Debian & Yocto: State of the Art

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Agenda

1. Introduction
2. Existing Projects
3. Vision
4. Current Development
5. Summary

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Motivation

- Introduce existing approaches
- Share the vision
- Collect feedback

Building Products with Linux

- **Product**
  - Linux base system
  - Customizations
  - Product-specific application
  - Third-party software
- **Development**
  - Create a single ready-to-flash image (U-Boot, kernel, rootfs)
  - Developer-oriented, repeatable process
- **QA**
  - Bug fixes and security updates for development and production releases
  - Long maintenance terms (at least 10 years after EOL)
- **License compliance**

What to Do

- **Select appropriate base system**
  - Linux distribution
- **Provide tools to manage the base system**
  - Build system
  - Framework for customization and product maintenance

Debian GNU/Linux

- **Binary distribution**

- **Features**
  - Multiple CPU architectures support
  - Official cross-toolchains
  - Security updates
  - Long-term support
  - Machine-readable licensing information (DEP-5)

- **Wish list**
  - Integration tool
  - Easier customization
  - Easier introduction of new architectures

Yocto Project

- **Source-based reference distribution**

- **Features**
  - Bitbake integration tool
  - Easily customizable
  - Layered collaboration model
  - Standalone SDK generation
  - Easier introduction of new architectures / SoCs

- **Wish list**
  - Reduce build times
  - Long-term support

yocto PROJECT

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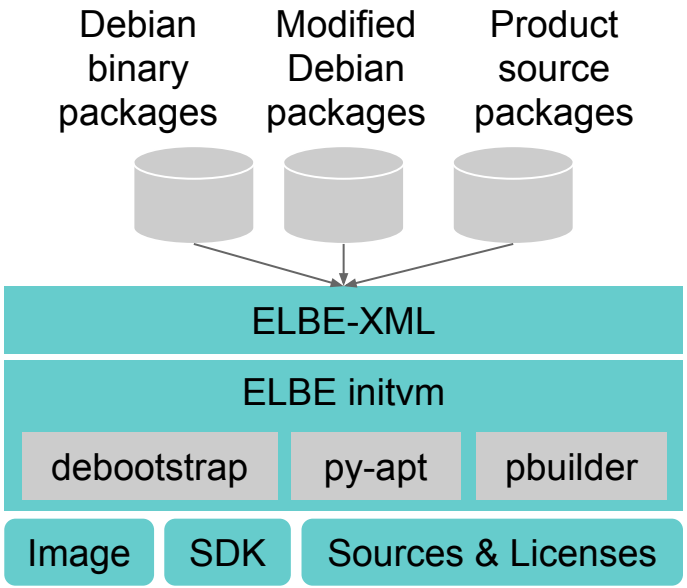
Existing Projects

- **nneta-elbe**
  - https://github.com/linutronix/nneta-elbe
- **Isar**
  - https://github.com/ilbers/isar
- **meta-debian (Deby)**
  - https://github.com/meta-debian/meta-debian

- **Other projects**
  - debos
  - vmdebootstrap / vmdb2
  - etc.

Existing Projects: elbe

- **nneta-elbe is based on elbe** https://elbe-rfs.org
  - RFS description in XML with variant management
  - Reproducible image built
    including bootloader installation, partitions, UBI, ...
  - Using Debian binary packages is the default
  - Customized packages and own software supported
  - Yocto-compatible cross-toolchain generation as SDK
  - License text collection / semi-automatic SPDX conversion



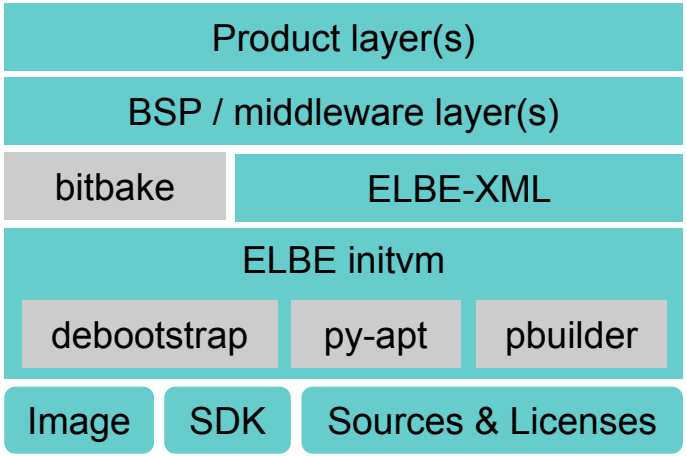
Existing Projects: nneta-elbe

- **nneta-elbe**

  https://github.com/Linutronix/nneta-elbe

  - Bitbake user frontend for elbe
  - Recipes for images
  - Recipes for source-packages
  - Bitbake just calls elbe commands

