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Own The Stack

FreeBSD from a vendor's perspective

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- Native Tongue: Elixir/Erlang, POSIX Shell
- Past: CTO, Systems Engineer
- Love: Unix and Film Photography
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Agenda

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- What we do
- Choosing an operating system for your appliance
  - Why FreeBSD
- Development Flow
  - Git(ea), Build(bot), ~~Packages~~ Poudriere, Ship
- Path to vendorship
- Unforeseen issues and corresponding solutions
- "These are not the tools you are looking for" -- Obi-Wan Freebie
- Conclusion
- Q&A

What we do

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We create virtual minefields inside the infrastructure to

Detect, Deceive, and Deter malicious actors.

illuria's deception technology uses decoys and lures to break the attackers' decision cycle, forcing them to reveal themselves.

a.k.a Honeypots on Steroids!!!

Choosing an operating system

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- **Spoiler Alert: Most of the time it's FreeBSD**
  - Unless: for embedded systems with specific drivers
  - Unless: Team wants $TOOL, not available on FreeBSD
- **Our needs:**
  - not PITA, always POLA
  - commercial friendly (BSDL?)
  - responsible community
  - single source of truth
  - easy to "replicate" and "own"

Choosing an operating system (cont.)

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- **Linux**
  - GPL → hard to modify, legally
  - Changes blazingly fast → hard to maintain
  - Divided community → hard to get proper and quick answers
- **illumos**
  - Unknown to the majority of ***our*** team
  - Very different than Linux and *BSDs → harder to teach
- **FreeBSD**
  - We already knew the nuances…
  - Centralized community → We know where to ask what
  - Single solution for a single problem ~~which has been around for years~~

Benefits of using FreeBSD (as a vendor)

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- We came for the license, we stayed for the technology (and the community)
- All brilliant things are in the base
  - ZFS
  - DTrace
  - Jails
- Many nice things are developed with base-in-mind, including but not limited to
  - `poudriere(8)`
  - `vm-bhyve(8)`
  - `dwatch(1)`
- All good, BUT, easy to fork, and tricky to maintain, especially for a startup.

Disclaimers

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It's a startup, so

- we're a team of 5 people working on everything
- we can't spend 500 USD/mo for a "build server"
- we can't wait hours till things compile
- we can’t afford giant resources
- we want to focus on our core problem

But it's also team of *BSD lovers, so…

These are ***our*** stories, we hope they help you :-)

Tech Stack | Software

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- **OS:** FreeBSD (obviously)
- **Programming Languages:**
  - Elixir/Erlang/OTP
  - FreeBSD Shell
  - JavaScript
  - Oberon
  - Rust
  - C
- **CI:** BuildBot
- **VCS:** Git on Gitea
- **Packaging:** Poudriere
- **Shipping:** Poudriere + Scripts

Tech Stack | Infrastructure

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- FreeBSD (obviously)
- Everything is a Jail
  - We use `jailer` for Jail automation (we built it, open-sourcing soon!)
- Non-FreeBSD things (Linux, Windows) are in VMs
  - We use `bhyve` with `vm-bhyve`
- "Server SSO" using NIS + NFS + AutoFS
  - DON'T TRY THIS AT HOME. We love old things that Just Works™
- Everything is tunneled among multiple locations between multiple continents
  - One of those locations (Armenia) is not FreeBSD-friendly (CDN-wise)

