Yocto Project® devtool Overview and Hands-On

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devtool

- Collection of tools for working on *recipes*:
  - **`devtool add`**
  - **`devtool edit-recipe`**
  - **`devtool upgrade`**
  - **`devtool finish`**
  - *etc...*

devtool

- *...and more!*
  - **`devtool modify`**
  - **`devtool deploy-target`**
  - **`devtool undeploy-target`**
  - **`devtool build`**
  - **`devtool build-image`**
  - *etc...*

devtool – why it exists

- Our build system is great for repeatable builds from source
- Working with the source itself was hard
- Tempting to just edit sources under tmp/work/…
  - But workflow is painful after that (forced builds, manual patch generation, lost work…)
- Help newer users add new software (alongside regular build and within eSDK)

devtool – past presentations

- ELC 2017
  - Using Devtool To Streamline Your Yocto Project Workflow - Tim Orling
  - https://www.youtube.com/watch?v=CiD7rB35CRE
- ELC 2017
  - Yocto Project Extensible SDK: Simplifying the Workflow for Application Developers - Henry Bruce
  - https://www.youtube.com/watch?v=d3xanDJuXRA&t=57s

devtool – past presentations

- ELC 2018
  - Working with the Linux Kernel in the Yocto Project - Sean Hudson
  - https://www.youtube.com/watch?v=tZACGS5nQxw

devtool – past presentations

- YPDD 2018 - ELC
  - Session 3, Devtool 1 - Tim Orling
  - https://www.youtube.com/watch?v=C-usM6gFVSY
- YPDD 2018 - ELC
  - Session 7, Devtool 2 - Tim Orling & Henry Bruce
  - https://www.youtube.com/watch?v=UYsqIP_Qt_Q

devtool – documentation

- Yocto Project Reference Manual
  - chapter 8 - *devtool* Quick Reference
  - https://www.yoctoproject.org/docs/current/ref-manual/ref-manual.html#ref-devtool-reference
- Yocto Project Application Development and the Extensible Software Development Kit (eSDK)
  - chapter 2 - Using the Extensible SDK
  - https://www.yoctoproject.org/docs/current/sdk-manual/sdk-manual.html#sdk-extensible

devtool – documentation

- Yocto Project Linux Kernel Development Manual
  - section 2.4 - Using *devtool* to Patch the Kernel
  - https://www.yoctoproject.org/docs/current/kernel-dev/kernel-dev.html#using-devtool-to-patch-the-kernel

devtool – documentation

```
$ devtool --help
usage: devtool [--basepath BASEPATH] [--bbpath BBPATH] [-d] [-q]
               [--color COLOR] [-h]
               <subcommand> ...

OpenEmbedded development tool

options:
  --basepath BASEPATH  Base directory of SDK / build directory
  --bbpath BBPATH      Explicitly specify the BBPATH, rather than getting it
                       from the metadata
  -d, --debug          Enable debug output
  -q, --quiet          Print only errors
  --color COLOR        Colorize output (where COLOR is auto, always, never)
  -h, --help           show this help message and exit

subcommands:
  Beginning work on a recipe:
    add                  Add a new recipe

...
```

devtool – documentation

```
$ devtool add --help
usage: devtool add [-h] [--same-dir | --no-same-dir] [--fetch URI]
                   [--fetch-dev] [--version VERSION] [--no-git]
                   [--srcrev SRCREV | --autorev] [--srcbranch SRCBRANCH]
                   [--binary] [--also-native] [--src-subdir SUBDIR]
                   [--mirrors] [--provides PROVIDES]
                   [recipename] [srctree] [fetchuri]

Adds a new recipe to the workspace to build a specified source tree. Can
optionally fetch a remote URI and unpack it to create the source tree.

arguments:
  recipename            Name for new recipe to add (just name - no version,
                        path or extension). If not specified, will attempt to
                        auto-detect it.
  srctree               Path to external source tree. If not specified, a
                        subdirectory of /z/ypdd/2018-10-devtool/my-
                        class/poky/build/workspace/sources will be used.
  fetchuri              Fetch the specified URI and extract it to create the
                        source tree

options:
  -h, --help            show this help message and exit
...
```

