Container Images Considered Harmful

(… and some things we can do about it.)

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Where?

- `https://github.com/openSUSE/umoci`
  - There is a ***very*** experimental branch with the demo code.
- `https://www.cyphar.com/blog/post/20190121-ociv2-images-i-tar/`
  - The much more long-form rant about `tar`.
- `https://github.com/cyphar/talks`
  - Where you can get the slides later.

An Ideal Image Format

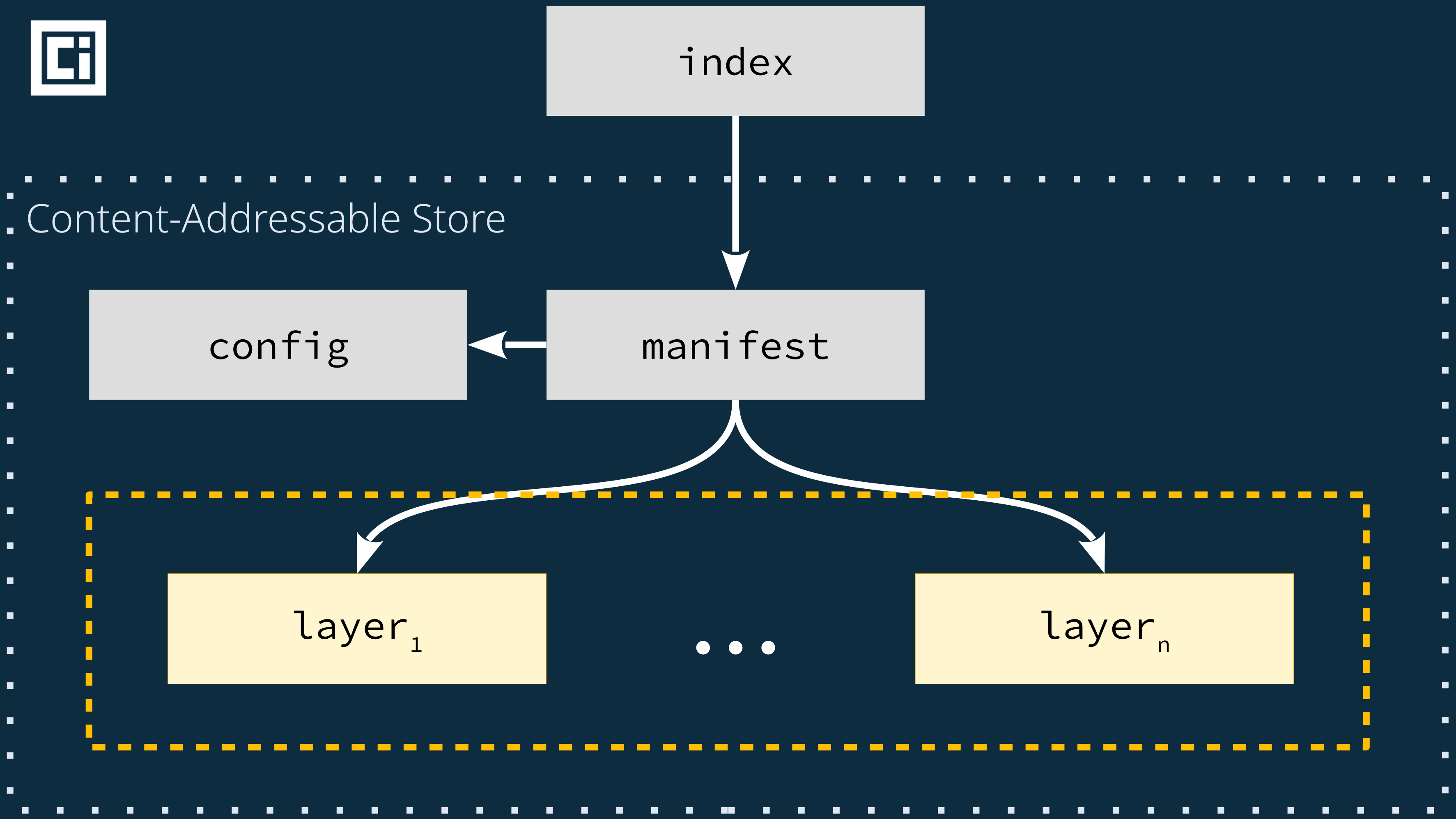
Deduplicated as much as possible (*transfer* and *storage*)

Parallelisable (*transfer* and *storage*)

Reproducible (and have a canonical representation)

Non-avalanching

Transparent



index

Content-Addressable Store

config

manifest

layer$_1$

. . .

layer$_n$

What’s Wrong With Tar?

- A fair bit.

An Ideal Image Format

Deduplicated as much as possible (*transfer* and *storage*)
Parallelisable (*transfer* and *storage*)
Reproducible (have a canonical representation)
Non-avalanching
Transparent

What Tar Gives Us

What Tar Gives Us

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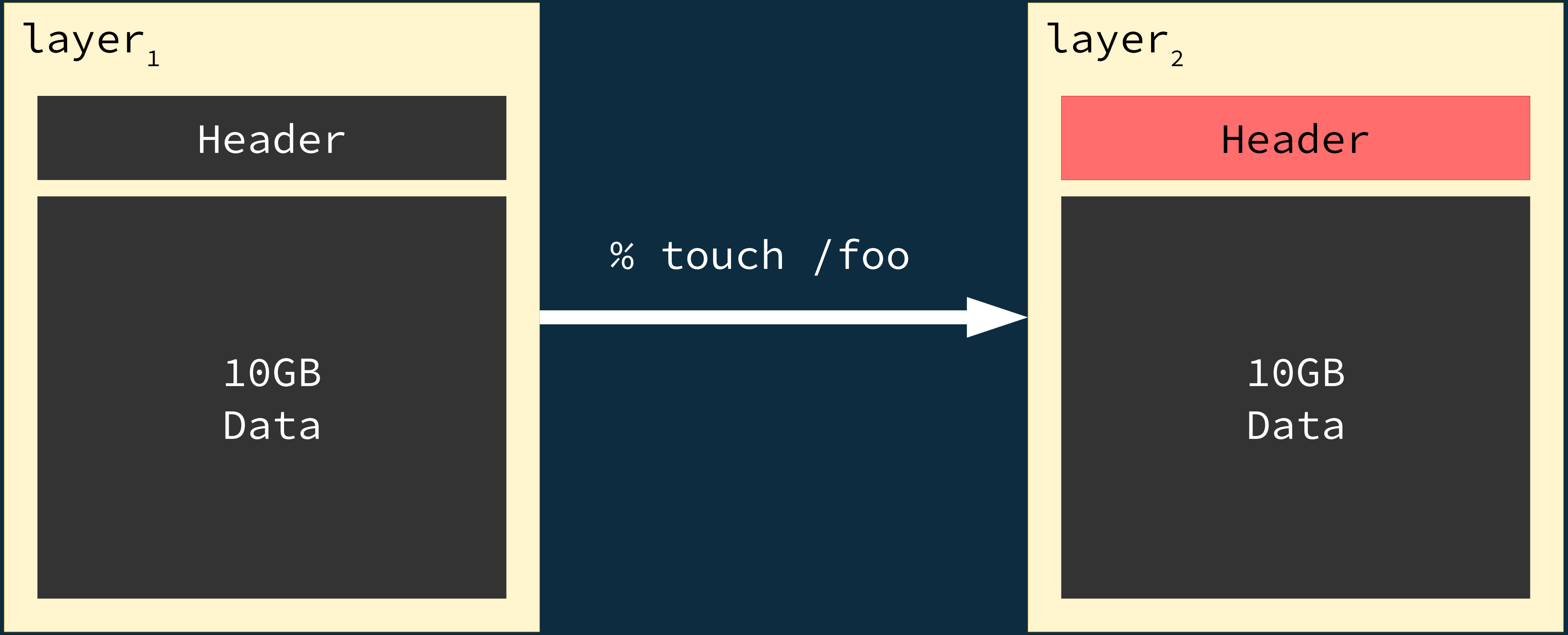


