CTSRD

CRASH-worthy Trustworthy Systems Research and Development

Building FreeBSD Without Root Privilege

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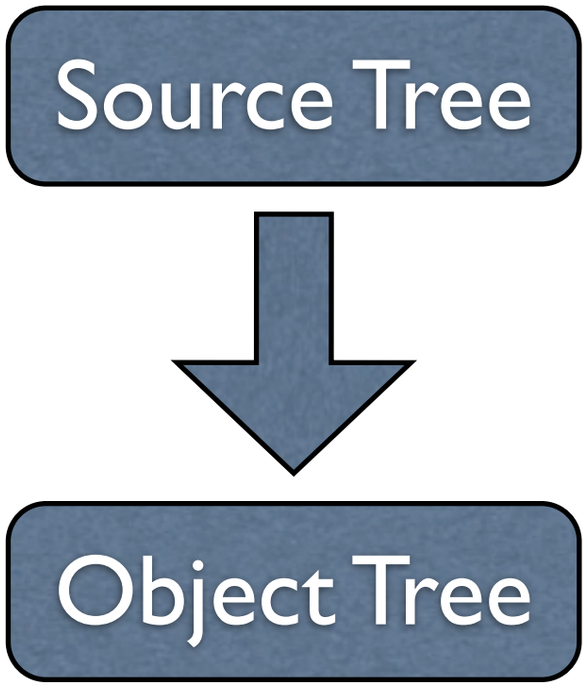
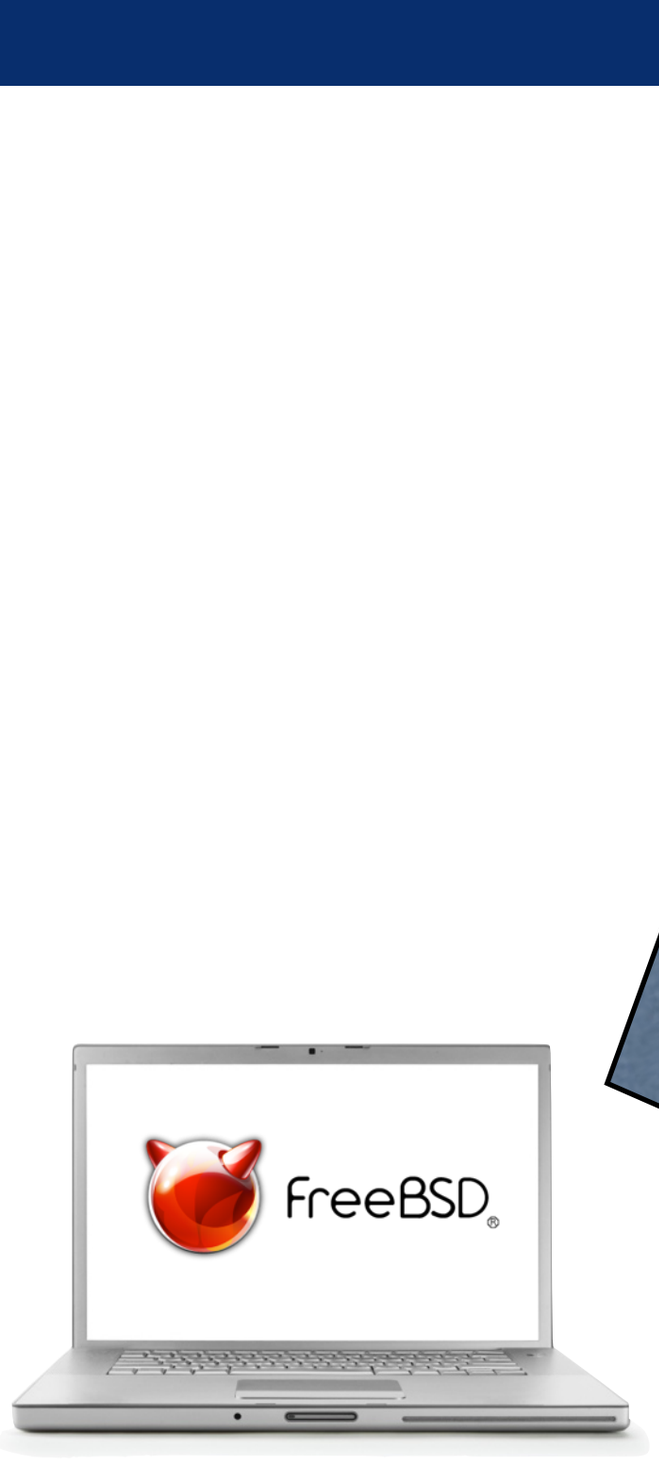