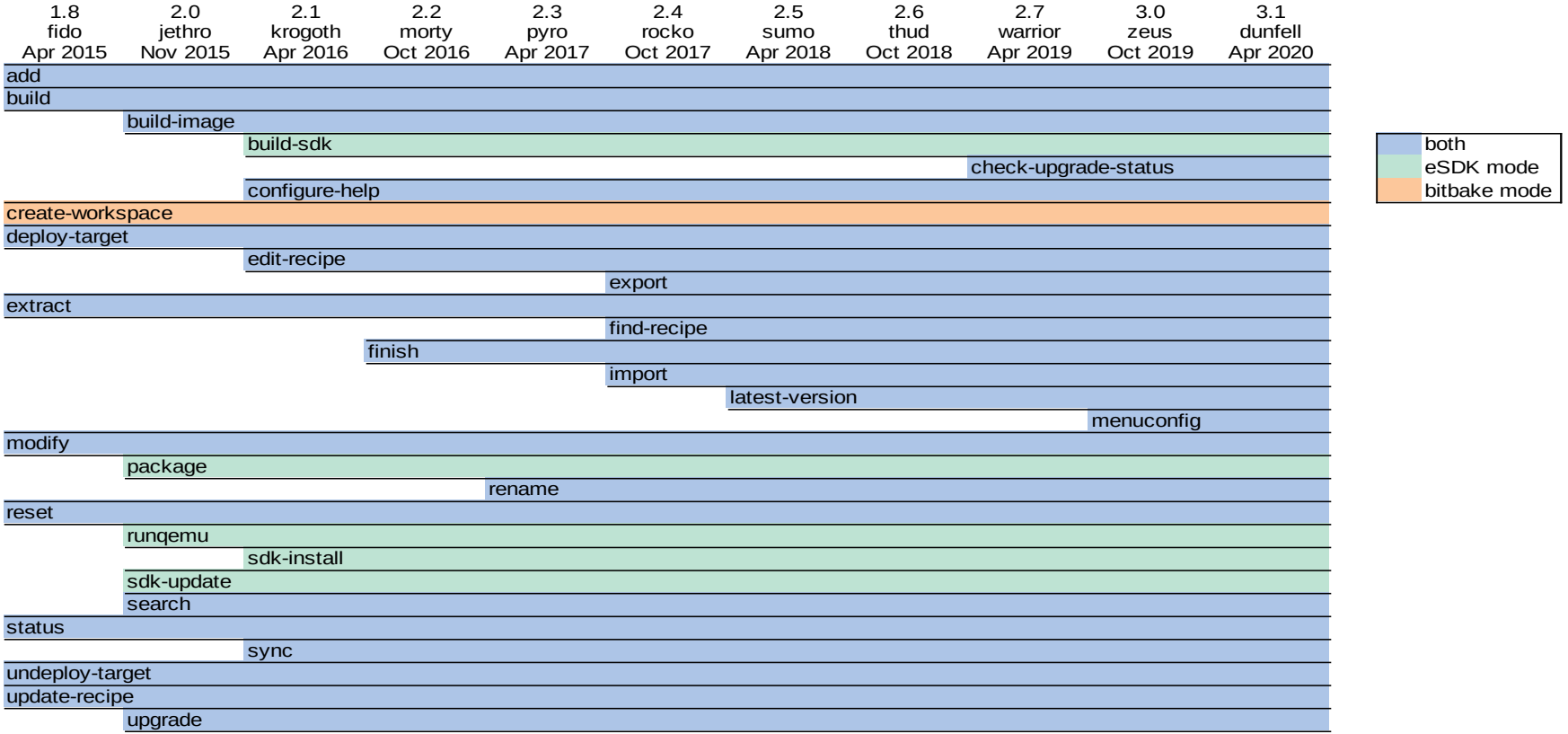
devtool – modes

- devtool runs in two modes
  - when run inside an eSDK: “eSDK mode”
  - when run outside an eSDK: “bitbake mode”

devtool – mode commands

- bitbake mode
  - add
  - build
  - build-image
  - configure-help
  - check-upgrade-status
  - ***create-workspace***
  - deploy-target
  - edit-recipe
  - export
  - extract
  - find-recipe
  - finish
  - import
  - latest-version
  - menuconfig
  - modify
  - rename
  - reset
  - search
  - status
  - sync
  - undeploy-target
  - update-recipe
  - upgrade
- eSDK mode
  - add
  - build
  - build-image
  - ***build-sdk***
  - configure-help
  - check-upgrade-status
  - deploy-target
  - edit-recipe
  - export
  - extract
  - find-recipe
  - finish
  - import
  - latest-version
  - menuconfig
  - modify
  - ***package***
  - rename
  - reset
  - ***runqemu***
  - ***sdk-install***
  - ***sdk-update***
  - search
  - status
  - sync
  - undeploy-target
  - update-recipe
  - upgrade

devtool development - functionality

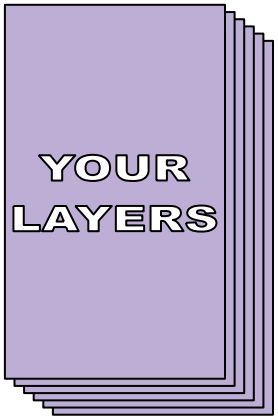


devtool – mode commands

- why does eSDK mode get all the extra features?
  - because an eSDK doesn’t have *bitbake* or *scripts/*
  - *devtool* is the cornerstone of the eSDK

