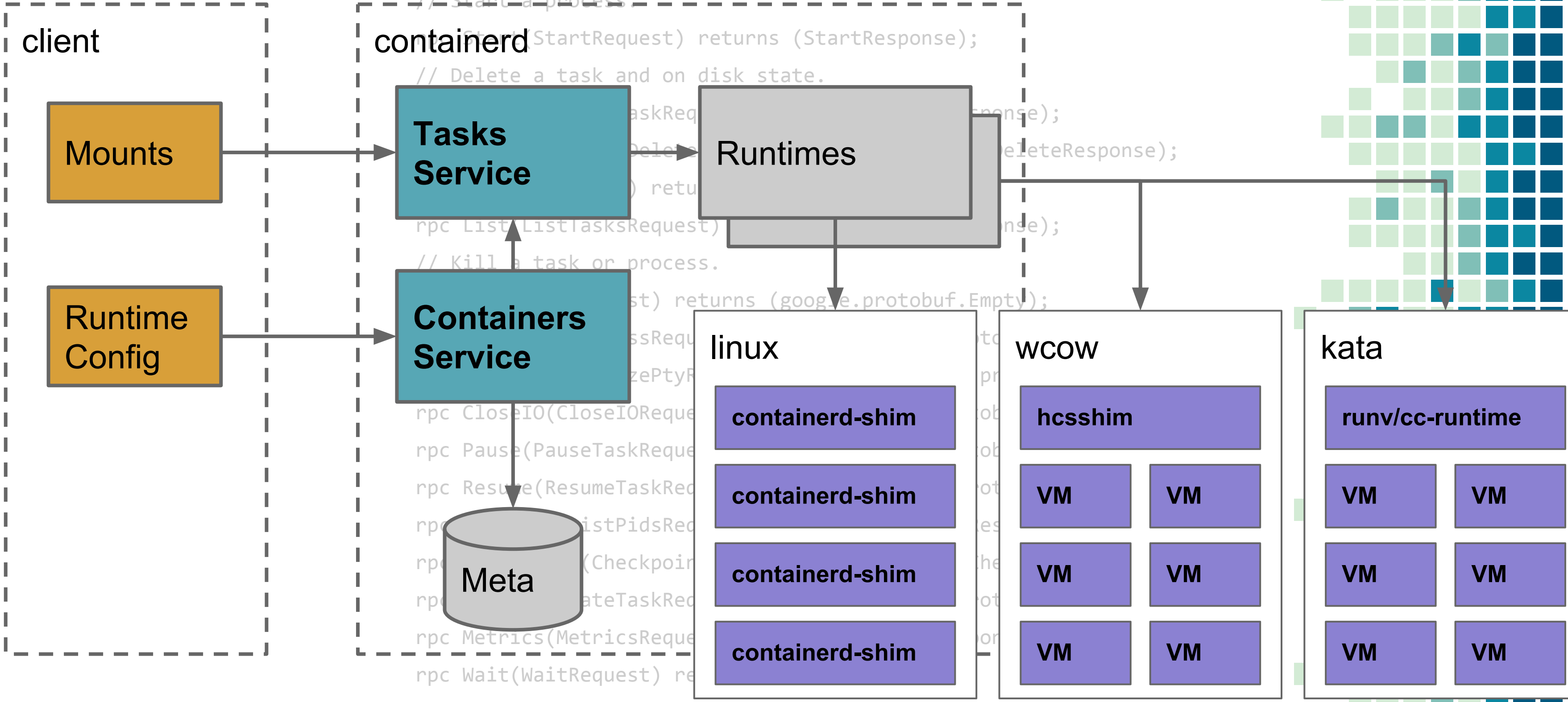
Example: Investigating Root Filesystem

```
$ ctr snapshot ls
…
$ ctr snapshot tree
…
$ ctr snapshot mounts <target> <id>
```