    and keeps track of the project status

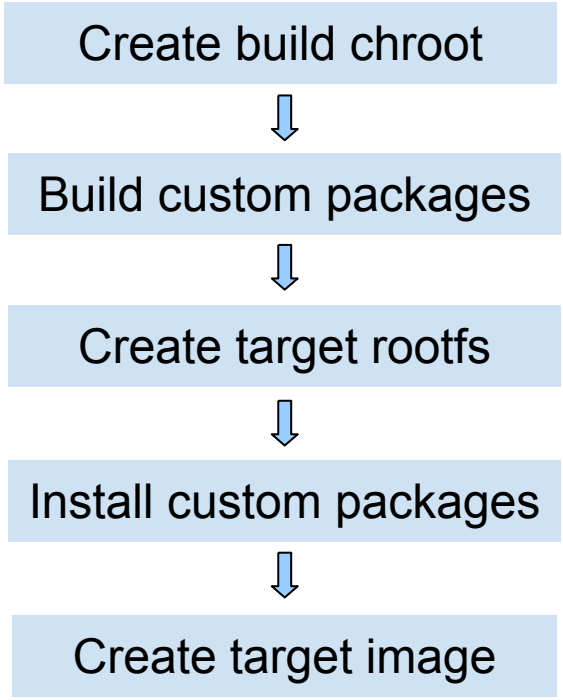


- **Our reasons for meta-eid**
  - Bootstrapping new architectures
  - Speedup source package build with cross-compile

Existing Projects: Isar

- https://github.com/ilbers/isar

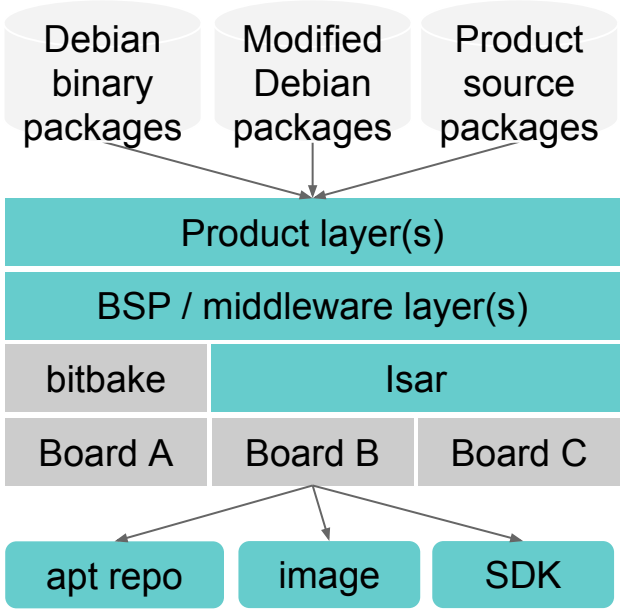
- **Package builder and image generator**
  - Installs the base system
  - Builds and installs product packages and customizations
  - Creates ready-to-use images
- **Uses**
  - Base system: Debian binary packages
  - Debian tools: dpkg-buildpackage, reprepro, apt, debootstrap...
  - BitBake: Efficient package build dispatcher
  - Layering for collaboration
- **Live demo at the Technical Showcase**