layer_1

Header

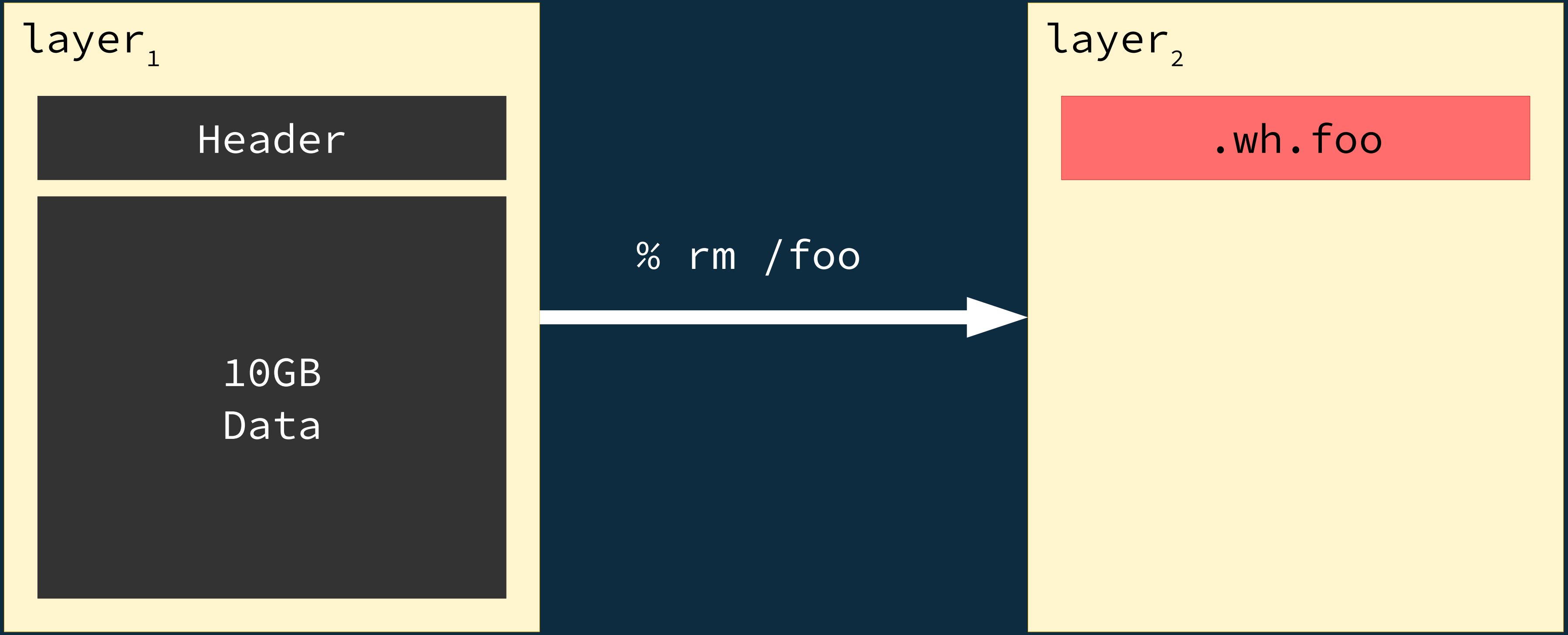
10GB
Data

```
% touch /foo
```

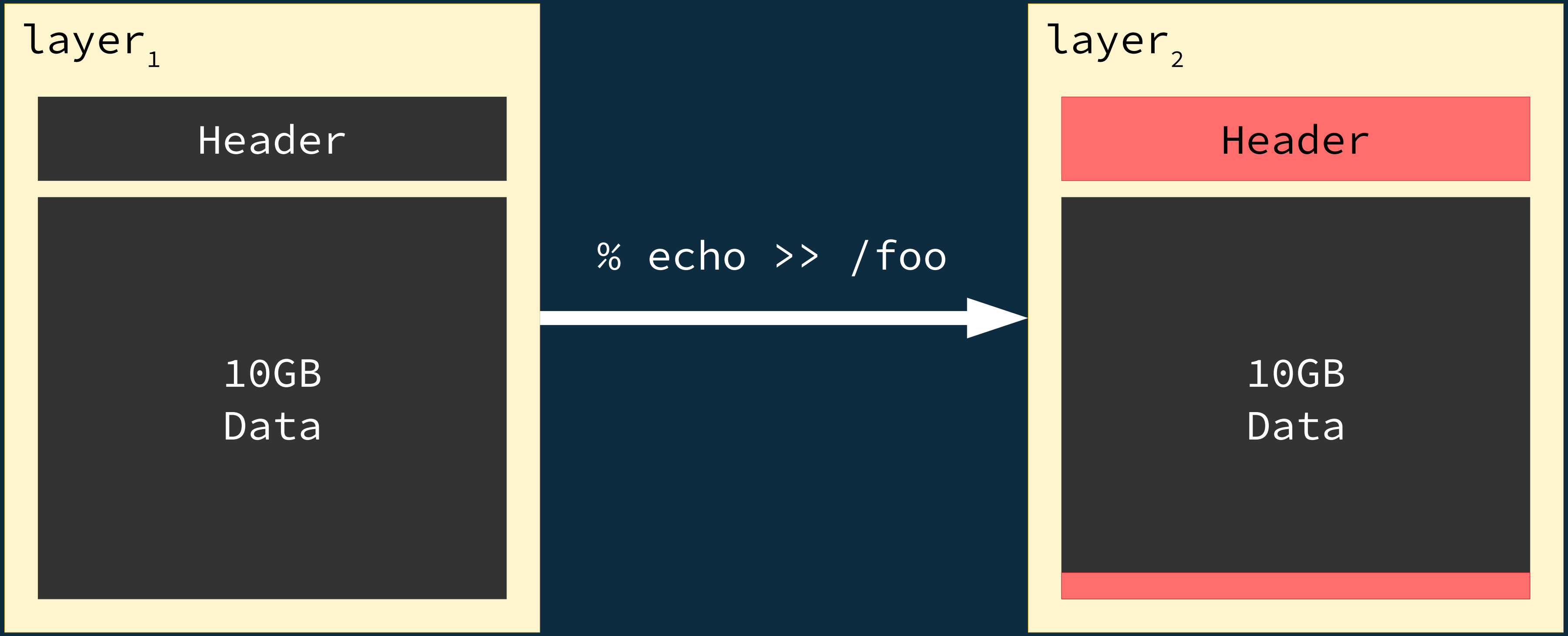
layer_2

Header

10GB
Data



I’m not pranking you – your image gets **bigger**.



