Container Native FS Interposer

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Mentors: Vasily Tarasov, Alex Merenstein

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Introduction

Container
Native FS
Interposer

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Goal

Introduce a filesystem interposer layer to k8s

- workload tracing
- workload metric collection
- faulty I/O
- throttle I/O
- fake I/O
- . . .

Architecture

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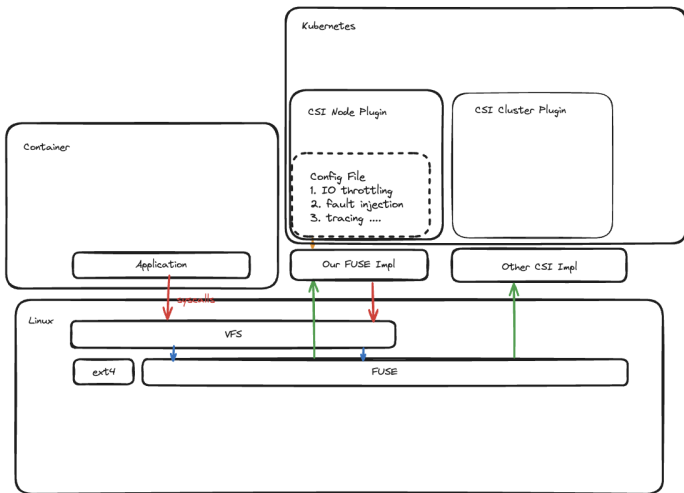Vasily
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Introduction

FUSE

CSI

Demo

Plans

Architecture

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FUSE

the mechanisms and API for implementing virtual file systems

CSI

a cloud native way to mount fuse filesystems into containers

What is FUSE

File System in Userspace

Benefits

- Develop virtual file systems in user space
- Can be implemented with any language
- Available in many linux distributions or even other OS

Drawbacks

- Poor performance
- Less reliable

How FUSE works

Components

- Kernel module `fuse.ko`
- Userspace library `libfuse`
- Utilities `fusermount`

Why FUSE

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- It's hard to ship kernel modules with container
- It's easier to instrument and debug userland programs
- It's widely used and already have a lot of existing implementations

What is CSI

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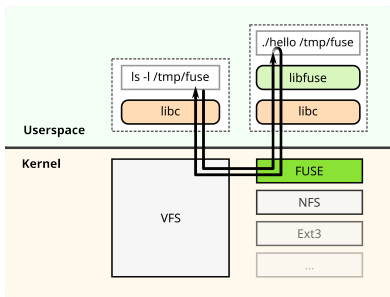Gonzalez,
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Container Storage Interface

- Container runtime agnostic way to manage storage
- Supported by Kubernetes, Mesos, Nomad, . . .
- Provisioning and mounting volumes

How CSI works

Why CSI

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- Declarative way to specify desired properties of a volume
- Interoperability with container technologies

Demo

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- Deploy CSI plugin in local k8s cluster
- Deploy container mounting a volume backed by CSI
- Inspect the content of the mounted CSI volume

Future Plans

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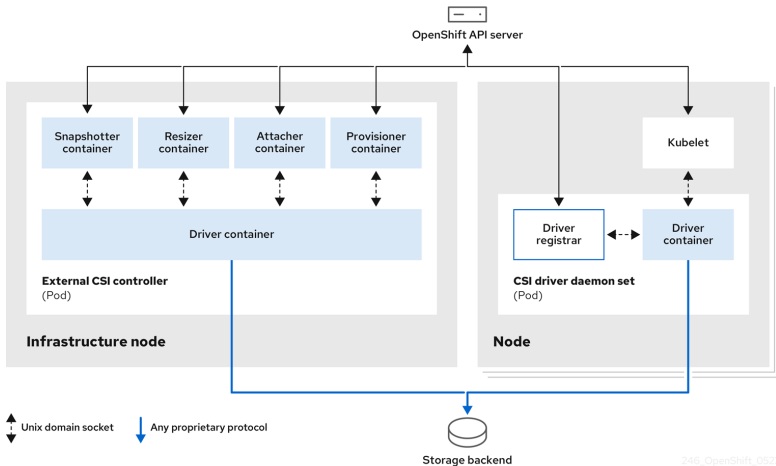Gonzalez,
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Extend FUSE with additional capability

Implement new utility FUSE filesystems for throttling/fault injection/etc.

Integrate the FUSE filesystems with CSI

Make the attributes of the FUSE filesystem configurable via the CSI interface

Burndown

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Plans

Title	Date	Moved to Done Estimated Hours	Moved to Done Actual Hours	Ideal Hours	Burndown Estimated	Burndown Actual	Team #	Hours/Sprint
	Sep 10, 2024	0	0	80	80	80	4	20
	Sep 11, 2024	0	0	74	74	74		
	Sep 12, 2024	0	0	69	69	69		
	Sep 13, 2024	0	0	63	63	63		
	Sep 14, 2024	0	0	57	57	57		
	Sep 15, 2024	0	0	51	51	51		
	Sep 16, 2024	0	0	46	46	46		
Learn FUSE/CSI	Sep 17, 2024	10	10	40	30	30		
	Sep 18, 2024	0	0	34	34	34		
Discussing plans	Sep 19, 2024	5	5	29	24	24		
Scaffolding for CSI plugin	Sep 20, 2024	14	13	23	9	10		
Adapt passthrough FUSE filesystem	Sep 21, 2024	1	1	17	16	16		
	Sep 22, 2024	0	0	11	11	11		
Package and deploy CSI	Sep 23, 2024	5	5	6	1	1		
Prepare for presentation and demo	Sep 24, 2024	6	6	0	-6	-6		

Moved to Done Estimated Hours, Actual Hours, Ideal Hours, Running Total Estimate and Running Total Actual