isar

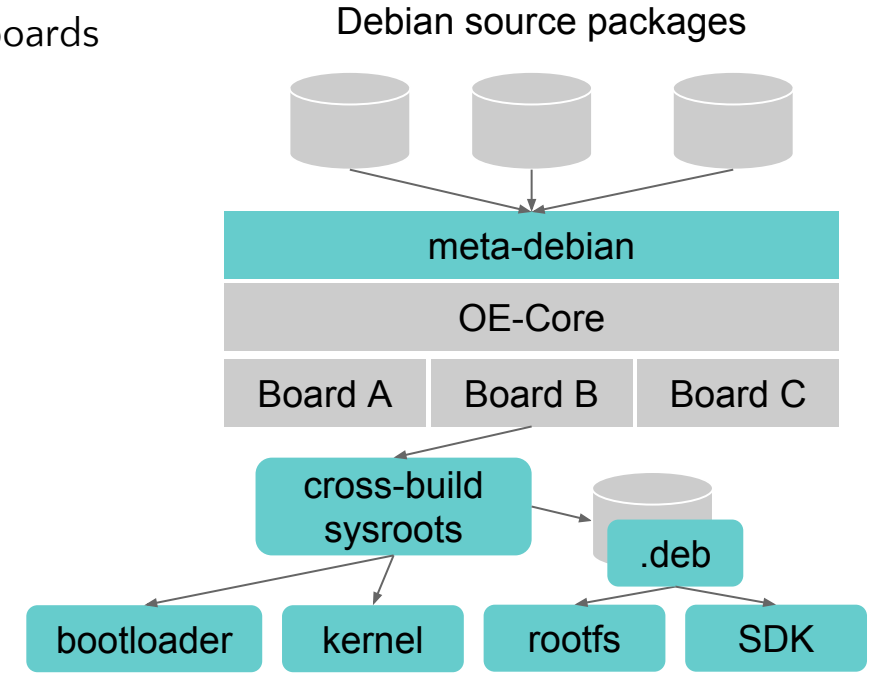
Existing Projects: Isar

- **Some features**
  - Native and cross-compilation
  - Upstream package patching
  - Debian SDK generation
  - Output to apt as well as images
  - Different CPUs and Debian versions in one product
  - Variant management through dependencies
- **Our reasons for meta-eid**
  - Keep the right mix
  - Don't reinvent the wheel
  - Improve the implementation



Existing Projects: meta-debian

- https://github.com/meta-debian/meta-debian
  - Metadata set for Yocto Project to build Debian sources
  - Ready-to-use image generation for embedded boards
    - Bootloader, kernel, root filesystem, SDK
- **Source-based distribution**
  - Cross-build everything from scratch
  - No need to keep binaries
  - High customizability
  - Various target CPUs and tuning available
- **Our reasons for meta-eid**
  - Build time improvement by reusing binaries
  - Less complexity and maintenance cost



Comparison

- **Providing similar features**
- **Partially based on the common tools**

	ELBE	Isar	meta-debian
Base system	Debian binary package	Debian binary package	Packages cross-built from Debian source
Integration tool	ELBE commands + bitbake wrapper	bitbake	bitbake
Package building	Debian toolchain	Debian toolchain	OE-Core
Image generation	debootstrap	debootstrap	OE-Core
Customization	Single XML file	bitbake recipes, (patched) Debian packages	bitbake recipes

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meta-eid

- **meta-eid is about collaboration**
  - meta-eid ‘founders’
    - nneta-**e**lbe
    - **I**sar
    - meta-**d**ebian

