



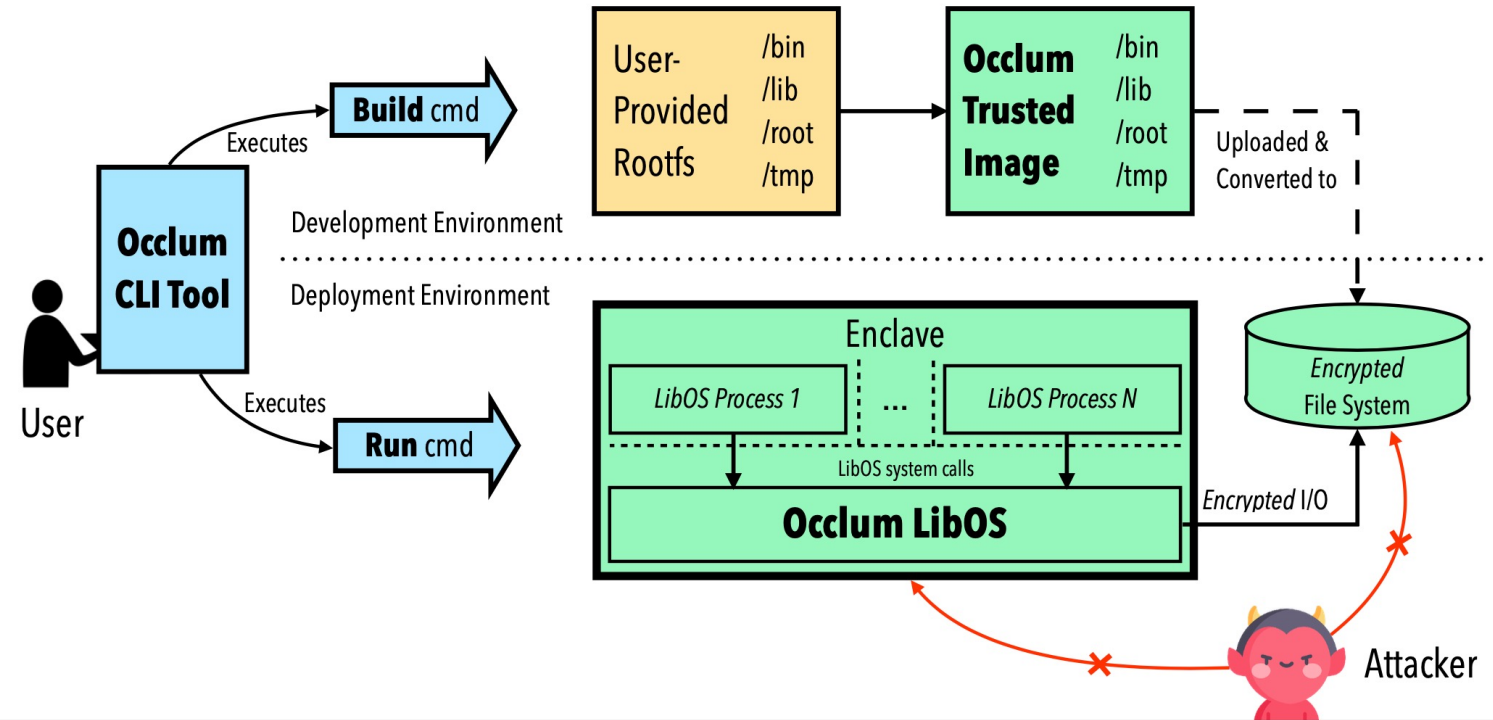
Occlum

A Memory-Safe, Multi-Process Library OS for Intel SGX

2021/11

Overview

A High-Level Overview



Major Features

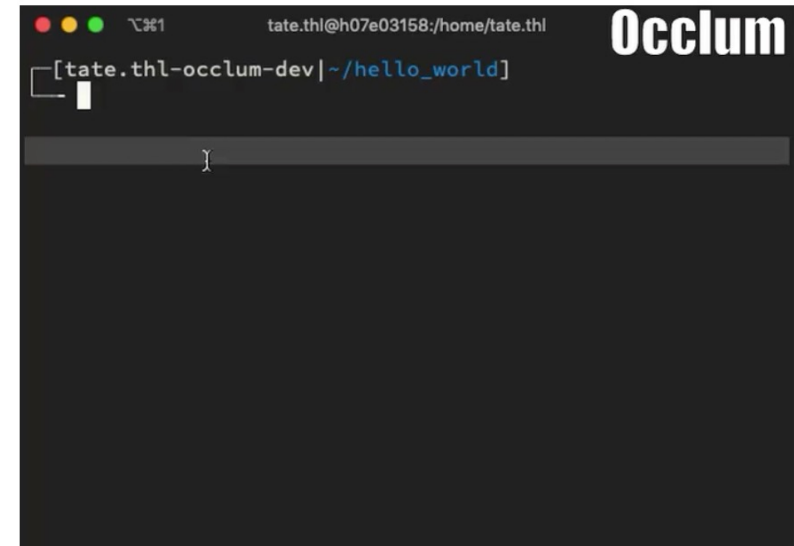
- Usability
 - **Container-Inspired Interface**
 - **Automatic dependency analysis**
- Performance
 - **Efficient Multitasking**
 - **Async/await**
 - **IO_uring**
- Functionality
 - **Multi-stage boot**
 - **Multiple Types of File Systems**
- Security
 - **Memory Safety**
 - **Memory randomization**