Development Flow

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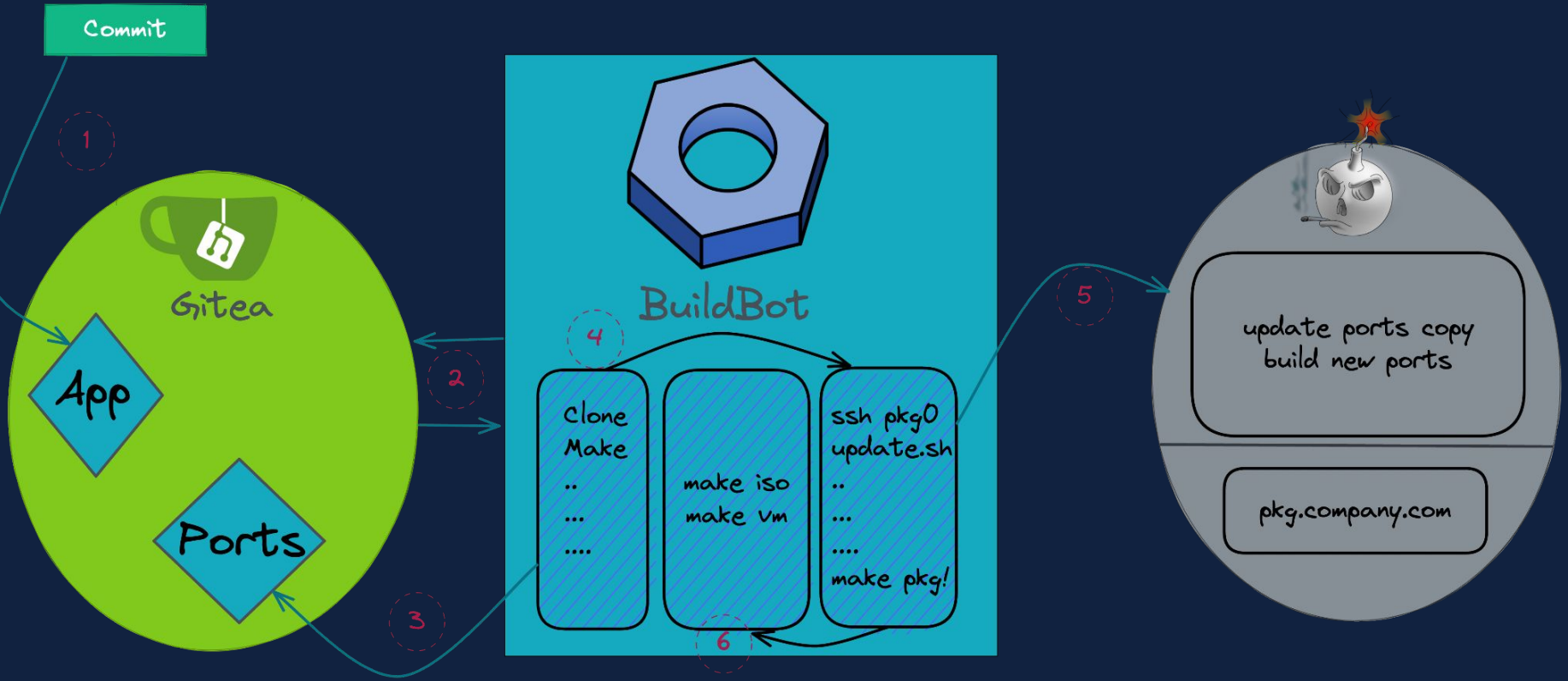

Development Flow; Git to Build

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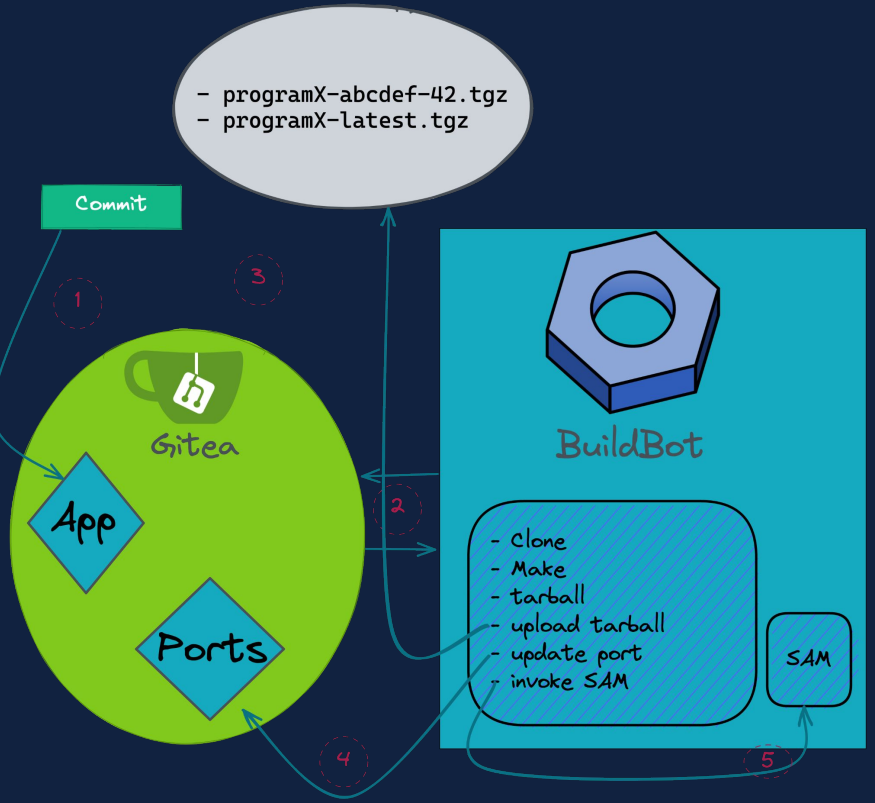

Development Flow; Our Typical Port

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```
...