- **Pronounced as “aid”**

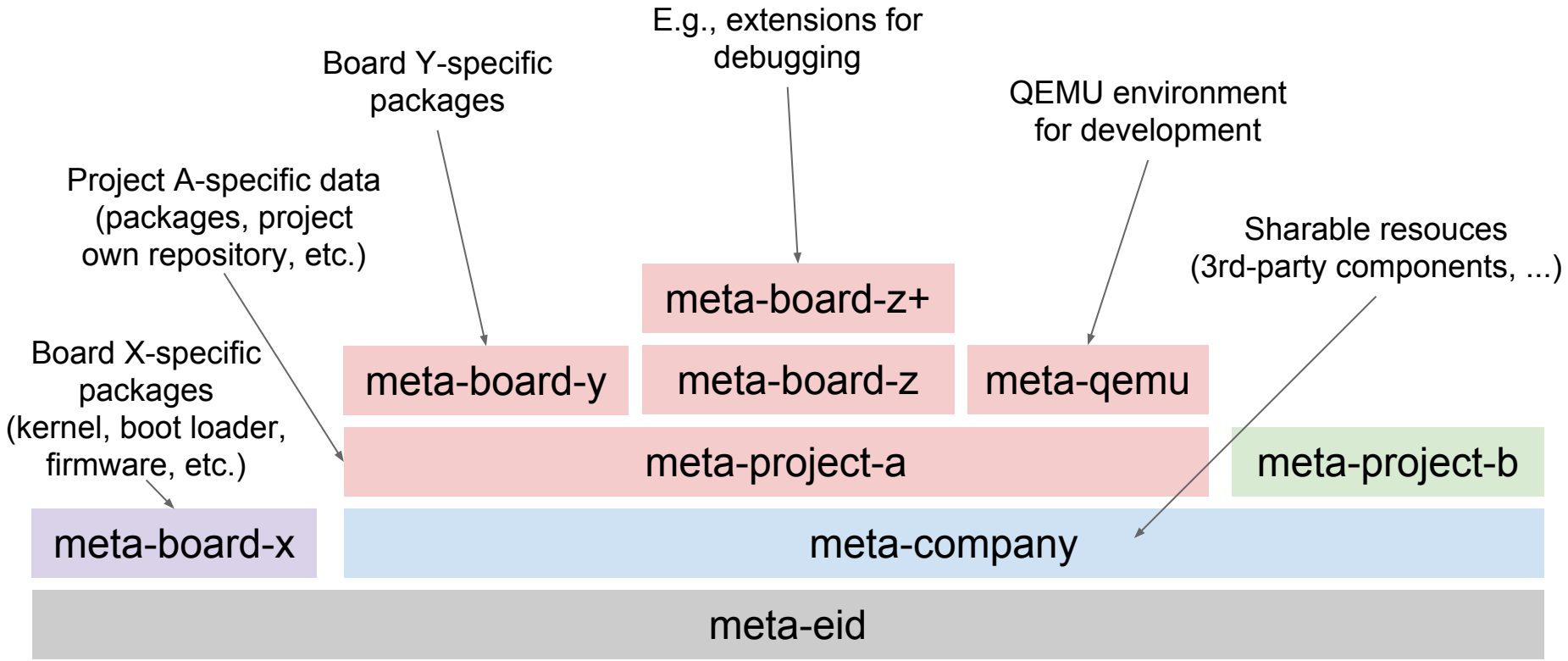
Vision I

- **Easy to use**
  - One-command building with bitbake
  - Classes and configuration options for common use cases
- **Easy to customize**
  - Changing build options, dependencies, packaging
- **Tooling**
  - Prefer existing tools
  - Not as a fork but wrapping, connecting, enhancing tools
    - Contribute to upstream projects
  - Clean, minimal architecture

Vision II

- **Build targets**
  - Build debianized and non-debianized sources
  - Generate ready-to-use images
  - Generate standalone SDK
- **Performance**
  - Reuse binary packages
  - Cross-building
  - Avoid unnecessary steps, parallelization blockers
- **Product-oriented**
  - Reproducibility
  - Metadata layering

Layering


E.g., extensions for debugging
Board Y-specific packages
QEMU environment for development
Project A-specific data (packages, project own repository, etc.)
Sharable resouces (3rd-party components, ...)
meta-board-z+
Board X-specific packages (kernel, boot loader, firmware, etc.)
meta-board-y
meta-board-z
meta-qemu
meta-project-a
meta-project-b
meta-board-x
meta-company
meta-eid

Nice to Have

- **Bootstrapping Debian**
  - Tuning for specific CPUs
  - Product-wide ‘EXTRA_CFLAGS’
  - Footprint