layer$_1$

Header

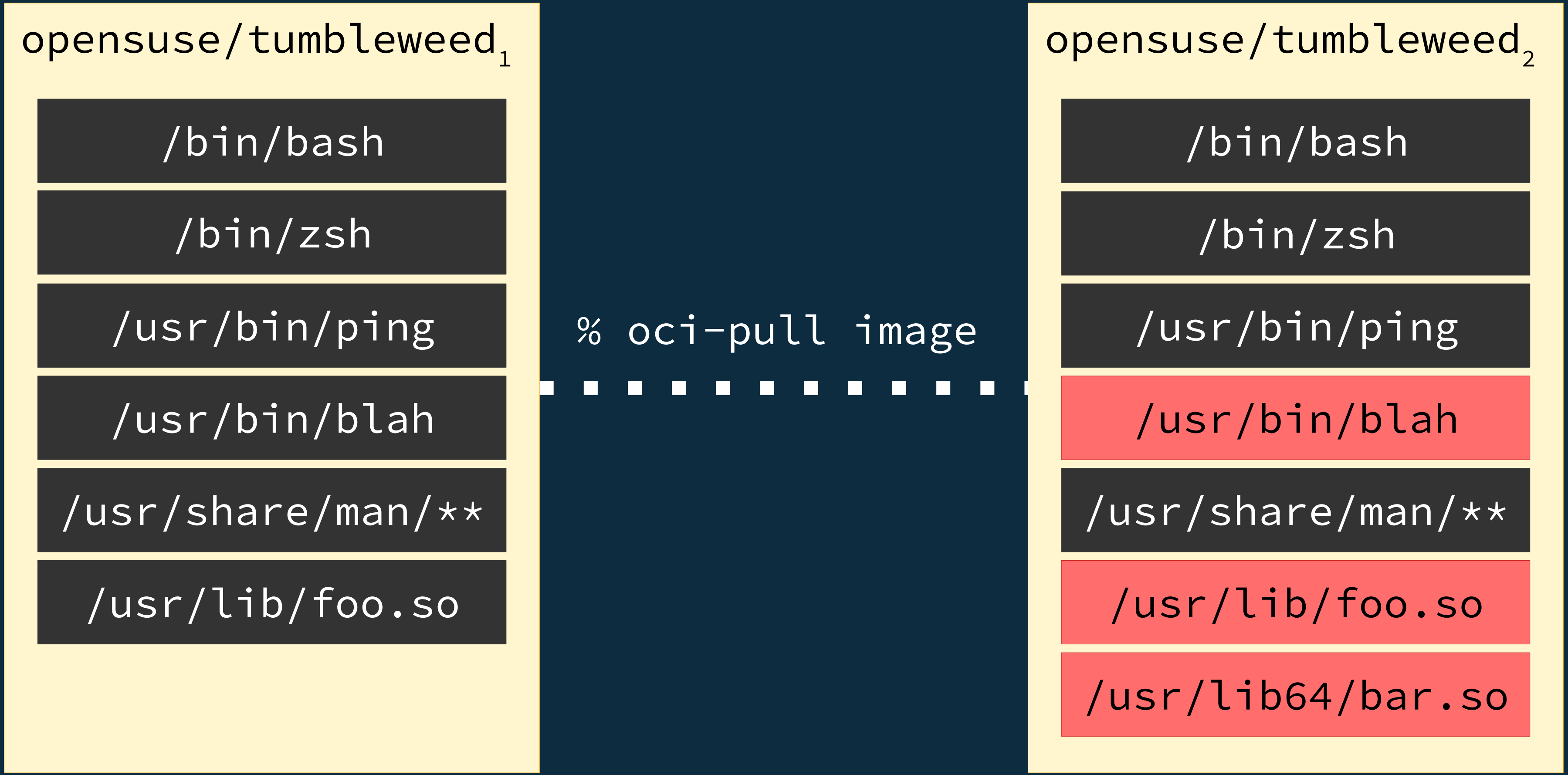
10GB
Data

```
% echo >> /foo
```

layer$_2$

Header

10GB
Data



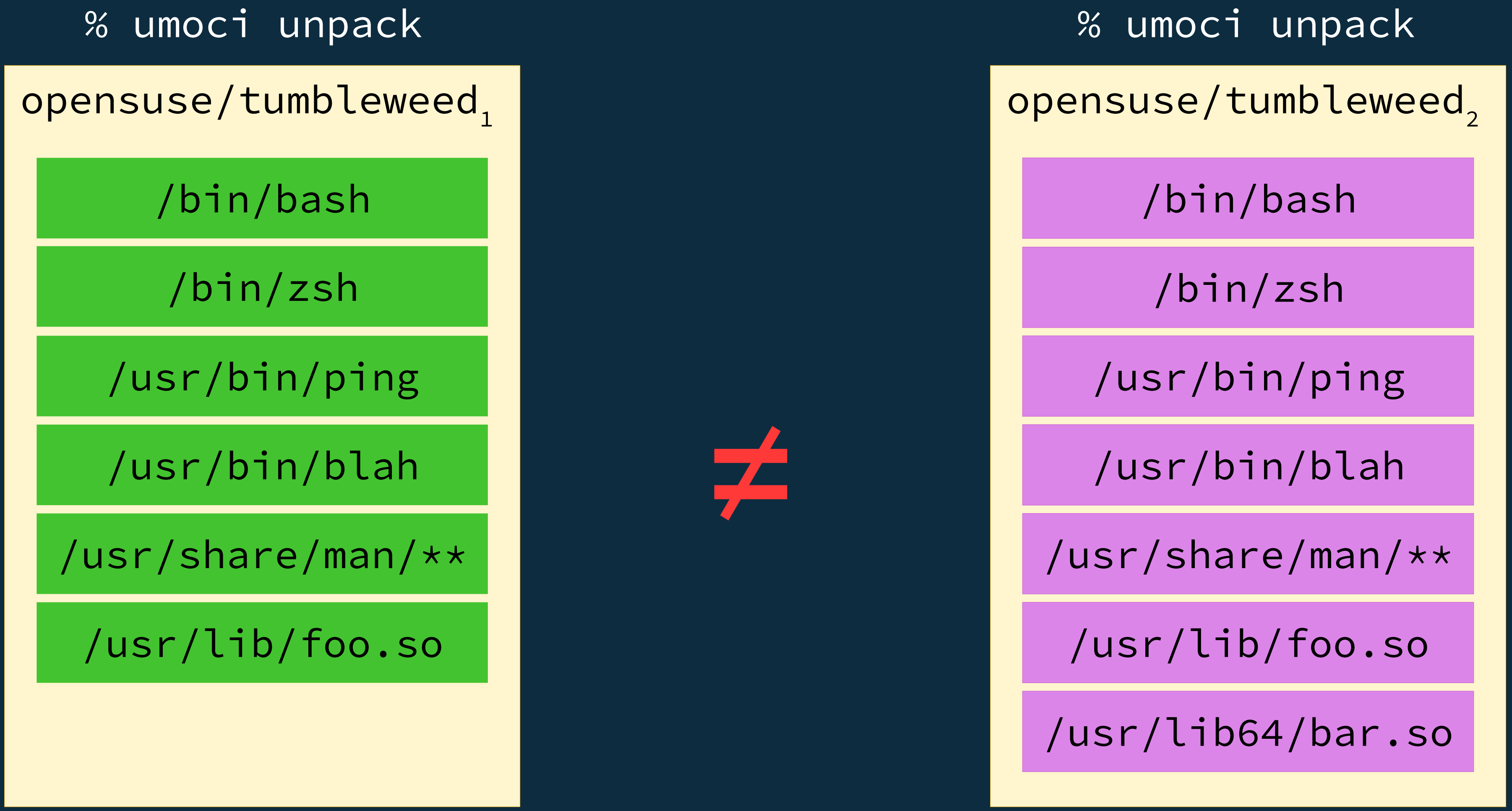
opensuse/tumbleweed$_1$

- /bin/bash
- /bin/zsh
- /usr/bin/ping
- /usr/bin/blah
- /usr/share/man/**
- /usr/lib/foo.so

```
% oci-pull image
```

opensuse/tumbleweed$_2$

- /bin/bash
- /bin/zsh
- /usr/bin/ping
- /usr/bin/blah
- /usr/share/man/**
- /usr/lib/foo.so
- /usr/lib64/bar.so



```
% umoci unpack
```

opensuse/tumbleweed$_1$

- /bin/bash
- /bin/zsh
- /usr/bin/ping
- /usr/bin/blah
- /usr/share/man/**
- /usr/lib/foo.so

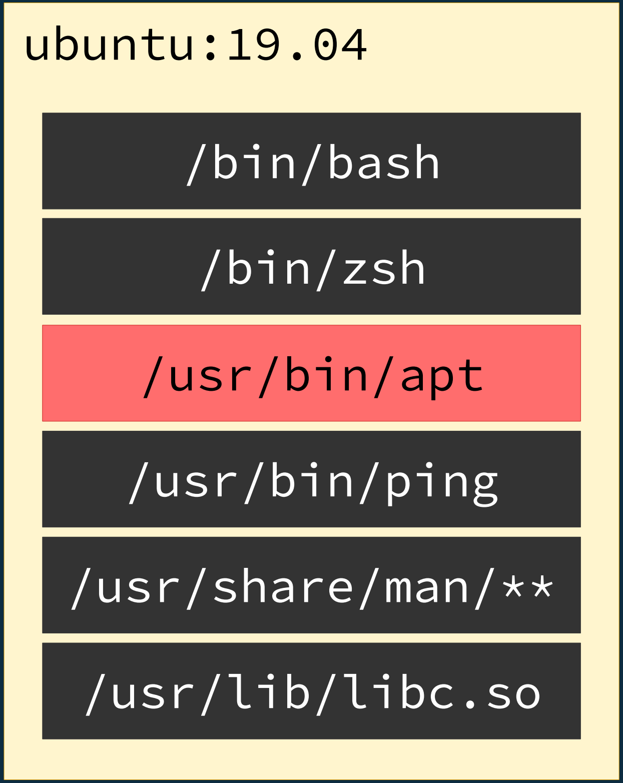
≠

```
% umoci unpack
```

opensuse/tumbleweed$_2$

- /bin/bash
- /bin/zsh
- /usr/bin/ping
- /usr/bin/blah
- /usr/share/man/**
- /usr/lib/foo.so
- /usr/lib64/bar.so

```
% oci-pull ubuntu
```