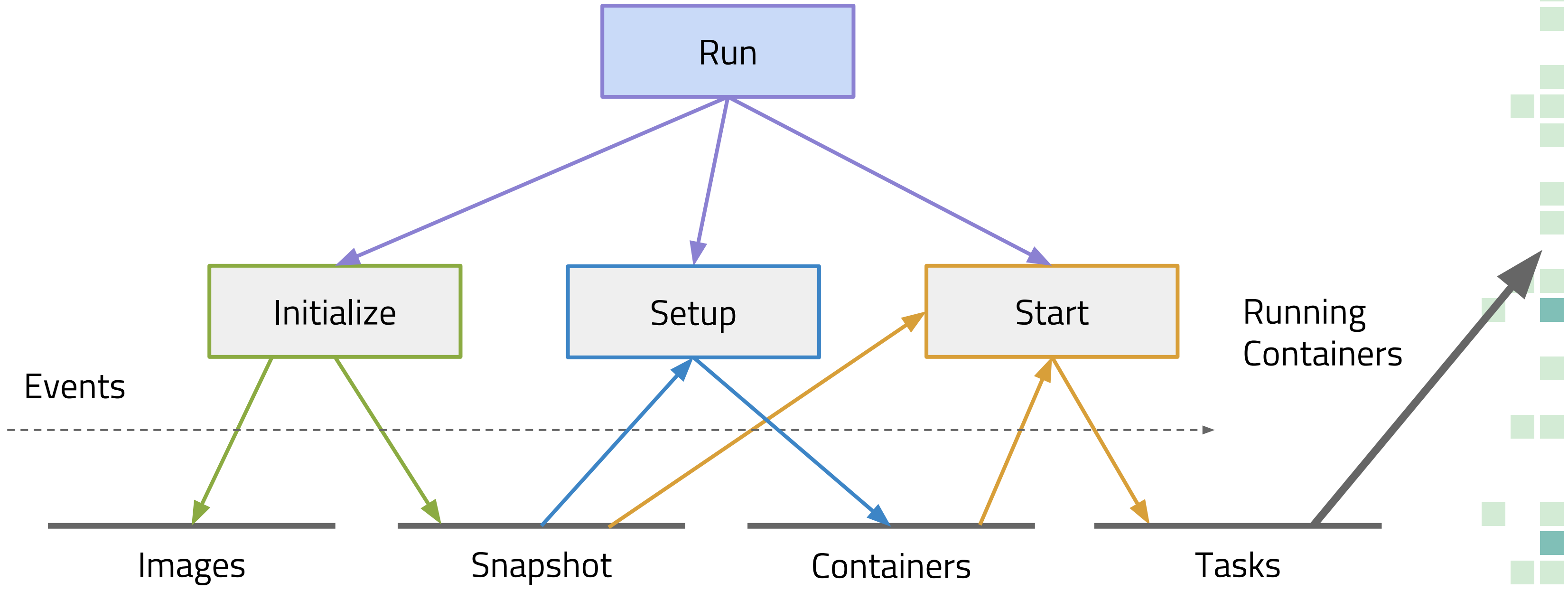
Running a container

Tasks and Runtime

```
service Tasks {
    // Create a task.
    rpc Create(CreateTaskRequest) returns (CreateTaskResponse);
    // Start a process.
    rpc Start(StartRequest) returns (StartResponse);
    // Delete a task and on disk state.
                       askReq                          ponse);
                       Dele                            eleteResponse);
                       ) retu
    rpc List(ListTasksRequest)                         nse);
    // Kill a task or process.
                       st) returns (google.protobuf.Empty);
                       ssRequ                          to
                       zePtyR                          pr
    rpc CloseIO(CloseIOReque                           ob
    rpc Pause(PauseTaskReque                           ob
    rpc Resume(ResumeTaskReq                           ot
    rpc                istPidsReq                      es
    rpc                (Checkpoi                       he
    rpc                ateTaskReq                      ot
    rpc Metrics(MetricsReque                           on
    rpc Wait(WaitRequest) re
}
```