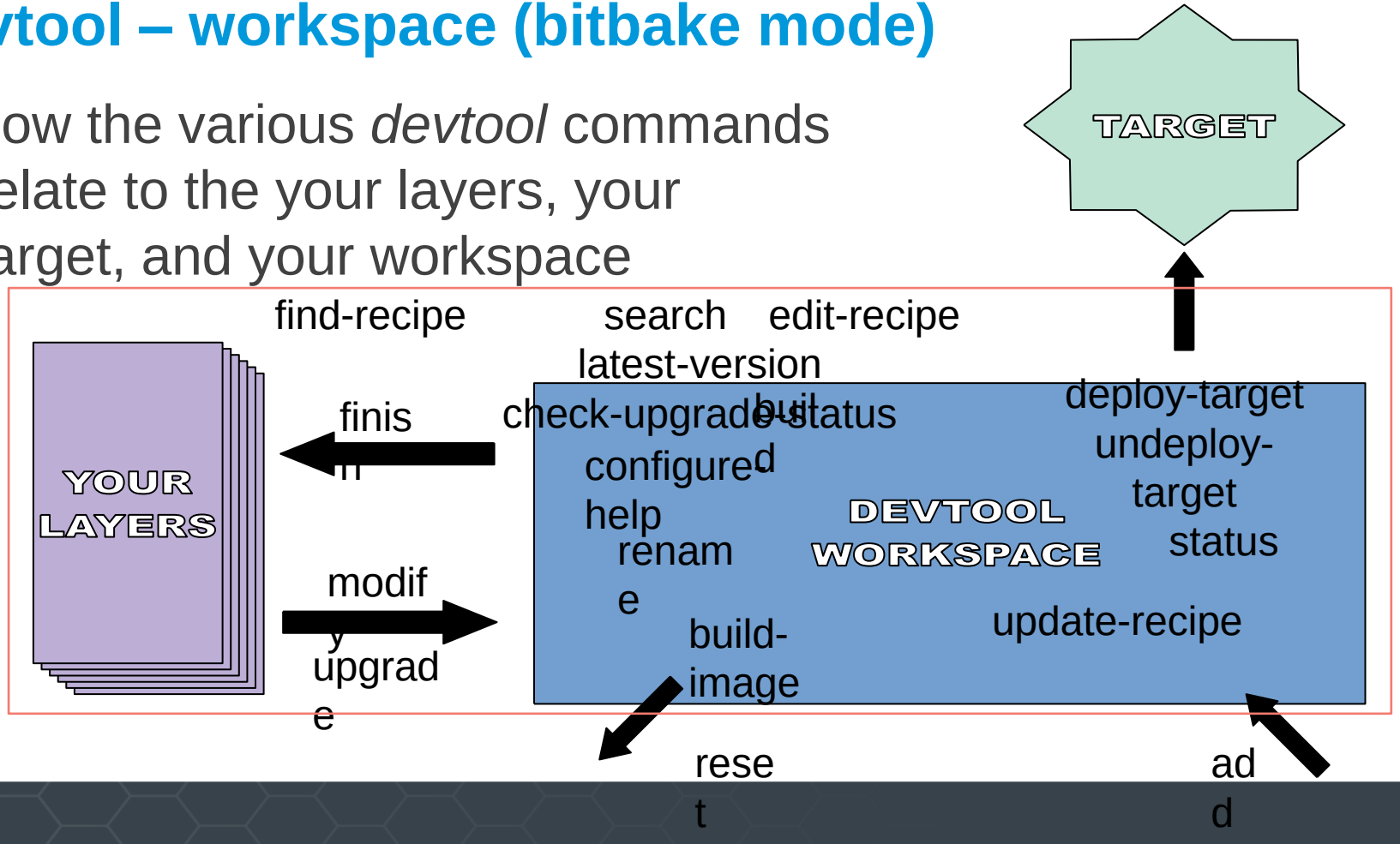
devtool – workspace

- a separate environment (layer) in which to work on recipes, sources, patches

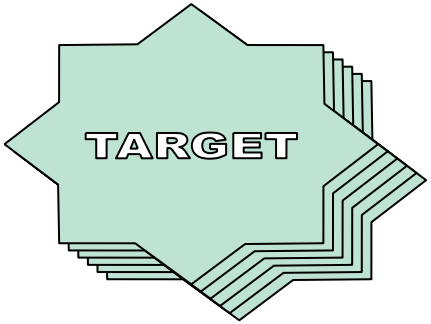


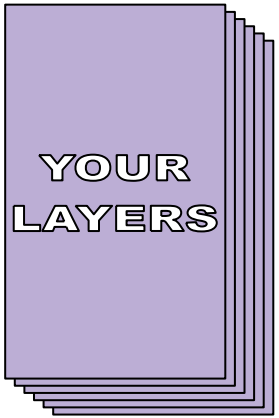
devtool – workspace (bitbake mode)

- how the various *devtool* commands relate to the your layers, your target, and your workspace



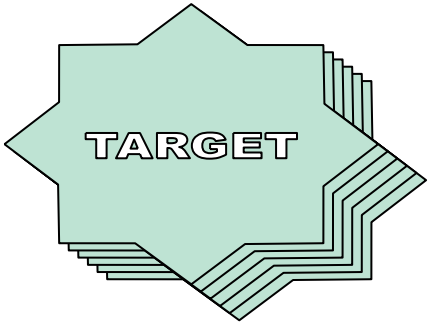
devtool – multiple targets?

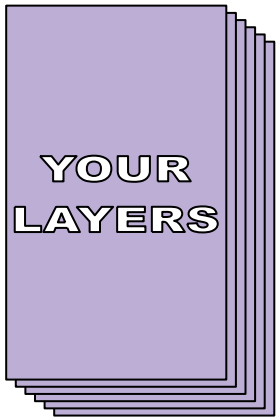




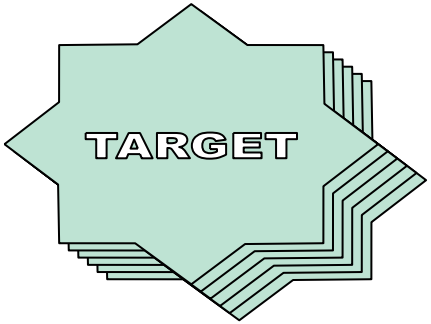
devtool – multiple targets?