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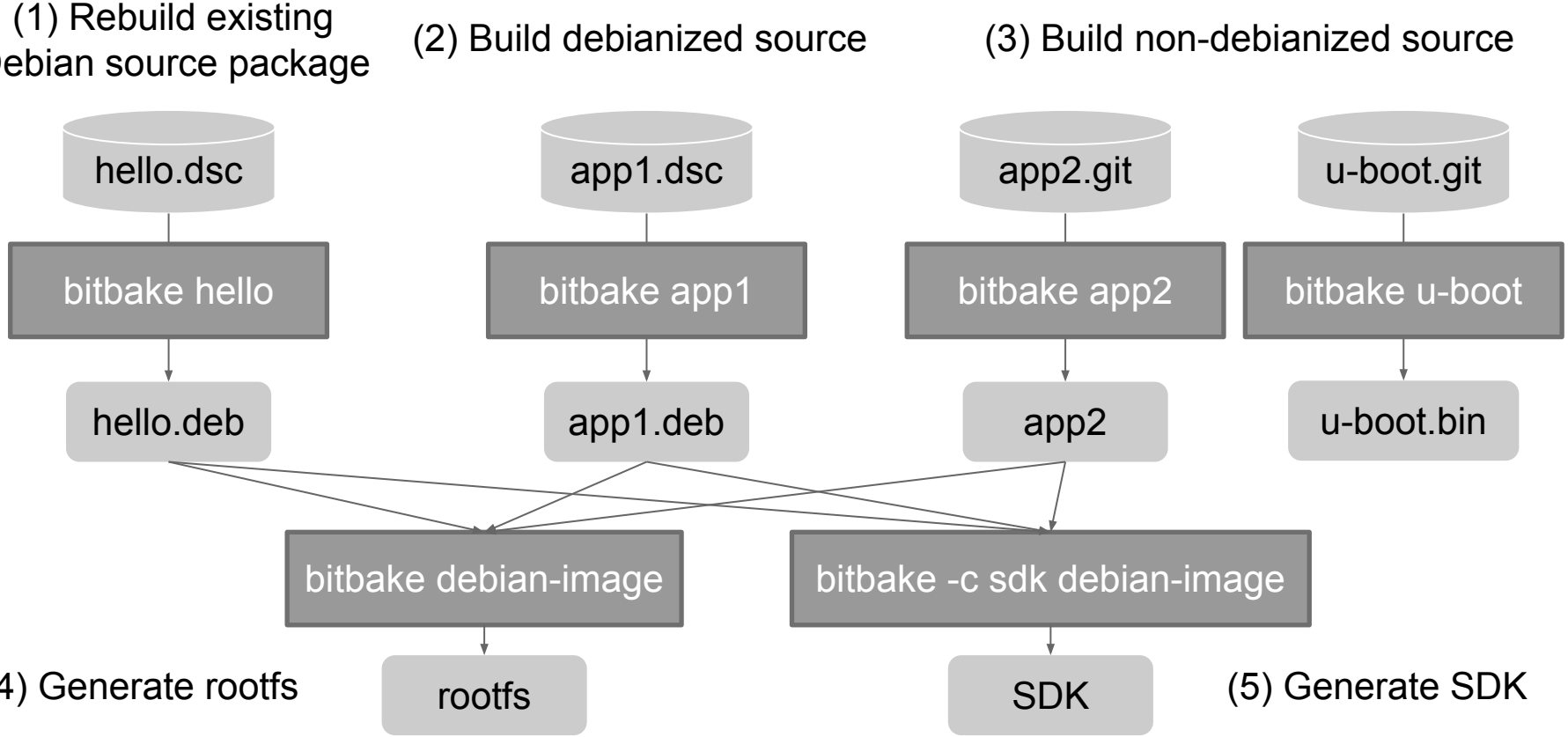