Starting a Container



Demo

Example: Pull an Image

Via **ctr** client:

```
$ export \
  CONTAINERD_NAMESPACE=example

$ ctr pull \
  docker.io/library/redis:alpine

$ ctr image ls
...
```

```
import (
        "context"

        "github.com/containerd/containerd"
        "github.com/containerd/containerd/namespaces"
)

// connect to our containerd daemon
client, err := containerd.New("/run/containerd/containerd.sock")
defer client.Close()

// set our namespace to "example":
ctx := namespaces.WithNamespace(context.Background(), "example")

// pull the alpine-based redis image from DockerHub:
image, err := client.Pull(ctx,
                 "docker.io/library/redis:alpine",
                 containerd.WithPullUnpack)
```

Example: Run a Container

Via **ctr** client:

```
$ export \
  CONTAINERD_NAMESPACE=example

$ ctr run -t \
  docker.io/library/redis:alpine \
  redis-server

$ ctr c
...
```

```go
// create our container object and config
container, err := client.NewContainer(ctx,
      "redis-server",
      containerd.WithImage(image),
      containerd.WithNewSpec(containerd.WithImageConfig(image)),
      )
defer container.Delete()

// create a task from the container
task, err := container.NewTask(ctx, containerd.Stdio)
defer task.Delete(ctx)

// make sure we wait before calling start
exitStatusC, err := task.Wait(ctx)
// call start on the task to execute the redis server
if err := task.Start(ctx); err != nil {
      return err
}
```

Example: Kill a Task

Via **ctr** client:

```
$ export \
  CONTAINERD_NAMESPACE=example

$ ctr t kill redis-server

$ ctr t ls
...
```

```
// make sure we wait before calling start
exitStatusC, err := task.Wait(ctx)

time.Sleep(3 * time.Second)

if err := task.Kill(ctx, syscall.SIGTERM); err != nil {
        return err
}

// retrieve the process exit status from the channel
status := <-exitStatusC
code, exitedAt, err := status.Result()
if err != nil {
        return err
}
// print out the exit code from the process
fmt.Printf("redis-server exited with status: %d\n", code)
```

Example: Customize OCI Configuration

```go
// WithHtop configures a container to monitor the host via `htop`
func WithHtop(s *specs.Spec) error {
	// make sure we are in the host pid namespace
	if err := containerd.WithHostNamespace(specs.PIDNamespace)(s); err != nil {
		return err
	}
	// make sure we set htop as our arg
	s.Process.Args = []string{"htop"}
	// make sure we have a tty set for htop
	if err := containerd.WithTTY(s); err != nil {
		return err
	}
	return nil
}
```

With{func} functions cleanly separate modifiers

Release

https://github.com/containerd/containerd/blob/master/RELEASES.md

Support Horizon

Release	Status	Start	End of Life
0.0	End of Life	Dec 4, 2015	-
0.1	End of Life	Mar 21, 2016	-
0.2	End of Life	Apr 21, 2016	December 5, 2017
1.0	Active	December 5, 2017	December 5, 2018
1.1	Active	April 23, 2018	max(April 23, 2019, release of 1.2.0, Kubernetes 1.10 EOL)
1.2	Next	TBD	max(TBD+1 year, release of 1.3.0)