ubuntu:19.04

/bin/bash

/bin/zsh

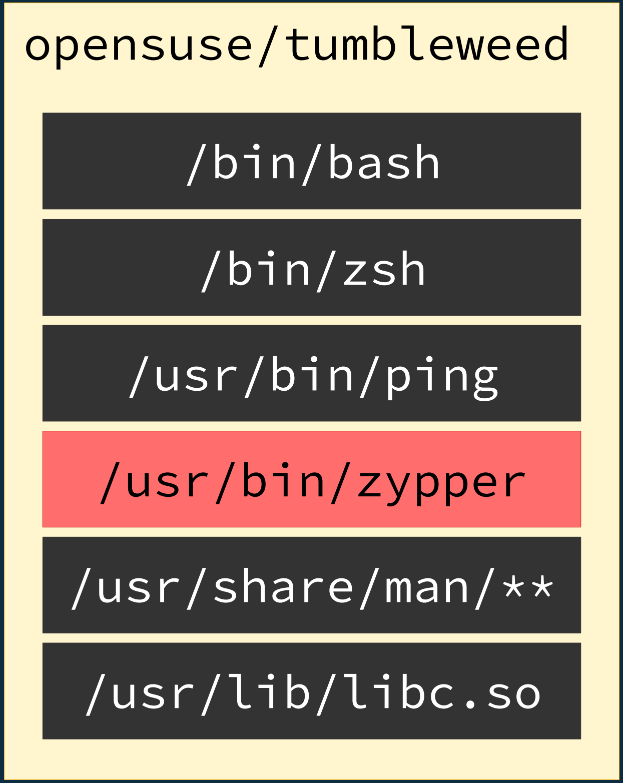
/usr/bin/apt

/usr/bin/ping

/usr/share/man/**

/usr/lib/libc.so

```
% oci-pull opensuse
```



opensuse/tumbleweed

/bin/bash

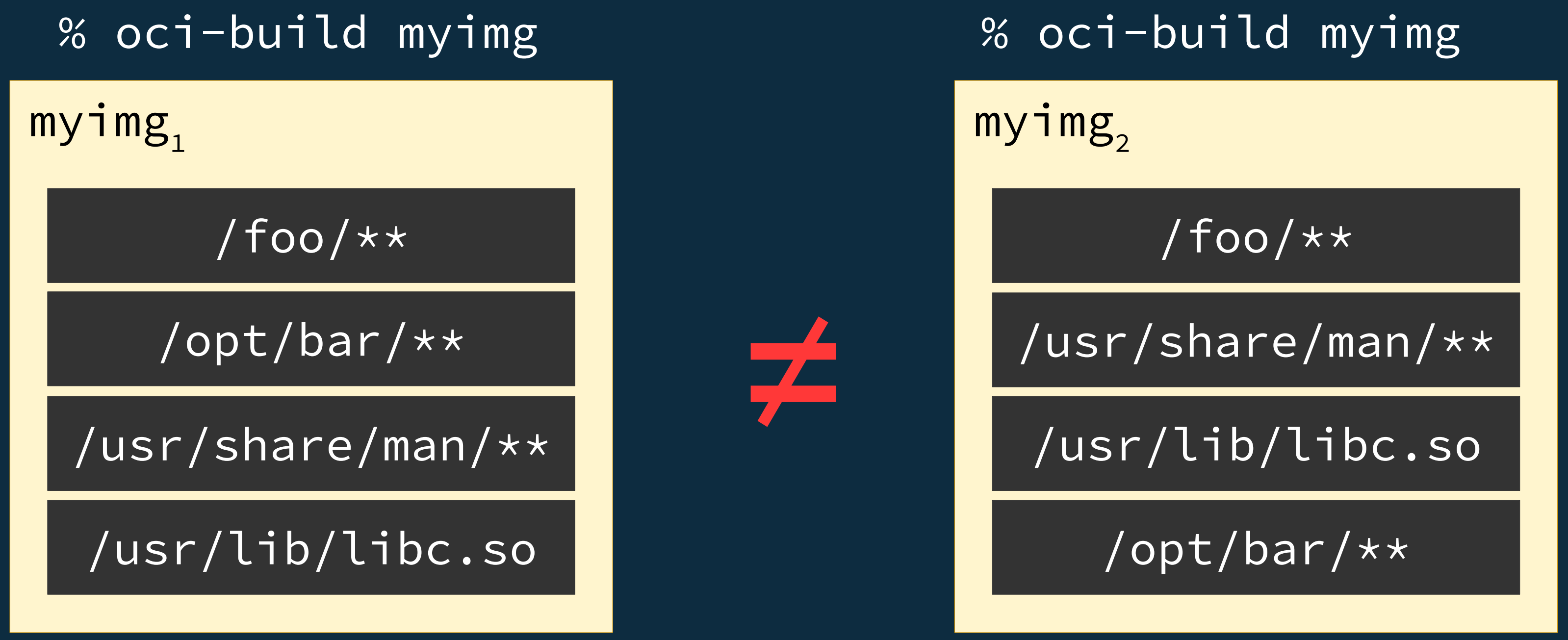
/bin/zsh

/usr/bin/ping

/usr/bin/zypper

/usr/share/man/**

/usr/lib/libc.so



```
% oci-build myimg
```

myimg$_1$

/foo/**

/opt/bar/**

/usr/share/man/**

/usr/lib/libc.so

≠

```
% oci-build myimg
```

myimg$_2$

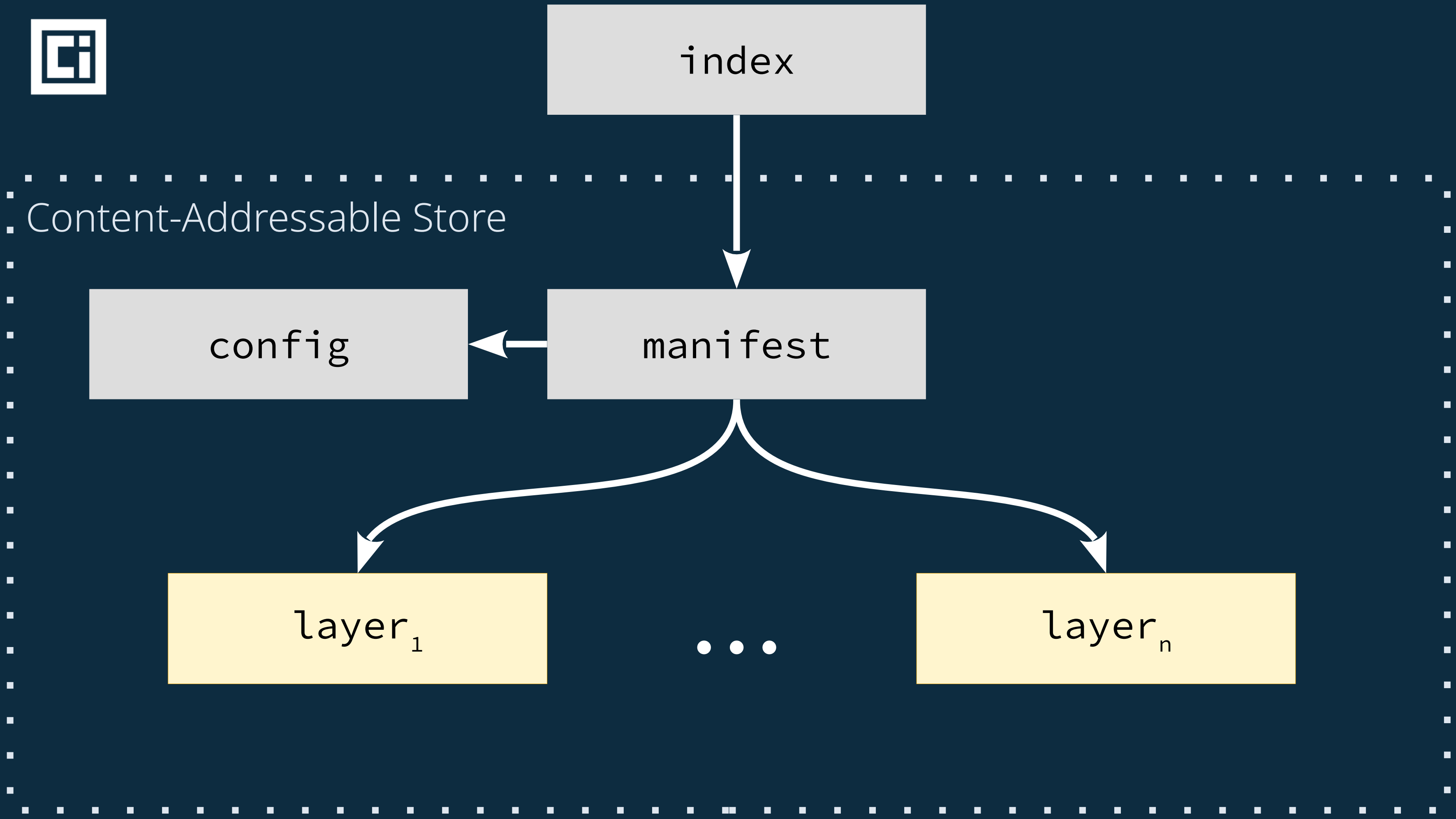
/foo/**

/usr/share/man/**

/usr/lib/libc.so

/opt/bar/**

What is the alternative?