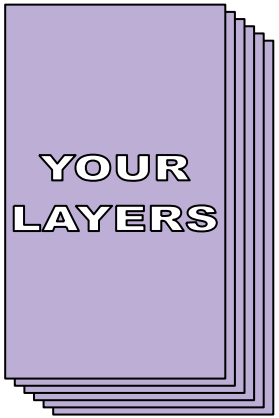
- yes
- specify target's IP with un/deploy-target

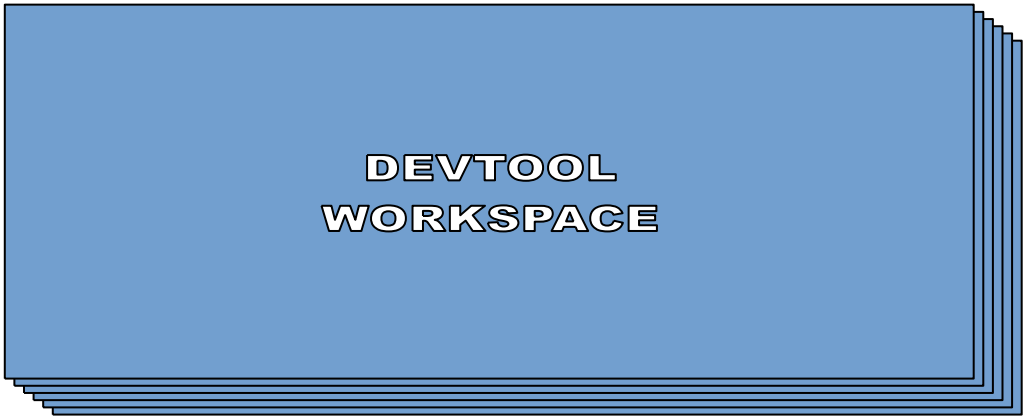




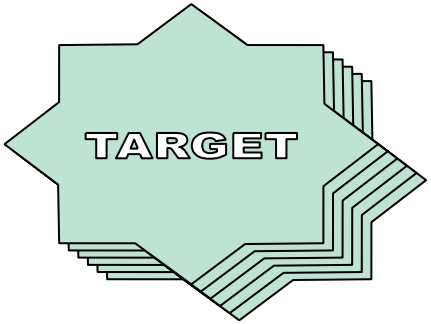
devtool – multiple workspaces?



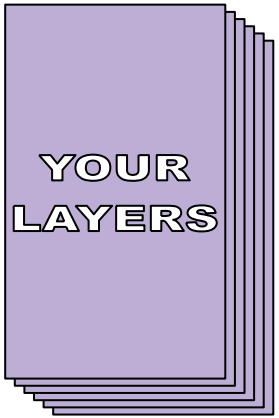


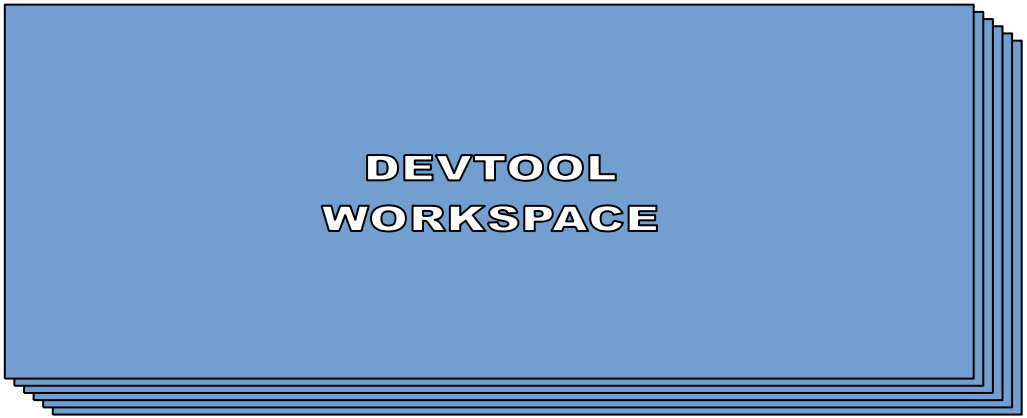


devtool – multiple workspaces?



- technically: yes (i.e. no errors)
- practically: no (the next replaces the previous, so there's only ever one)





Conclusion

- Try it out!
  - **`devtool add`** on a source tree (see hands-on)
  - **`devtool modify`** and work on an existing recipe
  - **`devtool upgrade`** existing recipe to a new upstream version
- See documentation links (earlier slide)
- Please send feedback!
  - Yocto Project mailing list, IRC, etc.

Questions?

Hands On

devtool – setup

```
$ edit/create ~/.ssh/config
```

```
Host qemu
        User root
        Hostname localhost
        Port 2222
        StrictHostKeyChecking no
        UserKnownHostsFile /dev/null
```

```
$ cd /scratch
$ git clone -b warrior git://git.yoctoproject.org/poky
$ . poky/oe-init-build-env poky/build-devtool
$ edit conf/local.conf
        MACHINE = "qemuarm"
        DL_DIR = "/scratch/downloads"
        SSTATE_DIR = "/scratch/sstate-cache"
        INHERIT += "buildhistory"
        IMAGE_INSTALL_append = " openssh"
        WARN_QA_append = " version-going-backwards"
        ERROR_QA_remove = "version-going-backwards"
        EXTRA_IMAGE_FEATURES ?= "debug-tweaks"
```

devtool – setup

```
$ bitbake core-image-base
$ bitbake-layers create-layer ../meta-foo
$ bitbake-layers add-layer ../meta-foo
$ git config --global user.name "name"
$ git config --global user.email "name@server.com"
```