PORTVERSION=    ${GIT_REVISION}
MASTER_SITES=   http://downloads.build.example.com/webapp/
DISTNAME=       ${PORTNAME}-${GIT_HASH}-${GIT_REVISION}
DIST_SUBDIR=    ${PORTNAME}

GIT_HASH=8e0bf8502b6cc45e2e4b0b29723077b26c4b46cf
GIT_REVISION=88

...

.include <bsd.port.mk>
```

Development Flow; Update Port on Success

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On success, buildbot changes the following user-defined macros in the port's Makefile and commits to the main branch:

```
-GIT_HASH=90c6a35b280734b72cef1509f44a5da75aadd765
-GIT_REVISION=27
+GIT_HASH=56a947ff8144d18fbbf719d002e7182aee830feb
+GIT_REVISION=28
```

Development Flow; Separation

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- `NO_BUILD=YES`
  - Skip the `build` step (`man 7 ports`)
- Clear separation of building and packaging
  - Building is done by BuildBot
  - Packaging is done by `poudriere`

Development Flow; Tarball to Package

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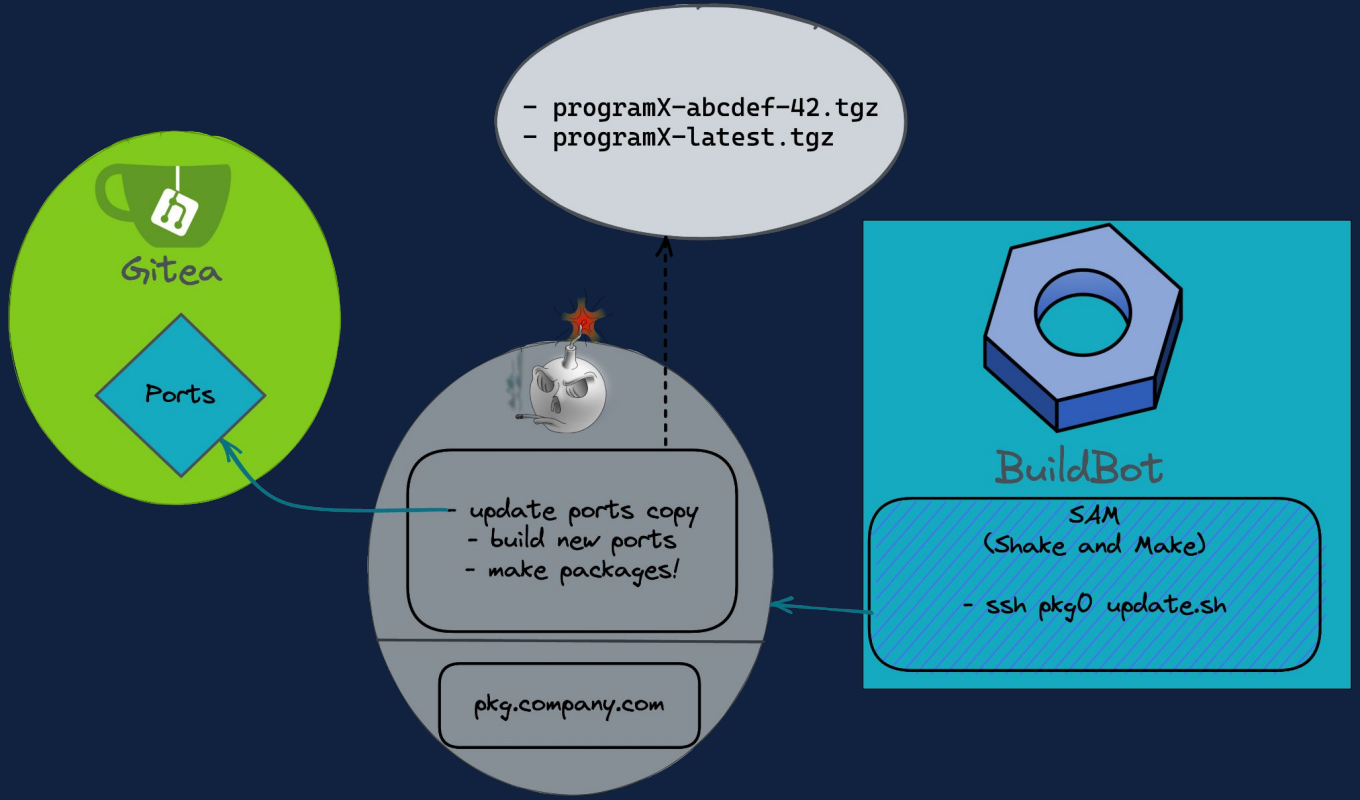

Ports Tree: Why Are We Shaking?

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Maintaining Ports Tree

- **Option one: Fork FreeBSD's Ports tree and add your own stuff**
  - **Pros:** Single Ports tree to use internally
  - **Cons:** You have to regularly pull your copy and maintain your Makefiles
  - Best practice of usage: When your software relies on FreeBSD ports

- **Option two: Have your own Ports tree and merge it with other trees**
  - **Pros:** Update other copies only when needed
  - **Cons:** Need a reliable way to merge
  - Best practice of usage: When your software is "standalone"

Merging Port Trees

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Portshaker:

- Simple (and single) configuration
- Simple to run