index

Content-Addressable Store

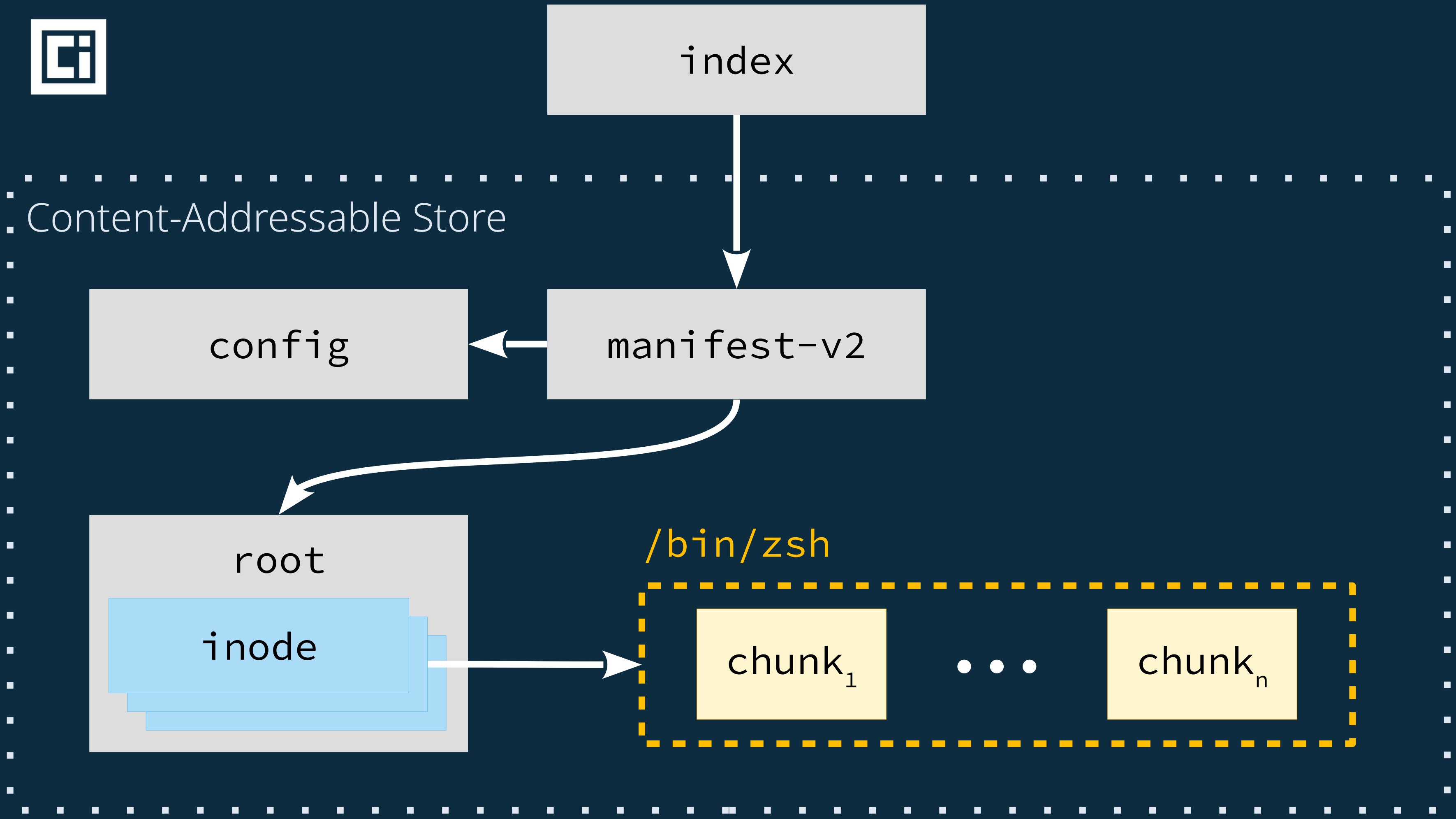
config

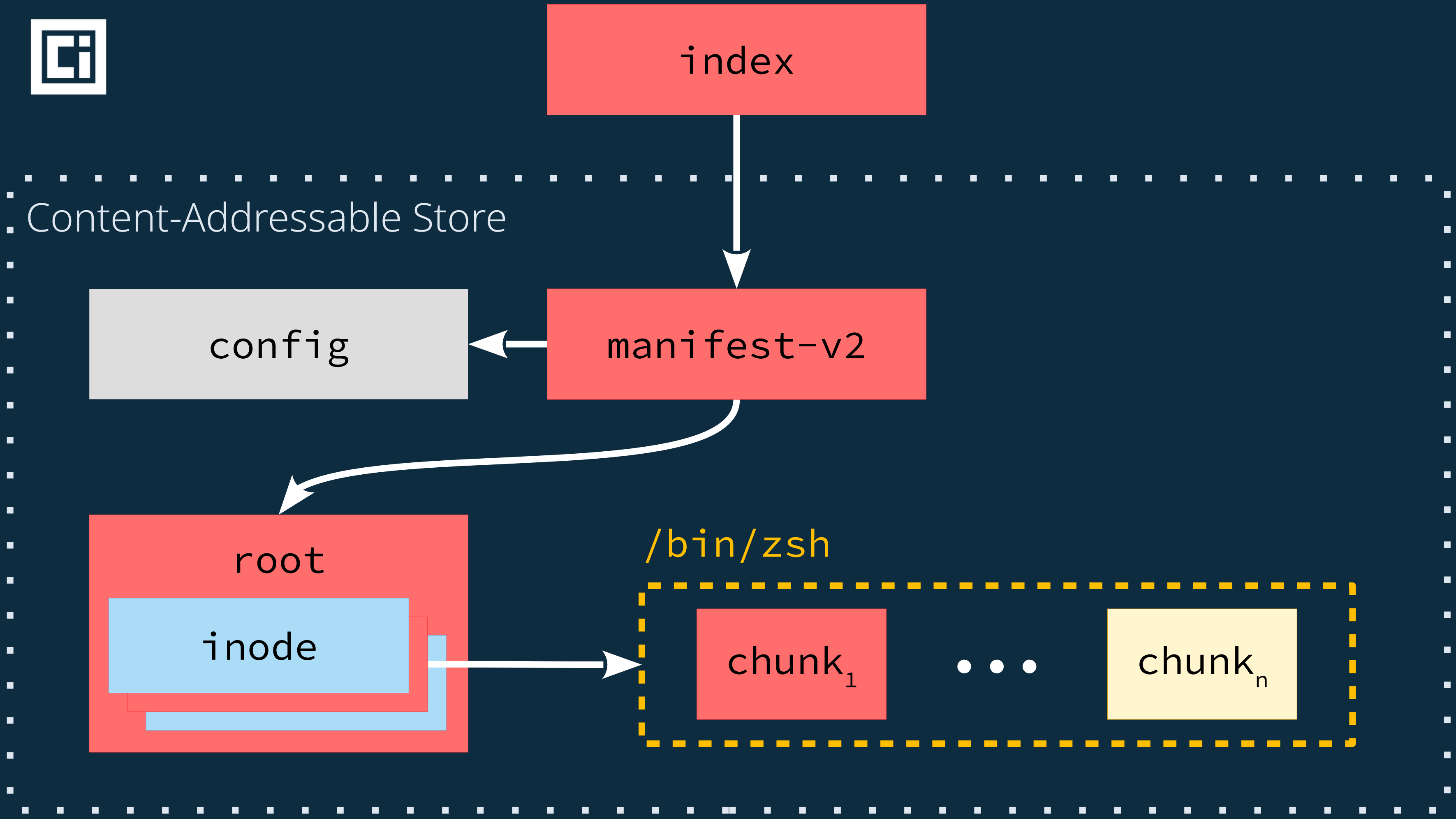
manifest

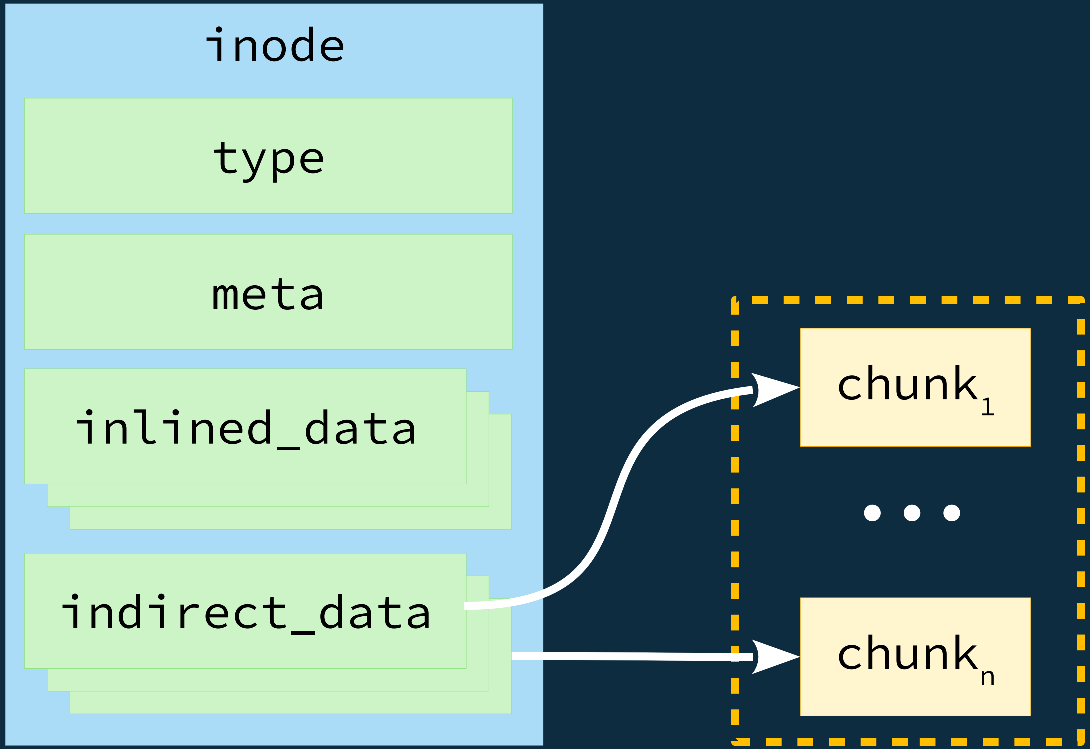
layer$_1$

…

layer$_n$


index
Content-Addressable Store
config
manifest-v2
root
inode
/bin/zsh
chunk$_1$
• • •
chunk$_n$


index
Content-Addressable Store
config
manifest-v2
root
inode
/bin/zsh
chunk$_1$
• • •
chunk$_n$



inode

type

meta

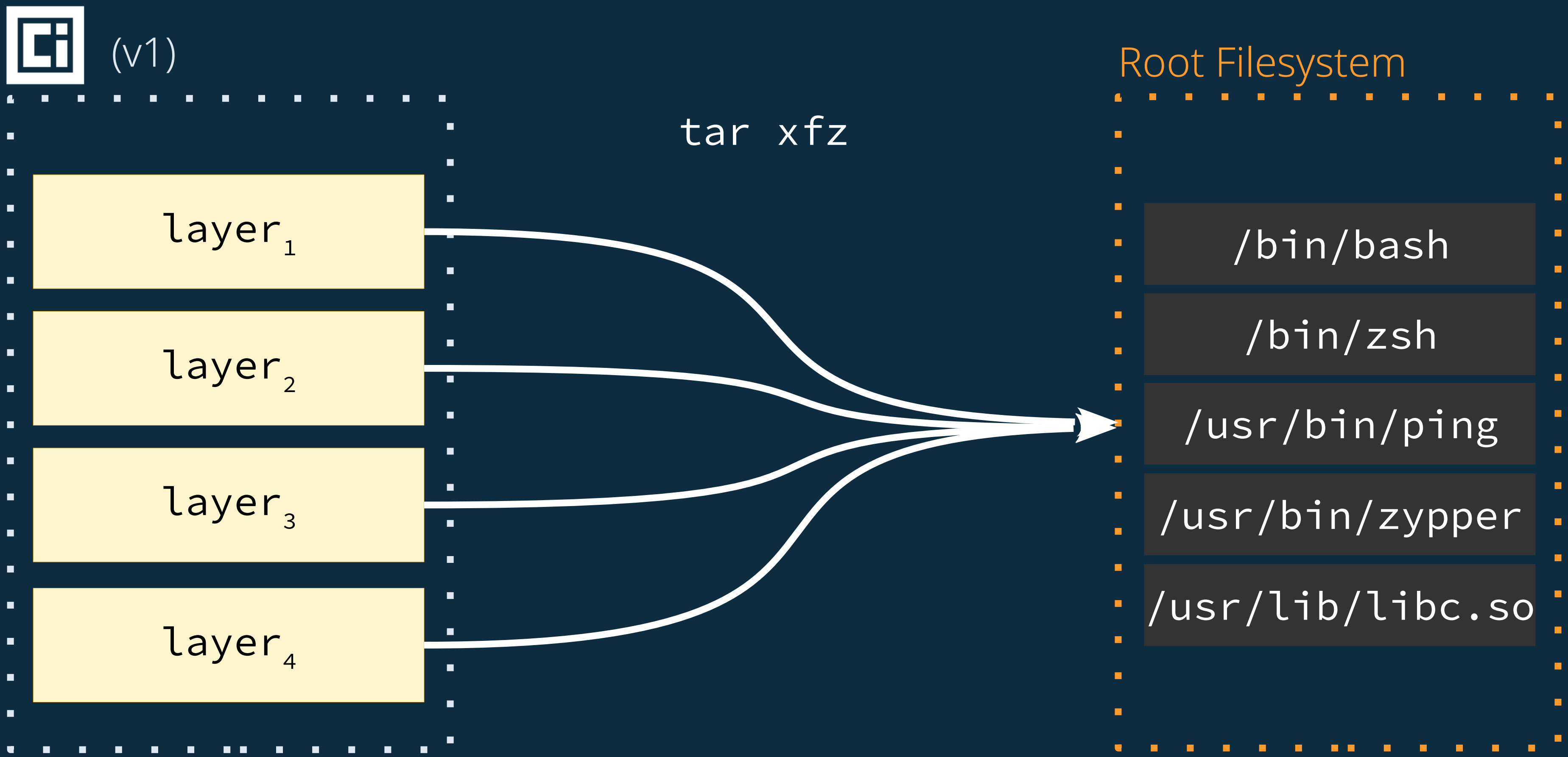
inlined_data

indirect_data

chunk_1

• • •

chunk_n



(v1)