- open a second ssh connection to the build machine

```
2$ cd devtool
2$ . poky/oe-init-build-env build
2$ runqemu slirp nographic serial
```

- do the exercises in the first connection, work on the target in the second connection
- login as "root", no password (thanks to "***debug-tweaks***")

devtool – getting started

```
$ devtool add \
    https://nano-editor.org/dist/v4/nano-4.2.tar.xz
```

- implicitly creates workspace (if it doesn't already exist)
- guesses the recipe name ***nano*** (correctly!)
- looks at the source and determines it's an ***autotooled*** project (true! and ***pkgconfig*** and ***gettext***)
- guesses at DEPENDS (correctly! ***ncurses*** and ***zlib***)
- creates a "rough" recipe

```
$ devtool status
$ devtool find-recipe nano
$ devtool edit-recipe nano
```

devtool – getting started

- let’s see if it builds

```
$ devtool build nano
```

- it works!

devtool – what goes in a workspace?

- the things on which you are working:
  - recipes
  - patches
  - sources
  - etc...

```
$ tree -d workspace
```

- ...except sources can be, optionally, outside the workspace

devtool – let's see nano run

- examine `buildhistory/images/qemuarm/glibc/core-image-base/installed-packages.txt`
  - verify there's no "nano" package
- in the terminal running qemu, log in and verify there's no nano

```
root@qemuarm# nano
-sh: nano: command not found
```

- send nano to target

```
$ devtool deploy-target nano qemu
```

- now nano runs

sidebar – SLIRP versus TUN/TAP

- Yocto Project supports several connection technologies for QEMU

qemu is defined in ~/.ssh/config (see earlier slide)

- SLIRP: advantage is no root access required, disadvantages are minimal documentation, requires SSH knowledge

```
2$ runqemu slirp nographic serial
$ devtool deploy-target nano qemu
```

- TAP: advantage is simpler setup, disadvantage is that it requires sudo access

```
2$ sudo runqemu nographic serial
$ devtool deploy-target nano root@192.168.7.2
```

devtool – let's see nano run

- build an entire image

```
$ devtool build-image core-image-base
...
NOTE: Building image core-image-base with the following additional
packages: nano
...
```

- examine `buildhistory/...../installed-packages.txt`
  - now there is a ***nano*** package
- why not just use "`bitbake core-image-base`"?
  - ***nano*** package not automatically added
  - devtool makes assumptions

devtool – upgrade

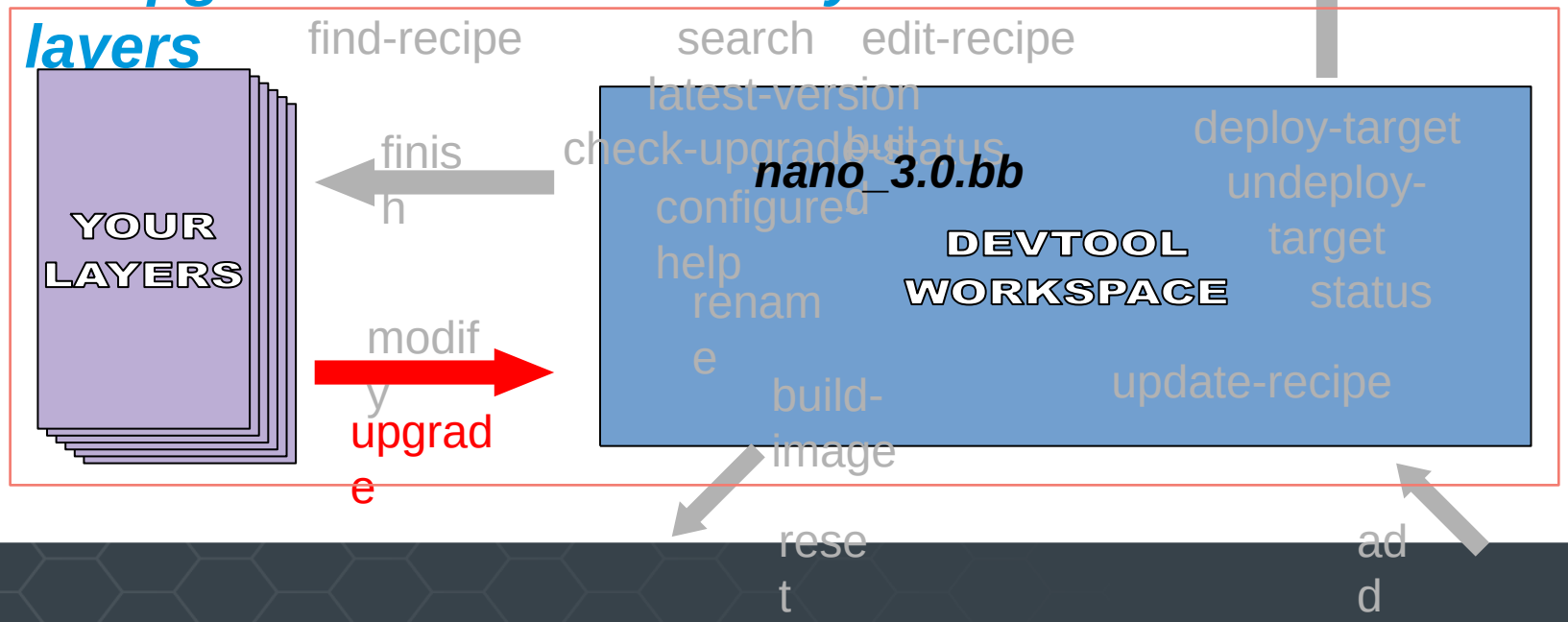
- try upgrading nano

```
$ devtool upgrade nano
ERROR: recipe nano is already in your workspace
```