Source Tree
Object Tree

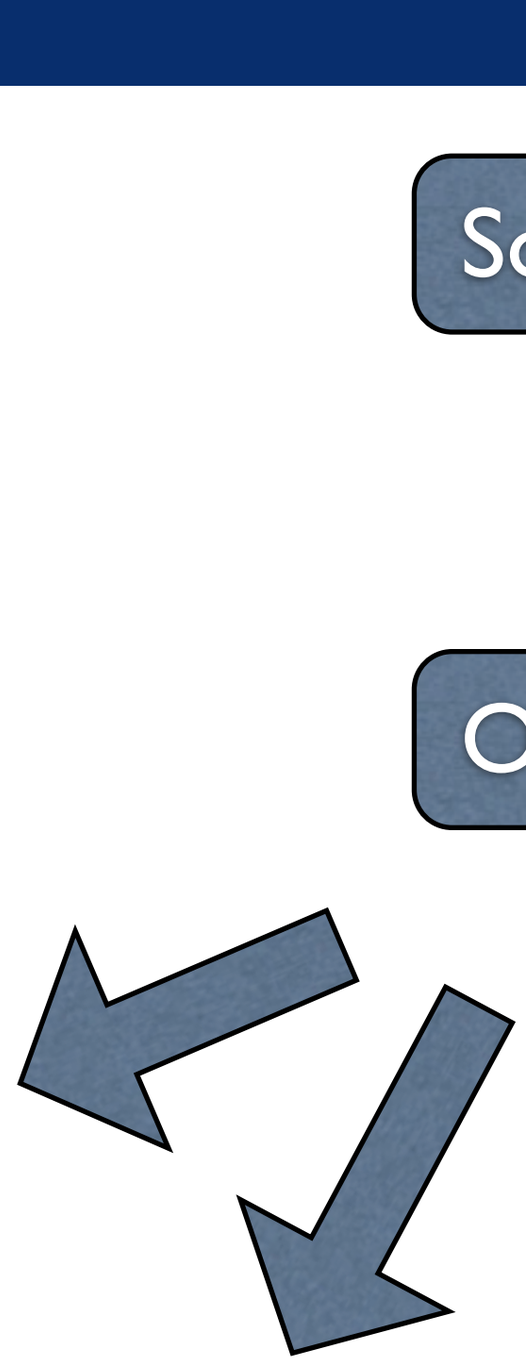

FreeBSD

Source Tree

Object Tree

Source Tree





Object Tree