Container-Inspired Interface

Container-Inspired Interface

- **Occlum core CLI commands**

- init
- build
- run
- start
- stop
- exec
- kill



Automatic dependency analysis

Redis Demo

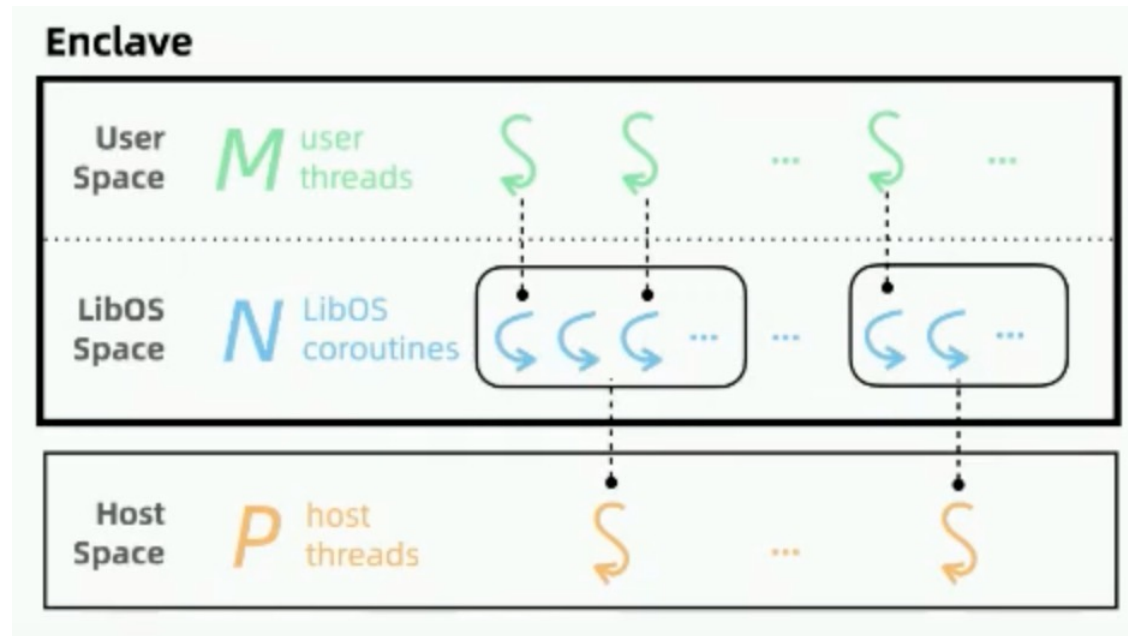
```
includes:  
  - base.yaml  
targets:  
  - target: /bin  
    copy:  
      - files:  
        - /usr/bin/redis-server
```

```
occlum new redis_instance  
cd redis_instance  
copy_bom -f ../redis.yaml --root image --include-dir /opt/occlum/etc/template  
occlum build
```