- we need to move the ***nano*** recipe to ***Your Layers*** before we can ***upgrade***
  - preferably our own (meta-foo)

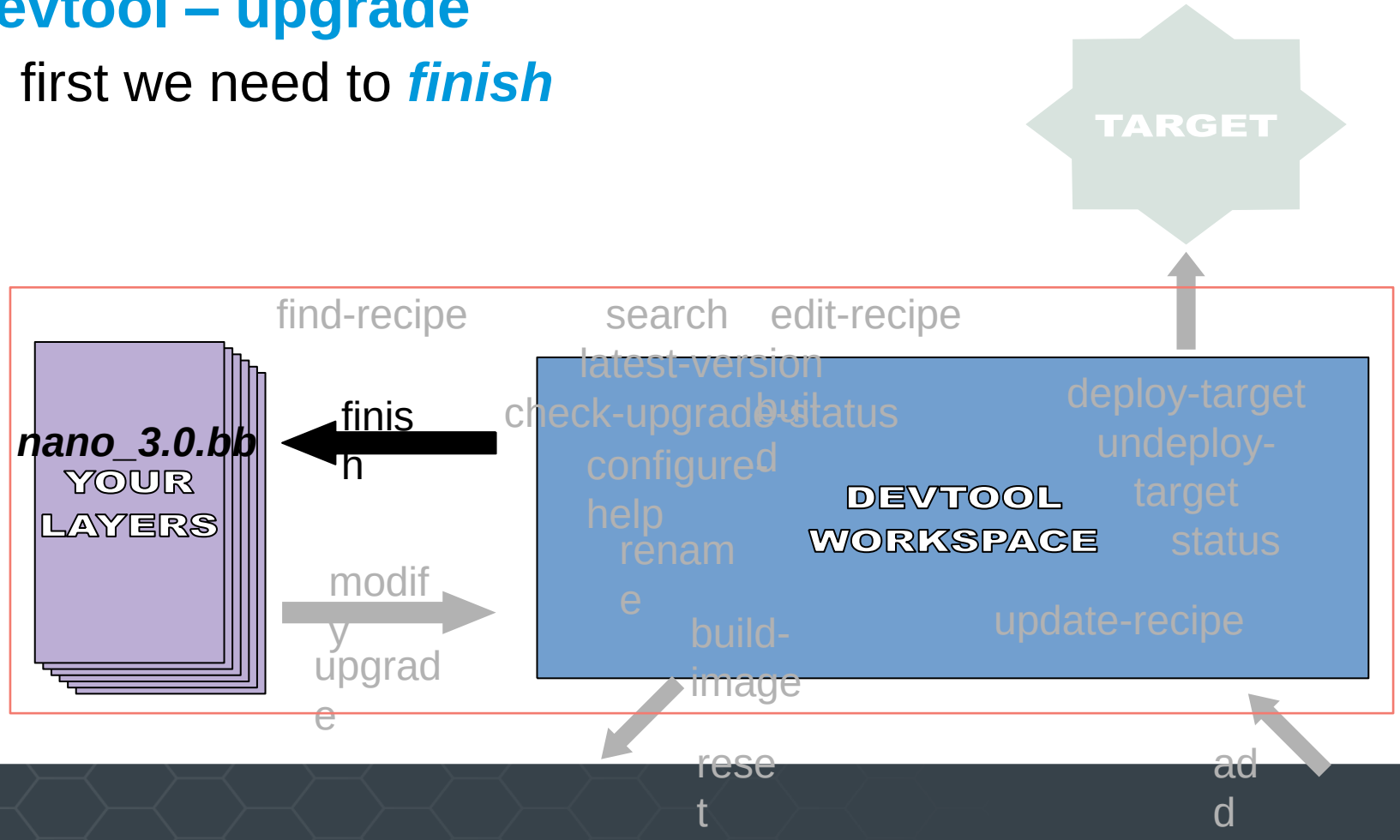
devtool – upgrade

- we can't ***upgrade*** a recipe that is already in the workspace
- an ***upgrade*** must come from ***your layers***