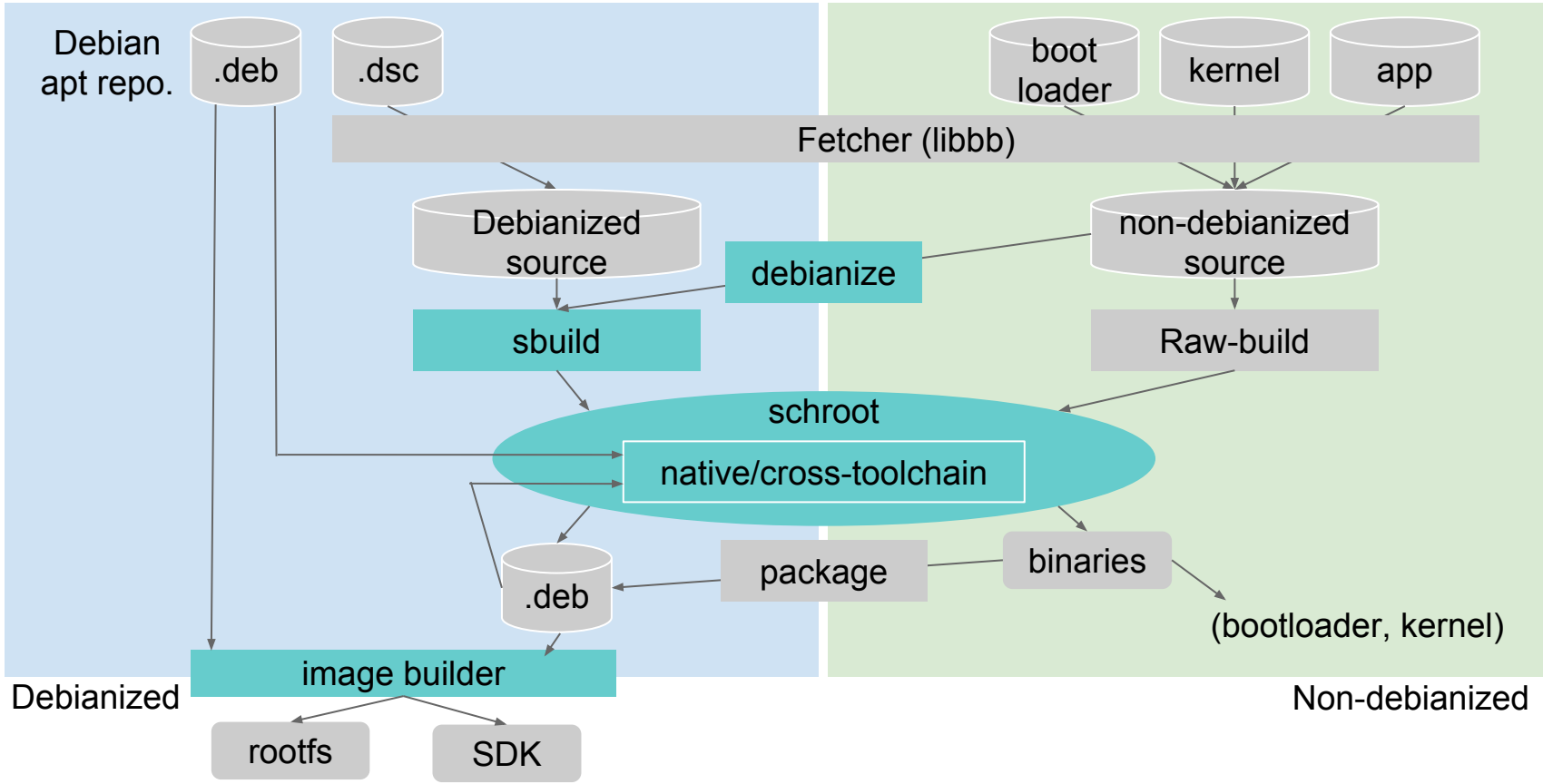
Use Cases