Performance

Enable Rust Async/await mechanism in Occlum

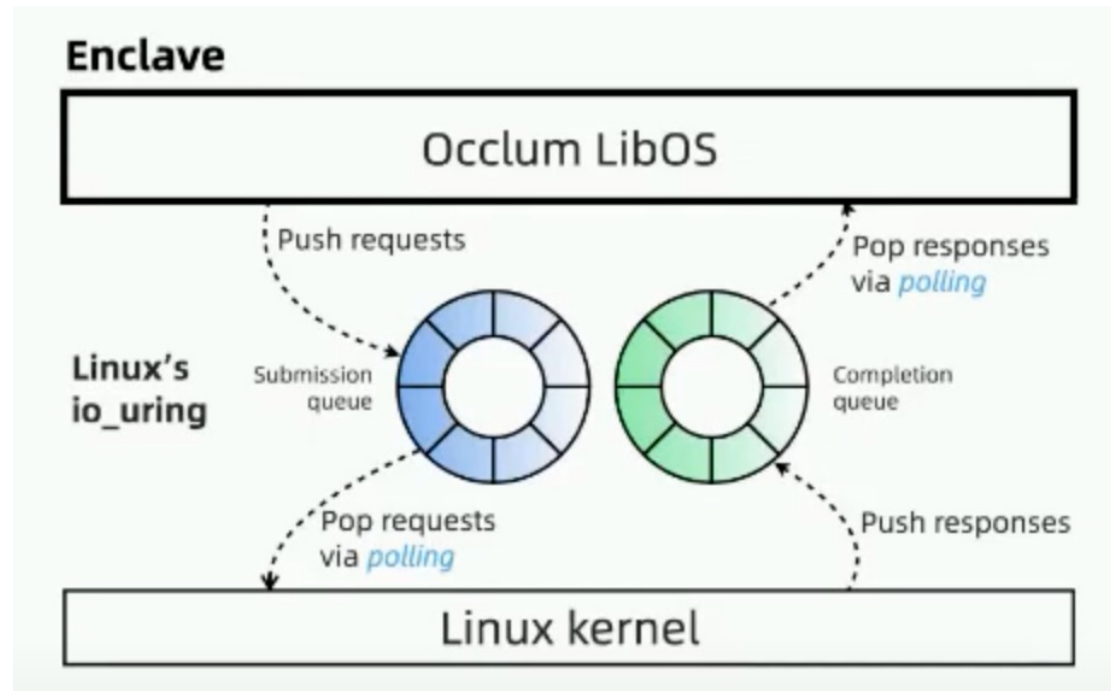
1 host thread: 1 SGX TCS : N Rust tasks : N application threads



Performance

Enable IO_uring in Occlum

Occlum handle network without Ocall



Functionality

- **Multi-stage boot**
 - The first stage is similar to the Linux initramfs. User could do some initialization tasks in this stage.
 - The second stage could be the unmodified application.
- **Multiple Types of File Systems**
 - SEFS is read-only and integrity guaranteed file system
 - Union-FS is similar to the overlay file system, which combine an read-only base SEFS and a writable empty SEFS
 - Encrypting SEFS