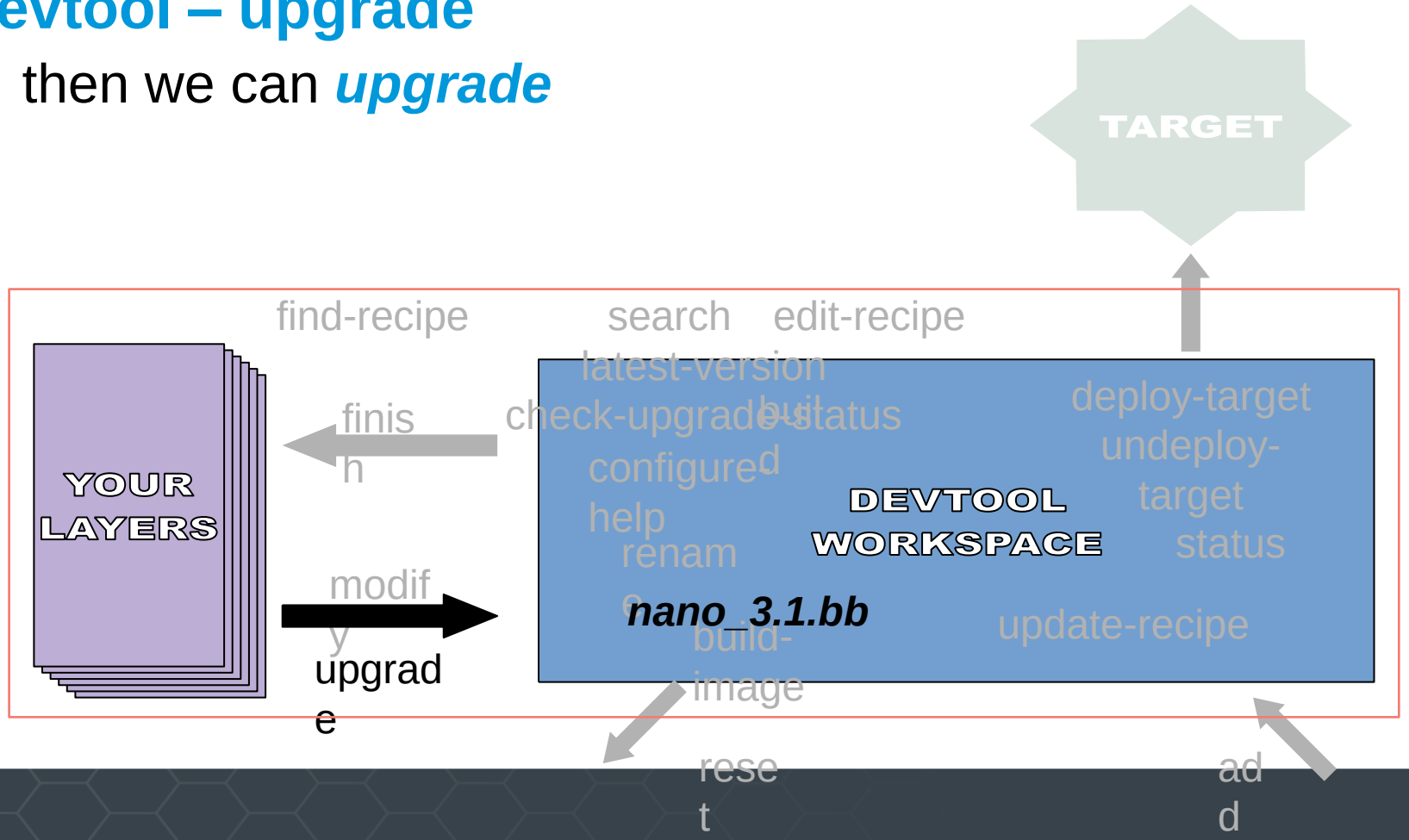
devtool – upgrade

- first we need to ***finish***



devtool – upgrade

- then we can ***upgrade***



devtool – upgrade

```
$ devtool finish nano ../meta-foo
ERROR: Source tree is not clean:
...
```

- this error is not a problem we introduced; it is a nano-specific issue

```
$ devtool finish -f nano ../meta-foo
INFO: Leaving source tree
/home/ilab01/devtool/build/workspace/sources/nano as-is; if you no
longer need it then please delete it manually
```

- it is worth noting that it will not remove the sources; we need to do it explicitly

```
$ rm -fr workspace/sources/nano
```

devtool – upgrade

```
$ devtool upgrade nano
...
ERROR: Automatic discovery of latest version/revision failed - you
must provide a version using the --version/-V option, or for
recipes that fetch from an SCM such as git, the --srcrev/-S option.
```

- in the specific case of ***nano***, devtool can't figure out how to find and upgrade tarballs (this information is not obvious from the URL)

devtool – upgrade

- we need to give devtool more help

```
$ devtool upgrade -V 4.3 nano
```

- it works!

```
$ devtool build nano
```

- it works!

devtool deploy-target - dive in

- is it okay to re-deploy a second time without cleaning up the first deploy?
  - yes... usually

```
root@qemuarm# cd /
root@qemuarm# ls -a
...
.devtool
...
root@qemuarm# cd .devtool
root@qemuarm# ls -l
-rw-r--r--    1 root     root          4969 Oct 20 06:03 nano.list
```

devtool deploy-target - dive in

- ***nano.list*** is created by devtool, per package, when it deploys to the target
- examine ***poky/scripts/lib/devtool/deploy.py*** for all the answers
  - it creates a script that is copied to target
  - preserves any files that would be clobbered
  - generates a list of files being deployed, so they can be undeployed
  - deploying starts by undeploying (same recipe name)

devtool deploy-target - dive in

- undeploy, and verify nano is removed from target, and the plumbing is also removed

```
$ devtool undeploy-target nano qemu
```

```
root@qemuarm# ls -a /
```

- remember to finish and cleanup

```
$ devtool finish -f nano ../meta-foo
$ rm -fr workspace/sources/nano
```

devtool - floating devtool commands

- some devtool commands don’t care whether the recipe is in the workspace or the layers

```
$ devtool status
NOTE: No recipes currently in your workspace

$ devtool edit-recipe bash
(works)

$ devtool latest-version bash
NOTE: Current version: 4.4.18
NOTE: Latest version: 5.0

$ devtool find-recipe bash

$ devtool search bash
```

devtool - multiple workspaces

- let's look at some devtool plumbing

```
$ cat conf/devtool.conf
[General]
workspace_path = /home/ilab01/devtool/build/workspace

[SDK]
target_basename = core-image-base

$ tail -3 conf/bblayers.conf
  /home/ilab01/devtool/meta-foo \
  /home/ilab01/devtool/build/workspace \
  "
```

devtool - multiple workspaces

- create a new workspace

```
$ devtool create-workspace ws2
$ head -2 conf/devtool.conf
[General]
workspace_path = /home/ilab01/devtool/build/ws2


$ tail -3 conf/bblayers.conf
  /home/ilab01/devtool/meta-foo \
  /home/ilab01/devtool/build/ws2 \
  "
```