tar xfz

Root Filesystem

layer$_1$

layer$_2$

layer$_3$

layer$_4$

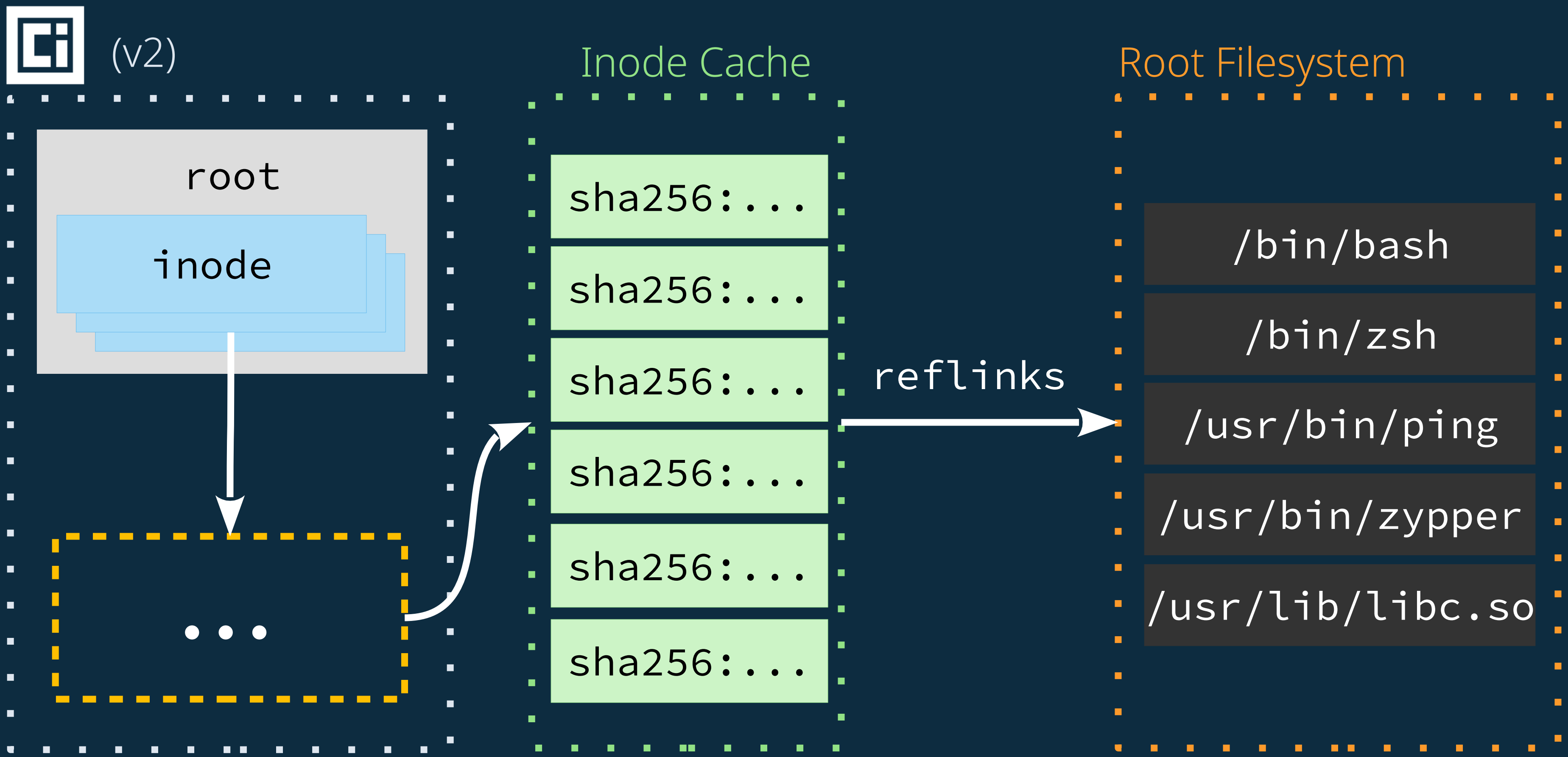
/bin/bash

/bin/zsh

/usr/bin/ping

/usr/bin/zypper

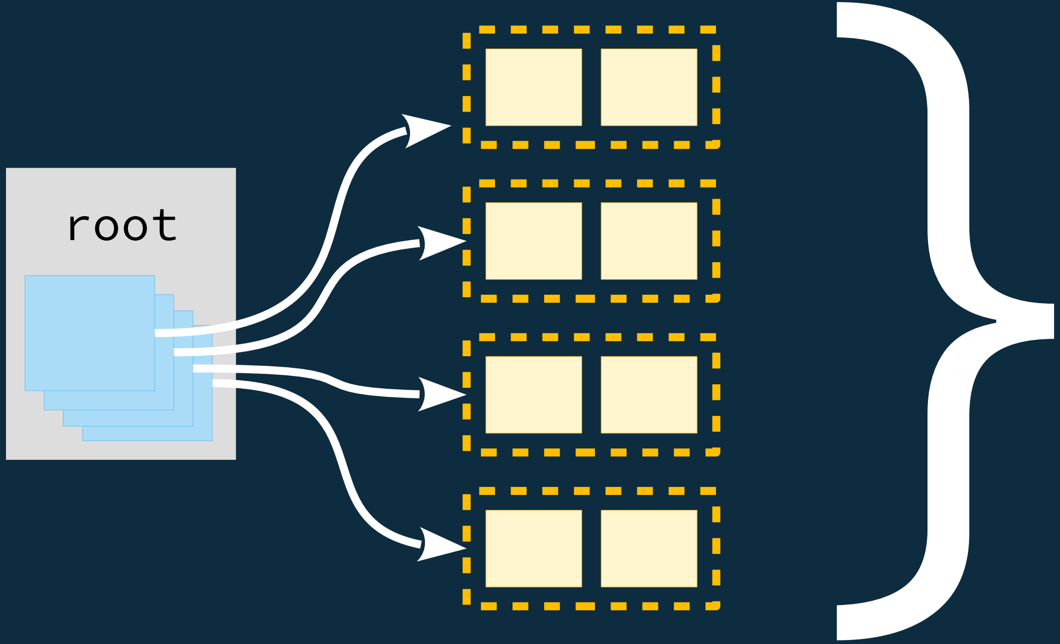
/usr/lib/libc.so


(v2)
Inode Cache
Root Filesystem
root
inode
...
sha256:...
sha256:...
sha256:...
sha256:...
sha256:...
sha256:...
reflinks
/bin/bash
/bin/zsh
/usr/bin/ping
/usr/bin/zypper
/usr/lib/libc.so

Stop!

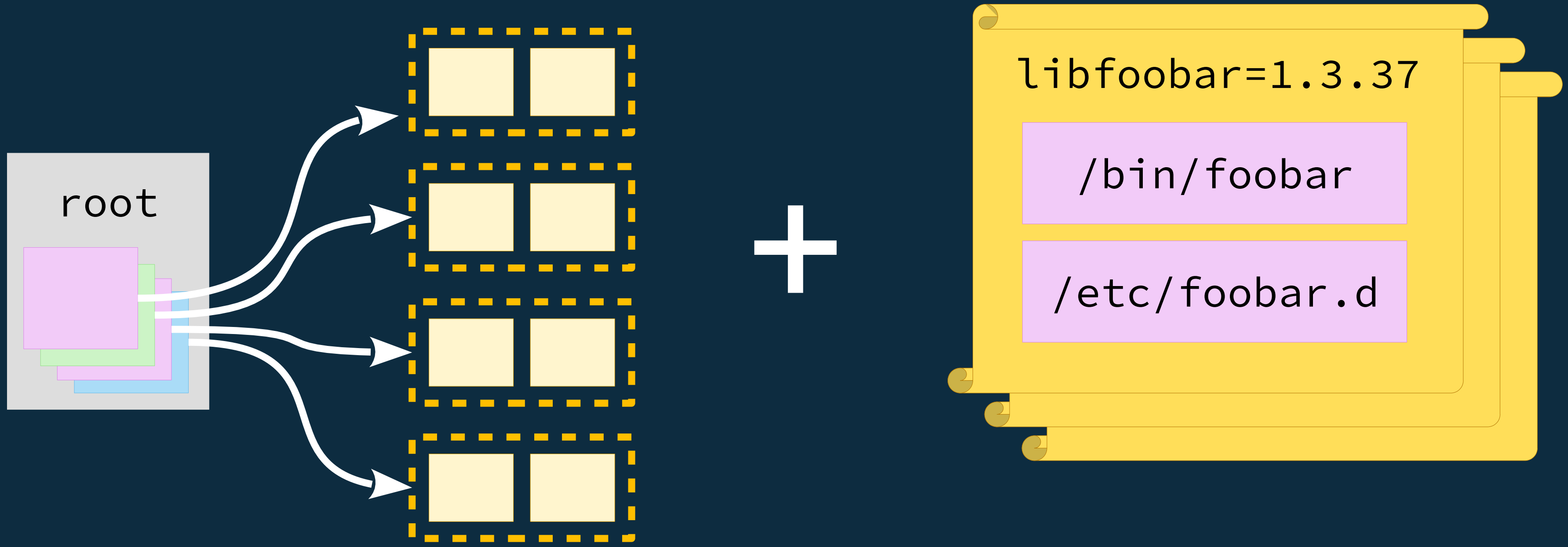
Demo time.

Bill of Materials



What is actually in this thing?

Bill of Materials

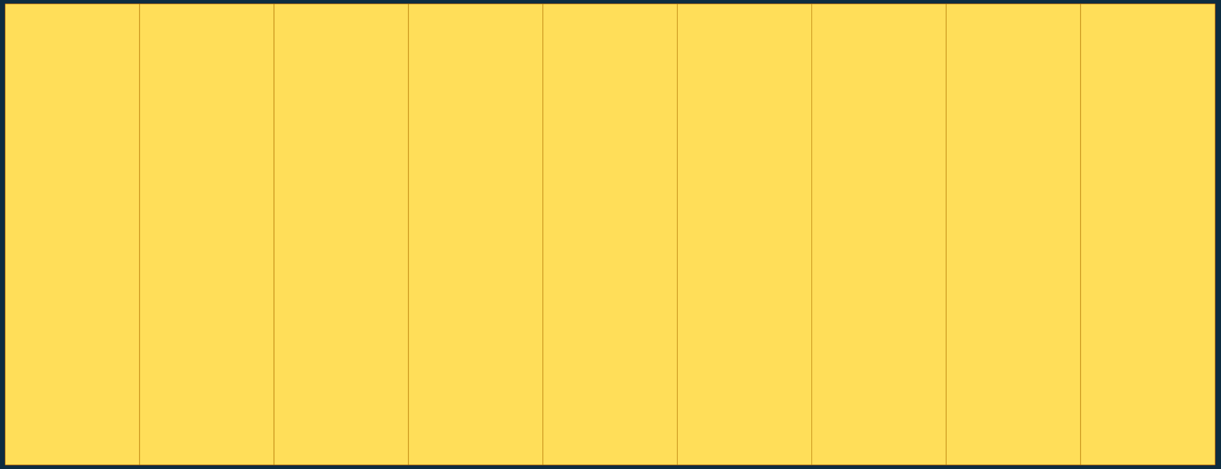


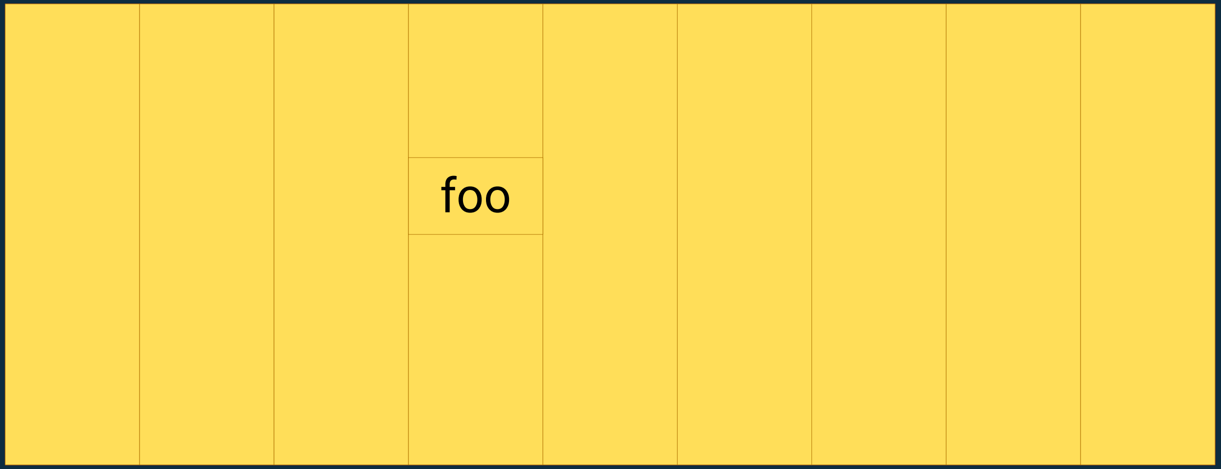
Next Steps?

- Reduce size of transfers (compression still beats us in many cases).
- Design the “bill of materials” format.
- Write a specification and submit it for review.
- Get everyone to switch.
  - This last one might take a while.