Supported Components

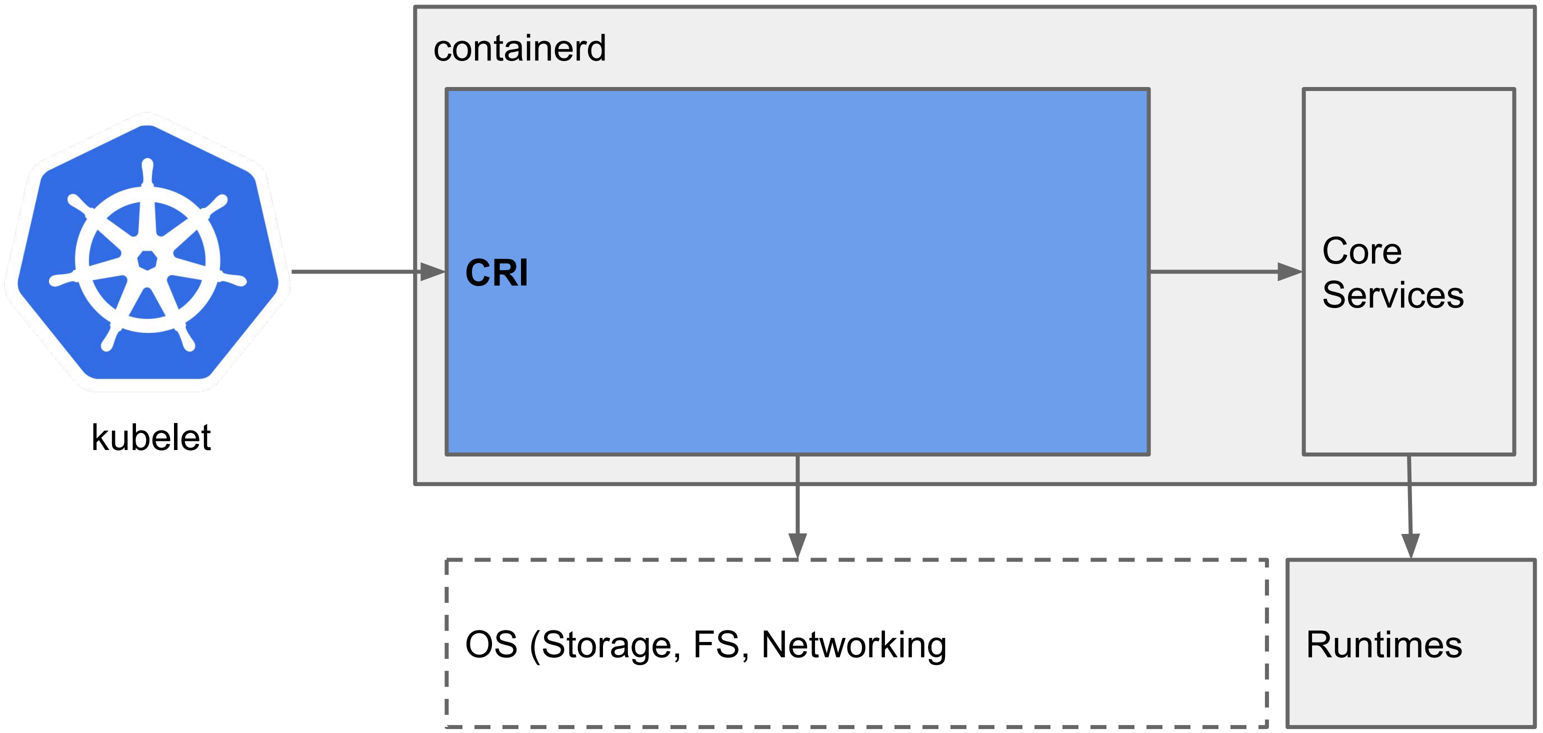
Component	**Status**	**Stabilized Version**	**Links**
GRPC API	Stable	1.0	api/
Metrics API	Stable	1.0	-
Go client API	Unstable	1.2 *tentative*	godoc
CRI GRPC API	Unstable	v1alpha2 *current*	api/
`ctr` tool	Unstable	Out of scope	-

1.1

https://github.com/containerd/containerd/releases/tag/v1.1.0

- Merged in Kubernetes CRI Support
- Additional Snapshotter: ZFS, AUFS and native

Kubernetes CRI Support



Going further with **containerd**

- **Contributing**: https://github.com/containerd/containerd
  - Bug fixes, adding tests, improving docs, validation
- **Using**: See the getting started documentation in the `docs` folder of the repo
- **Porting/testing**: Other architectures & OSs, stress testing (see bucketbench, containerd-stress):
  - `git clone <repo>, make binaries, sudo make install`
- **Upstream Testing:** https://k8s-testgrid.appspot.com/sig-node-containerd

KubeCon Talks

- **Take Control of your Filesystems with containerd's Snapshotters**
  - Wednesday May 2, 2018 16:25 - 17:00
  - C1-M5
- **containerd Deep Dive**
  - Friday May 4, 2018 15:40 - 16:15
  - B5-M1+3
-

Thank You! Questions?

- **Stephen Day**
  - https://github.com/stevvooe
  - @stevvooe
  - Docker Community Slack