- the first one disappears

devtool - creating a patch

- use-case? patches can be needed to
  - add/remove functionality
    - reduce size
    - remove dependency/dependencies
  - allow code to be (cross-)compiled

devtool - creating a patch

```
$ devtool add https://github.com/twoerner/autotool-devtool-
example/archive/v1.0.0.tar.gz
$ devtool build autotool-devtool-example
$ devtool deploy-target autotool-devtool-example qemu
```

```
root@qemuarm# autotool-devtool-example
Hello, world!
version: 1.0.0
Hello from the library
```

devtool - creating a patch

- edit the code

```
$ pushd workspace/sources/autotool-devtool-example
$ $EDITOR src/autotool-devtool-example.c
```

- change from

```
        printf("Hello, world!\n");
```

- to

```
        printf("Hello, devtool!\n");
```

devtool - creating a patch

- build, deploy, verify

```
$ popd
$ devtool build autotool-devtool-example
$ devtool deploy-target autotool-devtool-example qemu
```

```
root@qemuarm# autotool-devtool-example
Hello, devtool!
version: 1.0.0
Hello from the library
```

devtool - creating a patch

- cleanup

```
$ devtool finish autotool-devtool-example ../meta-foo
ERROR: Source tree is not clean:
 M src/ypdd-elce2018-example.c
```

- oops! but it's nice it didn't clobber or lose my work

```
$ pushd workspace/sources/autotool-devtool-example
$ git commit -avs
...
$ popd
$ devtool finish autotool-devtool-example ../meta-foo
...
INFO: Adding new patch 0001-update-salutation.patch
...
$ rm -fr workspace/sources/autotool-devtool-example
```

devtool - creating conflict

- now we'll update to a newer release, but the newer release will conflict with our patch

```
$ devtool upgrade autotool-devtool-example
...
Connecting to github.com (github.com)|192.30.253.113|:443...
connected.
HTTP request sent, awaiting response... 404 Not Found
2018-10-20 12:16:11 ERROR 404: Not Found.

ERROR: Automatic discovery of latest version/revision failed - you
must provide a version using the --version/-V option, or for
recipes that fetch from an SCM such as git, the --srcrev/-S option.
```

- devtool can't figure it out, we need to help it

devtool - creating conflict

```
$ devtool upgrade -V 1.0.1 autotool-devtool-example
...
WARNING: Command 'git rebase cdb5e8e1d76e5022ae754ea95dc5e4cf85af7670' failed:
First, rewinding head to replay your work on top of it...
Applying: update salutation
Using index info to reconstruct a base tree...
M       src/autotool-devtool-example.c
Falling back to patching base and 3-way merge...
Auto-merging src/autotool-devtool-example.c
CONFLICT (content): Merge conflict in src/autotool-devtool-example.c
error: Failed to merge in the changes.
Patch failed at 0001 update salutation
The copy of the patch that failed is found in: .git/rebase-apply/patch

When you have resolved this problem, run "git rebase --continue".
If you prefer to skip this patch, run "git rebase --skip" instead.
To check out the original branch and stop rebasing, run "git rebase --abort".

You will need to resolve conflicts in order to complete the upgrade.
```

devtool - resolving conflict

- keep the new, or keep the old?
  - keep the new

```
$ pushd workspace/sources/autotool-devtool-example
$ $EDITOR src/autotool-devtool-example.c
```

devtool - resolving conflict

- from

```
...
 13 <<<<<<< HEAD
 14          /* a meaningful comment */
 15          printf("Hello, world!\n");
 16 ||||||| merged common ancestors
 17          printf("Hello, world!\n");
 18 =======
 19          printf("Hello, devtool!\n");
 20 >>>>>>> update salutation
...
```

- to

```
...
 13          /* a meaningful comment */
 14          printf("Hello, devtool!\n");
...
```

devtool - resolving conflict

```
$ git add src/autotool-devtool-example.c
$ git rebase --continue
Applying: update salutation
$ popd
$ devtool update-recipe autotool-devtool-example
```

- inspect recipe updates

devtool - resolving conflict

```
$ devtool finish ypdd-elce2018-example ../meta-foo
$ tree ../meta-foo
../meta-foo/
...
├── recipes-nano
│   └── nano
│       └── nano_3.1.bb
└── recipes-ypdd-elce2018-example
    └── ypdd-elce2018-example
        ├── ypdd-elce2018-example
        │   └── 0001-update-salutation.patch
        └── ypdd-elce2018-example_1.0.1.bb
```

- considering there's *devtool finish*, how useful is *devtool update-recipe*?

devtool - modify

1) take existing recipe from layers

2) unpack sources into workspace

3) edit recipe or sources

4) ...

devtool - eSDK Mode

- the *e*SDK includes many improvements over the SDK
- combine everything of a regular SDK with all the functionality we've been looking at that is provided by devtool

Questions?

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