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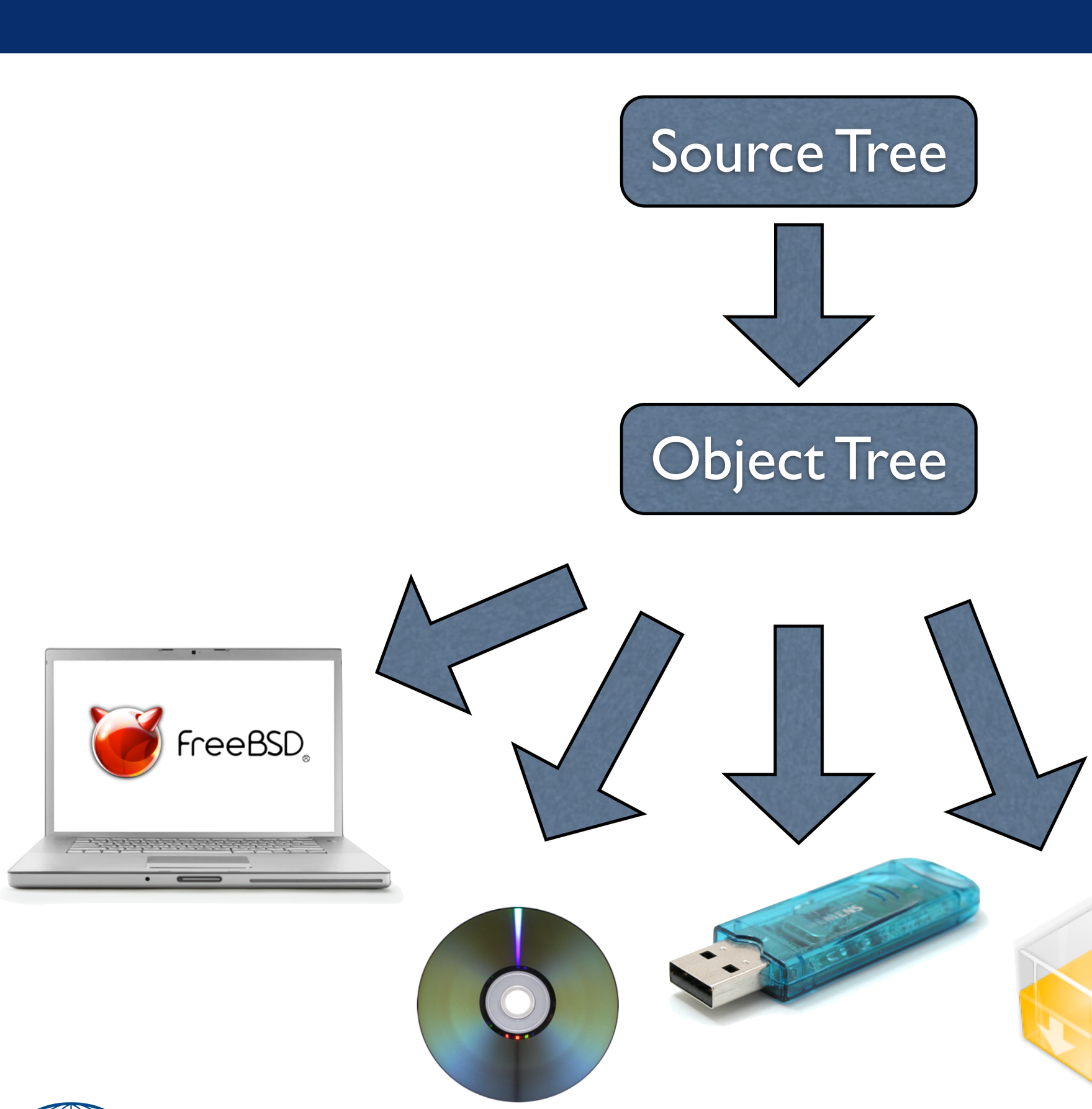
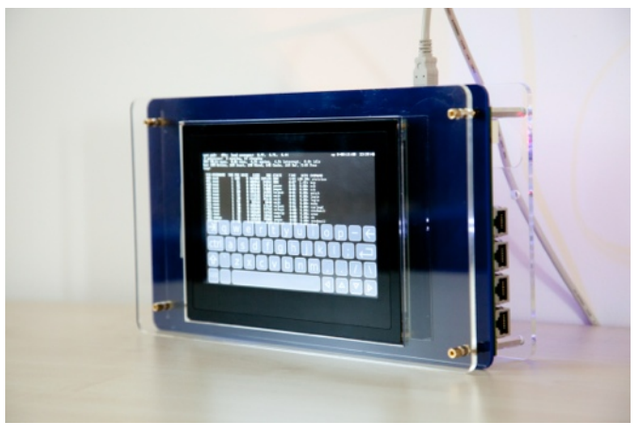