```
echo 'cloning company ports tree'
/usr/local/bin/portshaker -u company
echo 'merging port trees'
/usr/local/bin/portshaker -m default
echo 'merging done!'
/usr/local/bin/poudriere bulk -f /root/company-devel \
    -j company-devel-130 -p default
```

Building & Packaging; Final thoughts…

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We have, at this point

- CI that builds
- Poudriere that packages
- Everything automated

We need

- Package server (via HTTP)
- With authentication

pkg.conf with HTTP_AUTH

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```
/usr/local/etc/pkg/repos/example.conf

example: {
        url: "http://pkg.example.com/{ABI}/devel",
        enabled: yes,
        env: { HTTP_AUTH: "basic:*:user0:thepassword" }
}
```

Release

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If neither userland nor kernel is altered you ***do not*** need to build them to make an image:

- `poudriere-image(8)` could be used for your ISO images with a little hack[1]
- And a simple script could do the job for your VM images

[1] poudriere ISO/USB images are not meant to be installable, they are just live images. But it doesn't mean you cannot make them installable - we'll go over this in a bit…

ISO/USB images

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- `poudriere jail -c ...` (it shall contain a kernel)
- Fetch distribution tarballs (base.txz, kernel.txz, etc.)
- Add tarball of your files[1] next to other distfiles
- Run `make-manifest.sh` from `/usr/src/release/scripts` to update the MANIFEST file (beware it prints to `stdout` - read the code, it's small)
- Run `poudriere-image(8)` with the following options:
  `-t iso, -j <jail_name>, -c <directory_to_copy>`[2]
  `-n <iso_name> -h <hostname>`

(distribution files are required to have an installer)

[1] Custom Dist Structure
[2] Overlay Structure

Example for your custom tarball

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The overlay structure

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```
overlay/
└── usr
    └── freebsd-dist
    │   ├── MANIFEST
    │   ├── base.txz
    │   ├── kernel.txz
    │   ├── custom.txz
    │   └── …
    └── local
        └── …
```

Distfiles for 13.1-RELEASE:

`https://download.freebsd.org/releases/amd64/13.1-RELEASE/`

VM Images (ZFS)

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- Create a file of a specific size
- Create a memory disk (mdconfig)
- Partition it (gpart) [1]
- Create a zpool
- Create datasets and set their properties [2]
- Take care of distributions and configuration files
  (bsdinstall distfetch, distextract, and config could be used)
- Make your changes
- Export the pool
- Detach the memory disk

[1] Partitioning
[2] Datasets

Special thanks to bofh@ for his help

Partitioning the memory disk

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```
> gpart create -s gpt ${MD}
> gpart add -a 4k -s 512k -t freebsd-boot ${MD}
> gpart add -a 4k -t freebsd-zfs -l gpt_root ${MD}
> gpart bootcode -b /boot/pmbr -p /boot/gptzfsboot -i 1 ${MD}
```

ZFS Datasets and their properties (p.1)

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CAUTION: Make sure you're either on UFS or your desired pool name for the image differs from your system's.