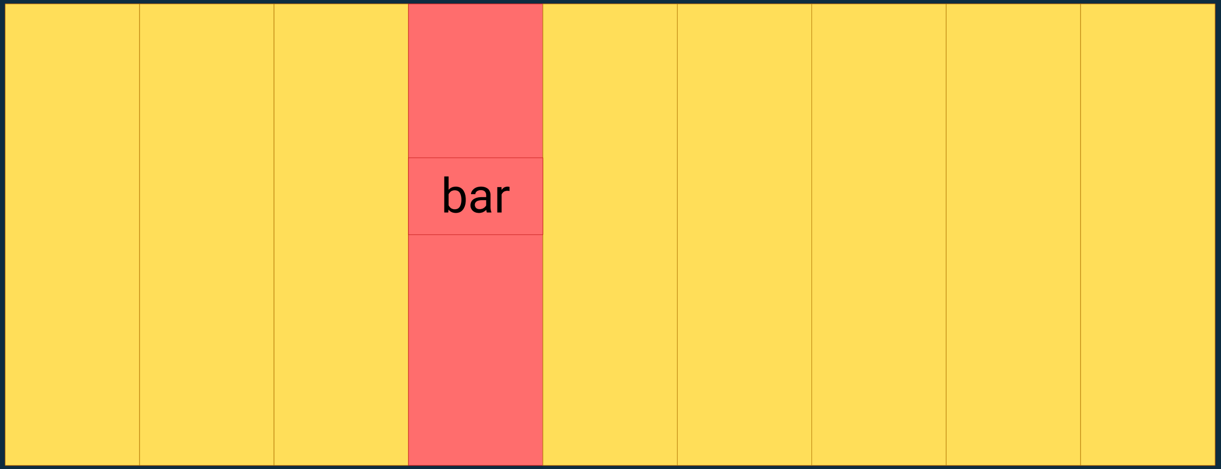
Questions?

Pictured: A Humble File.

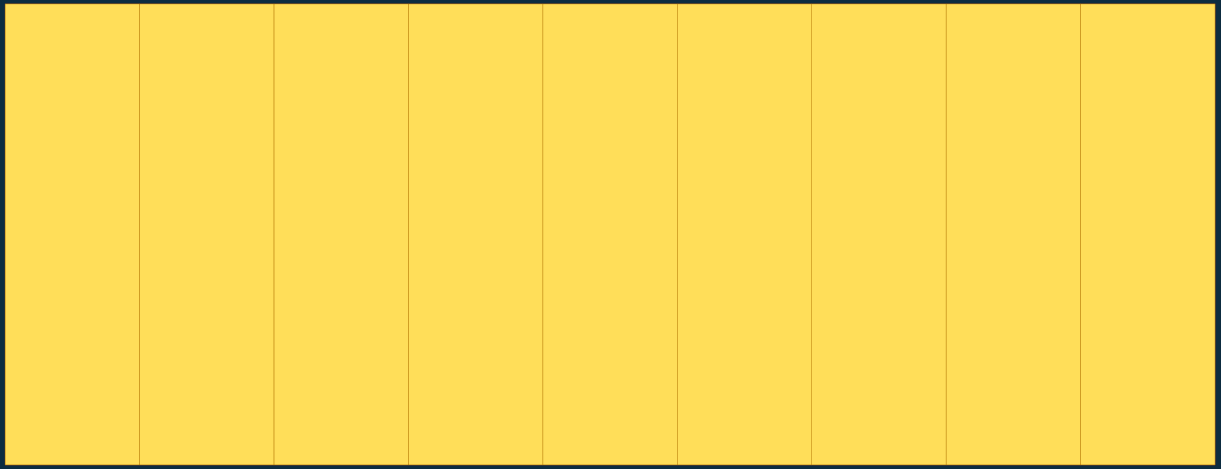


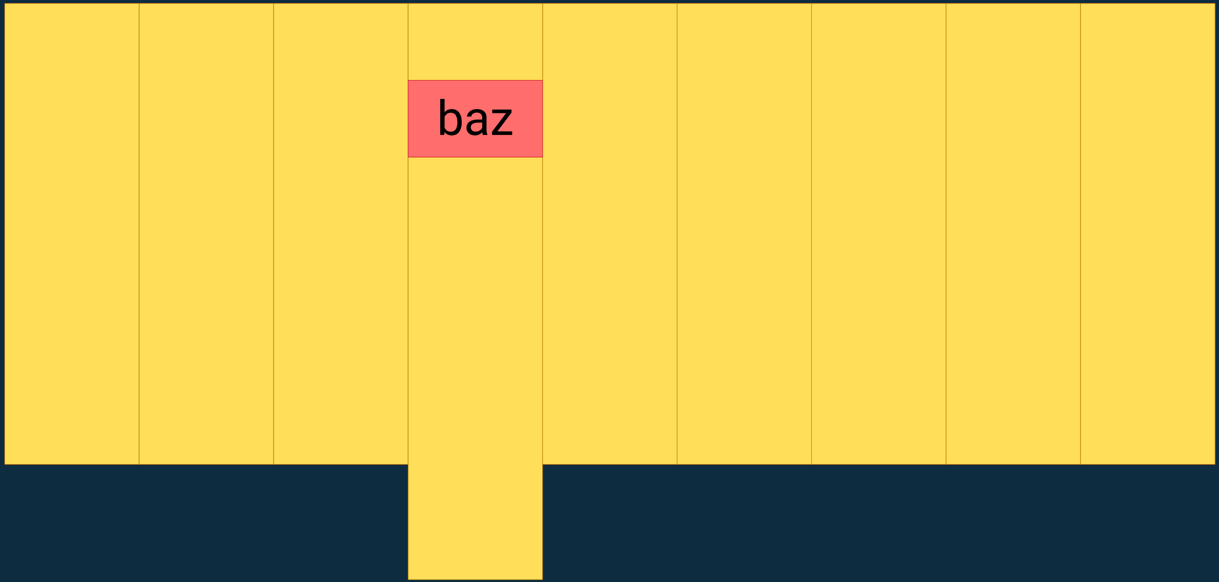


foo

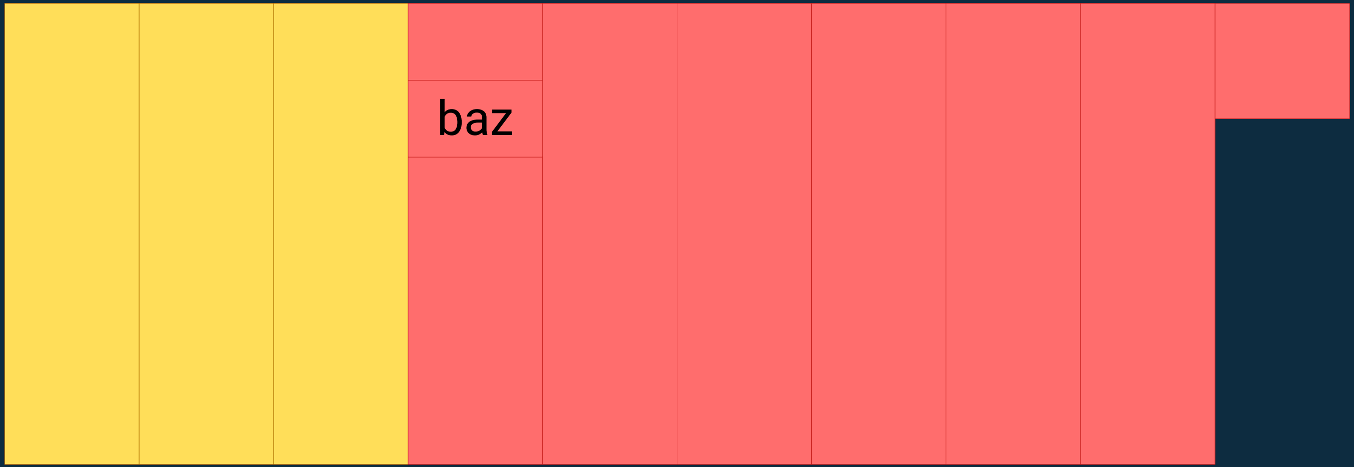


bar

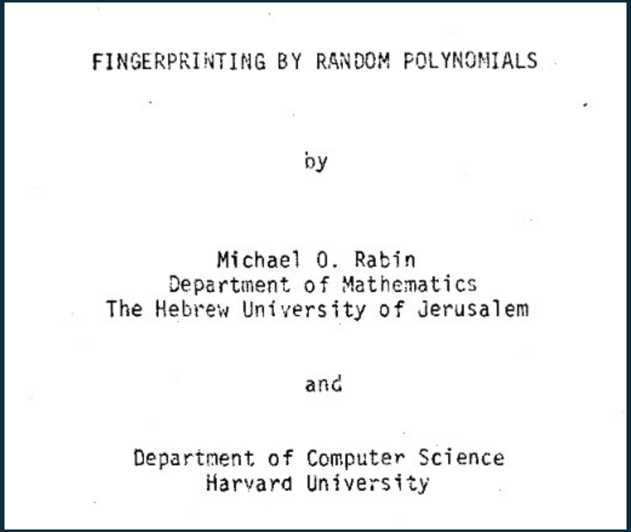




baz



baz



FINGERPRINTING BY RANDOM POLYNOMIALS

by

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The Hebrew University of Jerusalem

and

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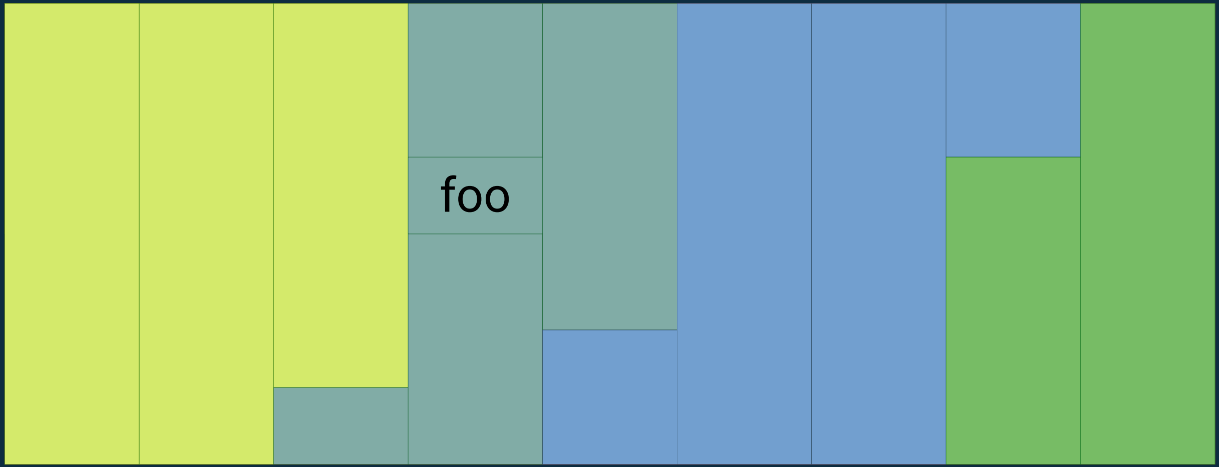
Harvard University