Object Tree

Source Tree

Object Tree



Source Tree

Object Tree

Problems of Privilege

- User errors compounded
- Trust too much code
- May not have root access
- Often no need

The User/Group Database Problem

```
$ make installworld
ERROR: Required auditdistd user is missing, see /usr/src/UPDATING.
*** [installcheck_UGID] Error code 1

Stop in /usr/src.
*** [installworld] Error code 1

Stop in /usr/src.
$
```

- Related to the privilege problem
- Why require unused users?

Outline of the Solution

- Install files as user
  - No suid
- Log correct permissions
- Teach image creation tools about logs
- Use user/group databases from source tree not installed system

Import of NetBSD `mtree`

- Added our features to NetBSD
- Added flavor support for compatibility
- Installed as `nmtree`
  - Will replace `mtree` in 10.0

New `install` options

- From NetBSD
  - `-M` (`-D`, `-h`, `-T`): metadata log
  - `-N`: user/group databases
  - `-U`: unprivileged operation
  - `-l`: hard and symbolic links

Build System Changes

- Remove use of `ln` in install targets
- User `nmtree` to create directories
- `NO_ROOT` and `DB_FROM_SRC`
- Remove duplicate installation of files

How to Use

```
$ make -DNO_ROOT -DDB_FROM_SRC DESTDIR=/path/to/dest \
    installworld
$ make -DNO_ROOT -DDB_FROM_SRC DESTDIR=/path/to/dest \
    distribution
$ make -DNO_ROOT -DDB_FROM_SRC DESTDIR= /path/to/dest \
    installkernel
$ cd /path/to/dest; makefs /path/to/output/image METALOG
```

- Create the log through the usual install process
- Use the log to build an image

Advanced Usage

```
$ makeroot.sh -k keys -K ctsrd \
    -p extras/etc/master.passwd -g extras/etc/group \
    -e extras/mdroot.mtree -e demo/demo.mtree \
    -e extras/ctsrd.mtree -s 26112k -f demo.files \
cheribsd-demo.img /path/to/dist
```

- Add files or subset the image
- `/usr/src/tools/tools/makeroot/`

Status

- Image creation with `tar` and `makefs`
- Shipping releases of CheriBSD
- Limited FreeBSD release support
- Merged to 9-STABLE

To Do

- Tools to audit `METALOG` vs installed files
- Support for partitioned disk images
  - Geom direct dispatch could simplify
- Make all releases without privilege
- Mechanism to install packages in an image

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External Toolchain Support

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Why Support External Toolchains?

- Test new compiler releases
- Allow odd compilers:
  - New (GPLv3) GCC
  - Proprietary/vendor provided
  - Experimental version of `clang`
- Build FreeBSD 10 on systems where `cc` isn't `clang`

Approach

- Top level (`buildworld`, etc) only
- Override `CC`, `CXX`, `CPP`, `AS`, ...
- Compiler not bootstrapped if `XCC` set
- Separate compiler and toolchain overrides
  - *Not the traditional worldview*

How to Use

- Set `XCC`, `XCXX`, `XCPP`, `XAS`, `XLD`, ...
- Alternatively, set:
  - `CROSS_COMPILER_PREFIX`
  - `CROSS_BINUTILS_PREFIX`
  - `CROSS_TOOLCHAIN_PREFIX` sets both

Status

- Committed to HEAD
  - Works with `clang`
- Documentation at:
  - https://wiki.freebsd.org/ExternalToolchain

To Do

- Move into `share/mk`
- Way set `COMPILER_*` variables
- More flexible way to handle compiler warning flags

Q & A