NOTE: *swap volumes are not discussed - consult manuals if they are required.*

```
> zpool create -R /mnt zroot /dev/${MD}p2
> zfs create -o mountpoint=none zroot/ROOT
> zfs create -o mountpoint=/ zroot/ROOT/default
> zfs create -o mountpoint=/tmp -o exec=on -o setuid=off
zroot/tmp
> zfs create -o mountpoint=/usr -o canmount=off zroot/usr
```

ZFS Datasets and their properties (p.2)

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```
> zfs create zroot/usr/home
> zfs create -o setuid=off zroot/usr/ports
> zfs create zroot/usr/src
> zfs create -o mountpoint=/var -o canmount=off zroot/var
> zfs create -o exec=off -o setuid=off zroot/var/audit
> zfs create -o exec=off -o setuid=off zroot/var/crash
> zfs create -o exec=off -o setuid=off zroot/var/log
> zfs create -o atime=on zroot/var/mail
> zfs create -o setuid=off zroot/var/tmp
> zpool set bootfs=zroot/ROOT/default zroot
```

VM Images (UFS)

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Building a UFS image is easier than both ISO and ZFS images.

```
$ poudriere image -c <overlay> -n <name> -h <hostname>\
-f <pkg-list> -j <jail> -w <swap> -b -s <size> -t usb
```

“-b” is used to place the swap first to allow the primary partition to be grown on demand, and “-f <pkg-list>” specifies a list of packages to be pre-installed. For the latter, you should have used poudriere-bulk(8) first.

FreeBSD Release; HOW WE DO IT

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- Unmodified Kernel and User-land
  - `poudriere-image(8)` for ISO/USB images
    - Custom dist files, `custom.txz`
    - Simple overlay

Example for our custom tarball

The overlay structure

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rc.local

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```
echo "Please choose the appropriate terminal type for your system."
echo "Common console types are:"
echo "   ansi Standard ANSI terminal"
echo "   vt100VT100 or compatible terminal"
echo "   xtermxterm terminal emulator (or compatible)"
echo "   cons25w  cons25w terminal"
echo
echo -n "Console type [vt100]: "
read TERM
TERM=${TERM:-vt100}
export TERM

/usr/local/bin/custom_installer
```

/usr/local/bin/custom_installer

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```
echo "starting installer"
#SET HOSTNAME
exec 3>&1; _hostname=$(dialog --backtitle "LureOS Installer" --inputbox "Set \
Hostname" 0 0 2>&1 1>&3);
exec 3>&-;
…
#SET DISK
…
cat <<EOF > /tmp/install.script
DISTRIBUTIONS="kernel.txz base.txz custom.txz"
export ZFSBOOT_VDEV_TYPE=stripe
export ZFSBOOT_DISKS=${_disk}
…
#!/bin/sh
sysrc hostname="${_hostname}"
…
EOF
bsdinstall script /tmp/install.script
```

/usr/local/bin/custom_installer

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```
echo "starting installer"
…
cat <<EOF > /tmp/install.script
…
#!/bin/sh
sysrc hostname="${_hostname}"
sysrc sshd_enable="YES"
REPOS_DIR="/etc/pkg/" pkg bootstrap -y
pkg add /usr/local/company/latest/packageX-latest.tgz
sysrc mydaemon_enable="YES"
passwd root
…
EOF
bsdinstall script /tmp/install.script
```

FreeBSD Release; VM Images

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- `truncate -s 10G disk0.img ; mdconfig -f disk0.img`
- copy "generated" `install.script`
  - `export ZFSBOOT_DISK=md0`
  - Hardcode some values
- `bsdinstall script install.script`
- Host shall be using UFS
  - `bsdinstall` exports all zpools, for some reason…

Unforeseen Issues & Corresponding Solutions

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- disk0.img size: used vs real
- `poudriere-image(8)` requires a kernel
- qemu-img from qemu-tools
- The Jail running `poudriere` requires it too!

These are not the tools you are looking for

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https://github.com/freebsd/poudriere/wiki/poudriere-image.8

https://github.com/michaeldexter/occambsd

https://github.com/michaeldexter/imagine

https://github.com/5u623l20/vultr-freebsd-zfs

/usr/libexec/bsdinstall

/usr/share/bsdconfig

Caring := Sharing

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- src
  - Good testing
  - Requires time
  - Large change? make it gradual
  - Follow up
- Ports
  - Ports are for everyone, not just for $WORK
- Docs
  - Apologies, we've been lazy :-)

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That's all folks!

Thanks

Q&A

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