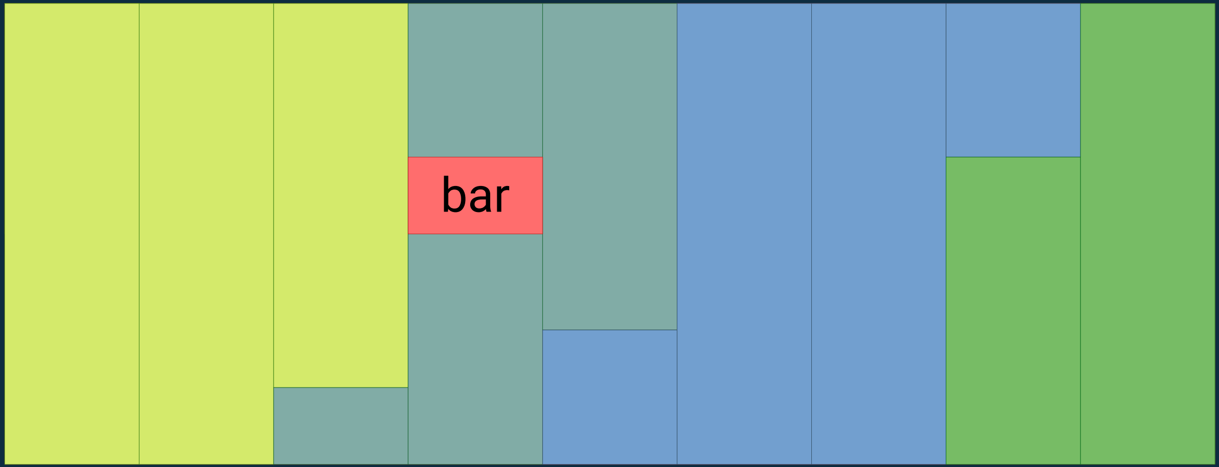
We have to go back (to 1981)!

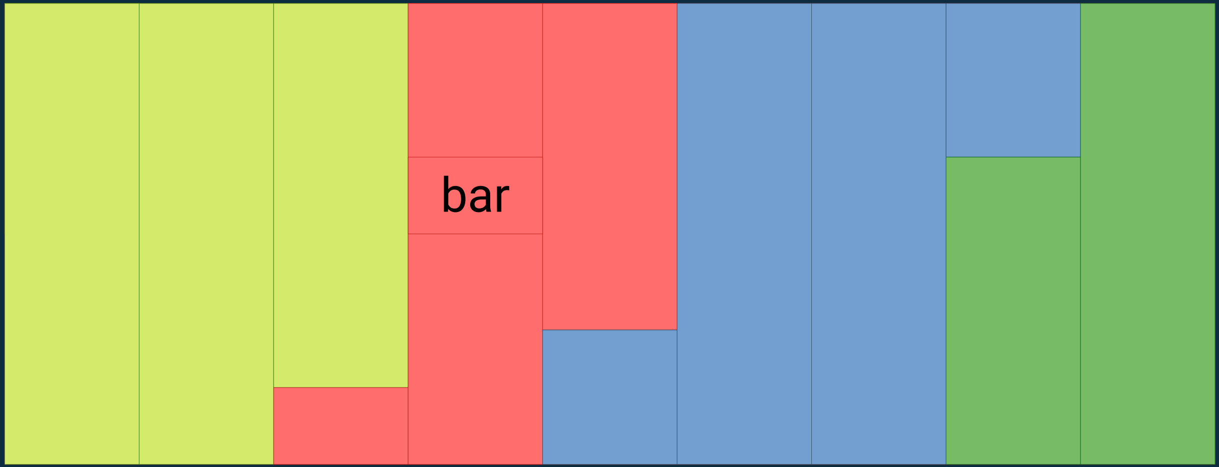
Content-Defined Chunking

Pictured: A(nother) Humble File.

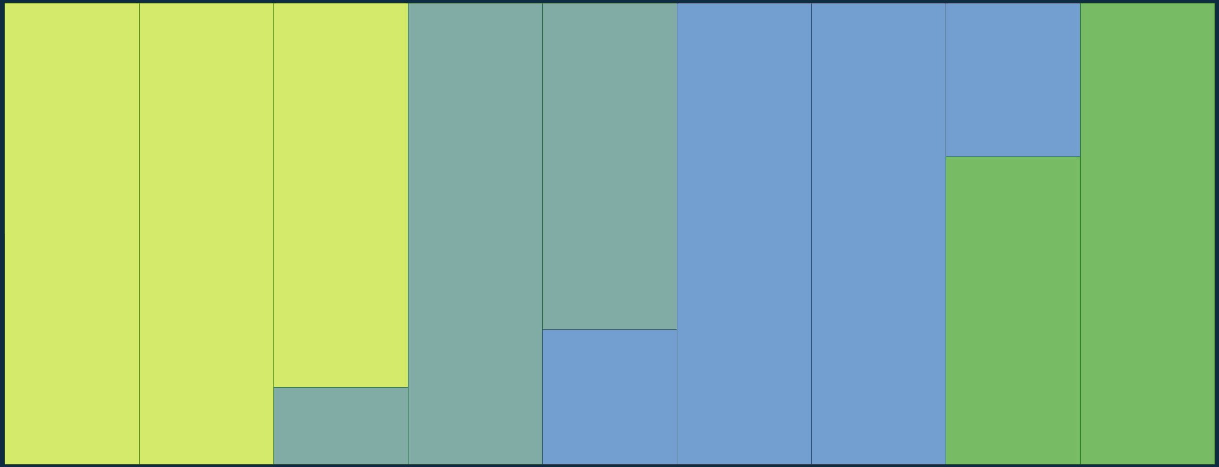


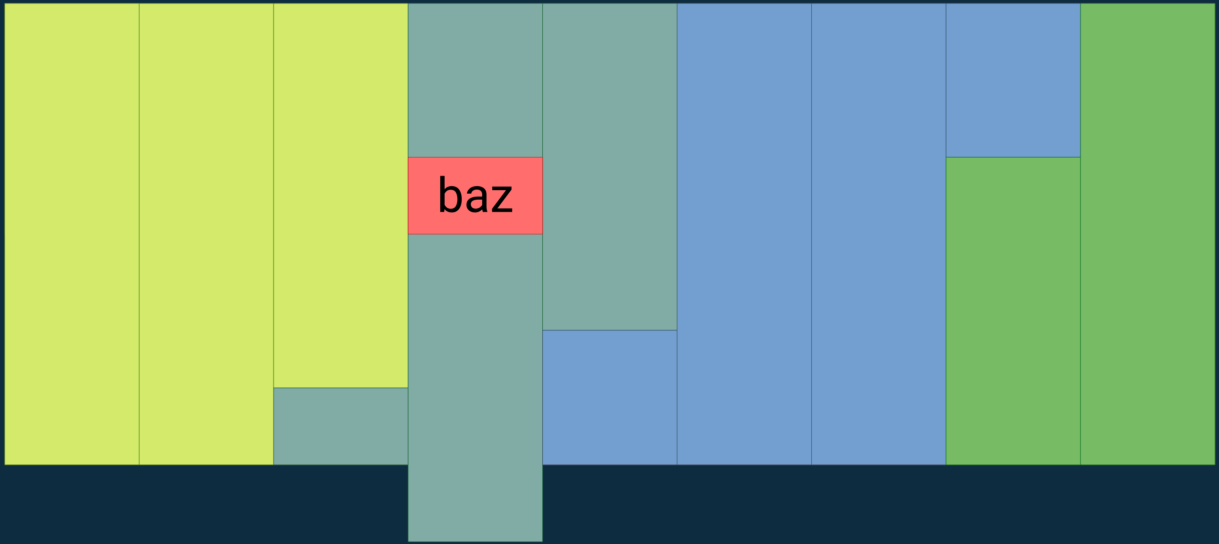
foo


bar

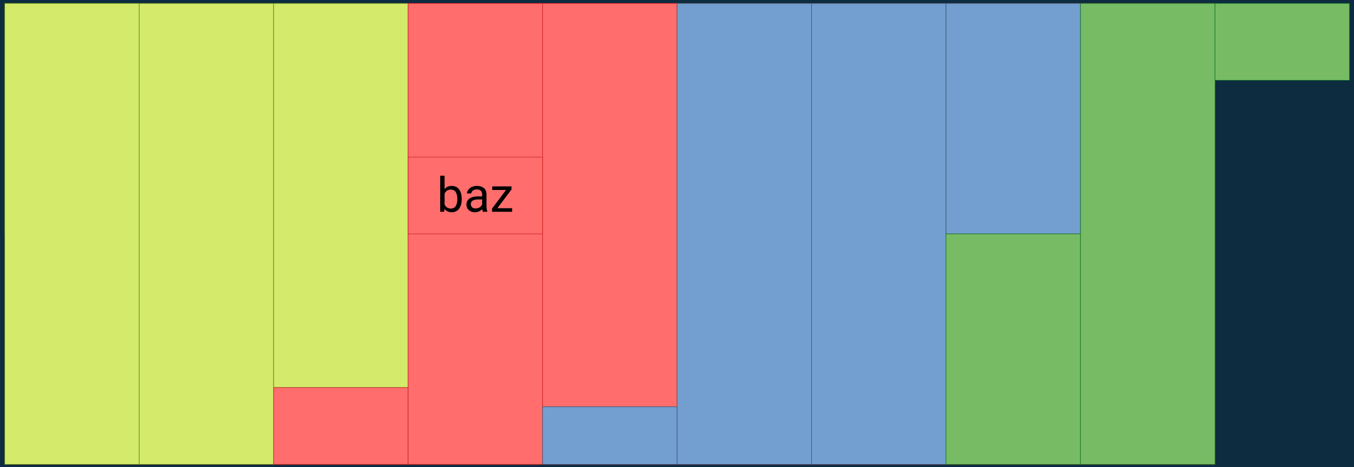


bar





baz



baz