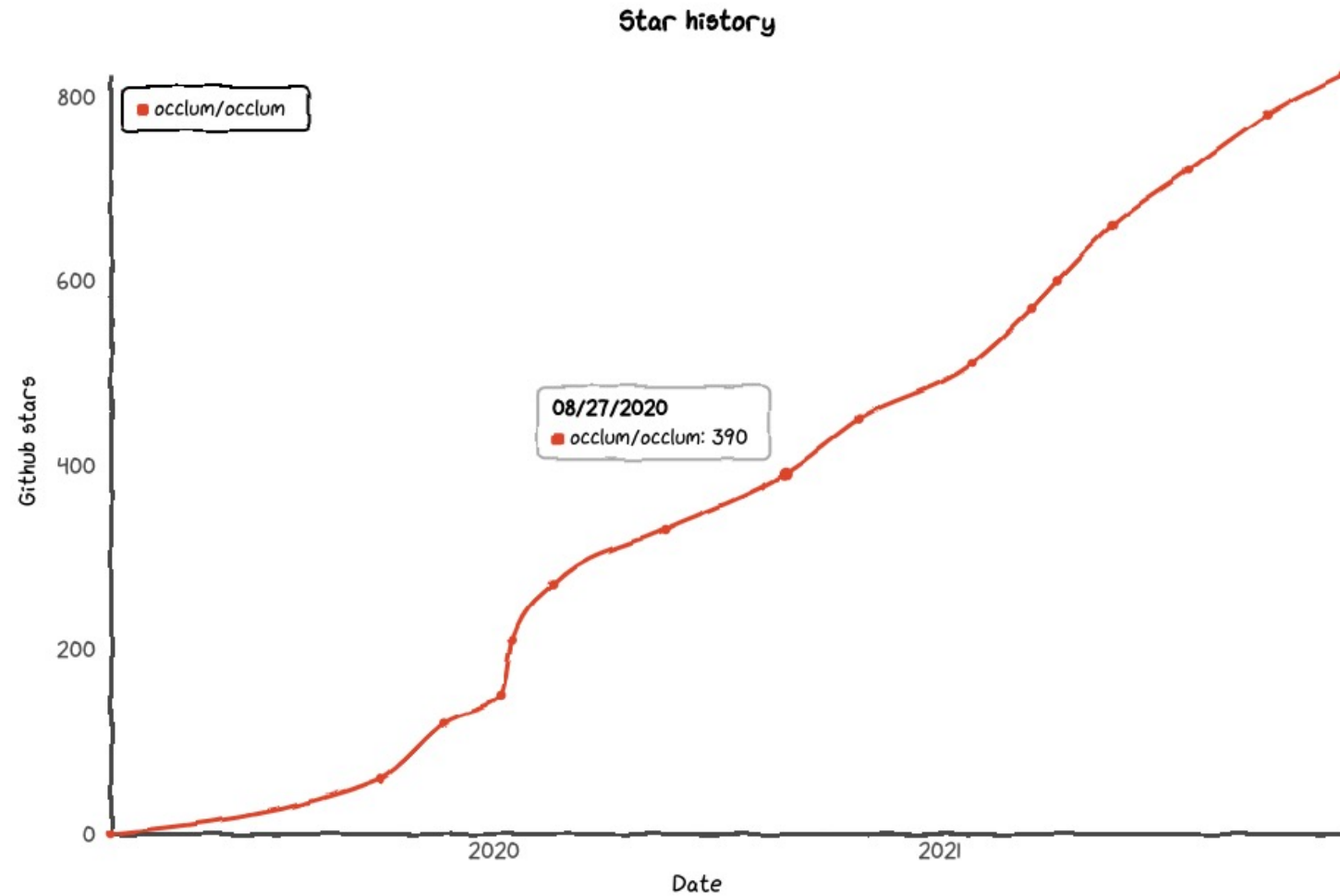
Security

- By default SGX EPC is encrypted
- Occlum enables memory random allocation
 - Attacker is hard to know the data address inside Occlum
 - Efficient use of memory

The supported usages

- bash/fish (C/C++)
- Flink (Java)
- Pytorch (python)
- sqlite (C/C++)
- tensorflow (python/C/C++)
- opencvino (C/C++)
- xgboost (C/C++)
- redis (C/C++)
- Vault (golang)

Occlum Star
number is
800+



Dependency

- New dependencies
 - atomic = "0.5"
 - memoffset = "0.6.1"
 - resolv-conf
 - Itertools
 - ctor = "0.1"
 - intrusive-collections = "0.9"
 - io-uring
 - futures