(1) Rebuild existing Debian source package
(2) Build debianized source
(3) Build non-debianized source
hello.dsc
app1.dsc
app2.git
u-boot.git
bitbake hello
bitbake app1
bitbake app2
bitbake u-boot
hello.deb
app1.deb
app2
u-boot.bin
bitbake debian-image
bitbake -c sdk debian-image
(4) Generate rootfs
rootfs
SDK
(5) Generate SDK

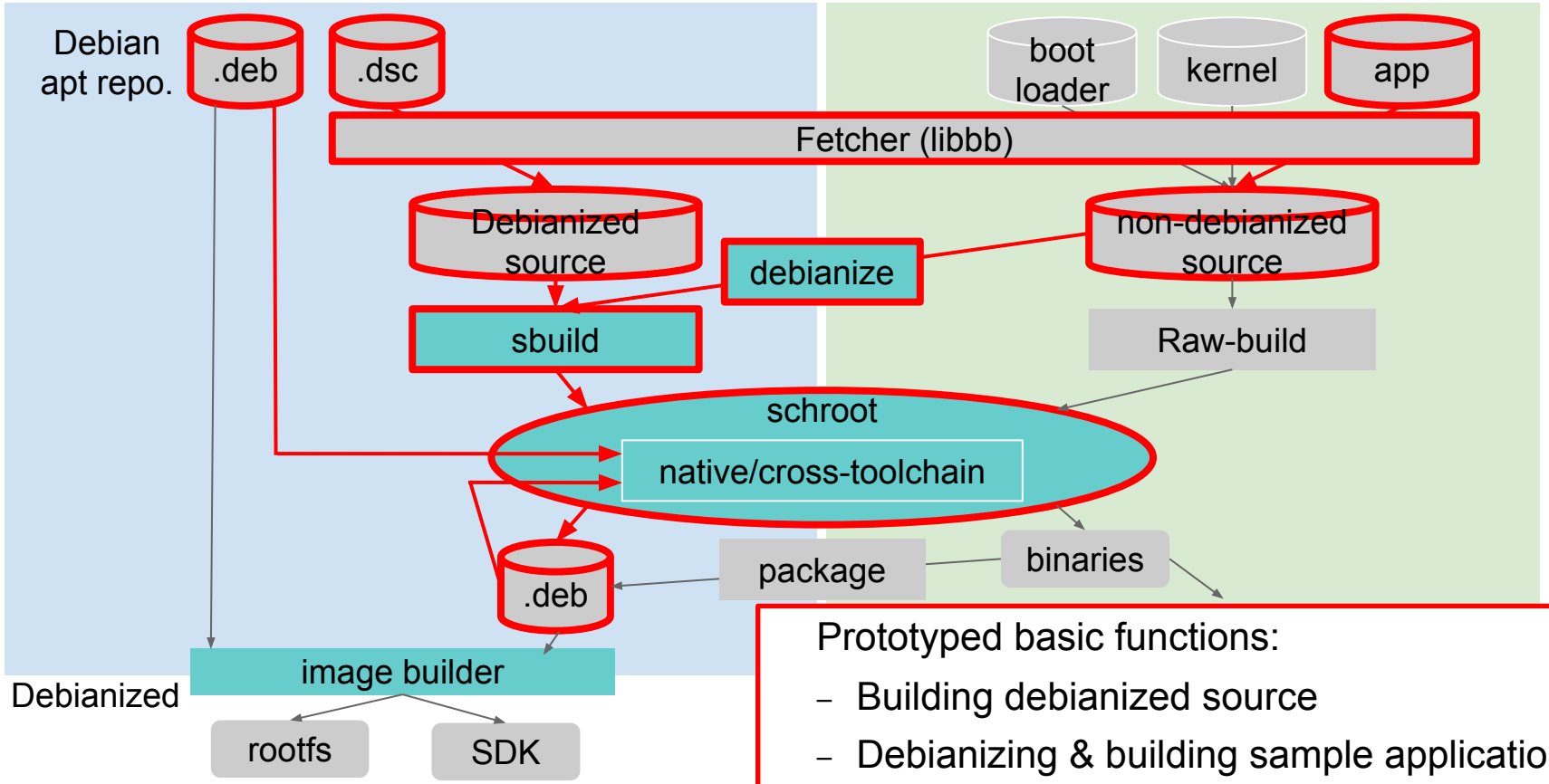
Required Functions

- **Source fetcher**
  - bitbake + extensions for Debian source packages (dsc, git, ...)
- **Dependency resolution**
  - Use apt for build- and run-time dependency resolution
  - Use bitbake dependency mechanism for building 'local' recipes
  - Use both at the same time without duplication
- **Package builder**
  - sbuild
- **Cross-toolchain for non-Debian sources**
  - Debian chroot
- **Image generator**
  - Debootstrap and other tools

Workflow


Debian
apt repo.
.deb
.dsc
boot
loader
kernel
app
Fetcher (libbb)
Debianized
source
debianize
non-debianized
source
sbuild
Raw-build
schroot
native/cross-toolchain
.deb
package
binaries
(bootloader, kernel)
image builder
Debianized
Non-debianized
rootfs
SDK

Current Development Status



Prototyped basic functions:

- Building debianized source
- Debianizing & building sample application

Examples: Rebuild Debian source package

- **hello_2.9-2+deb8u1.bb**

```
inherit debian-dsc
inherit sbuild
DSC_URI = "${DEBIAN_REPO}/pool/main/h/${PN}/${PN}_${PV}.dsc;md5sum=abc..."
```

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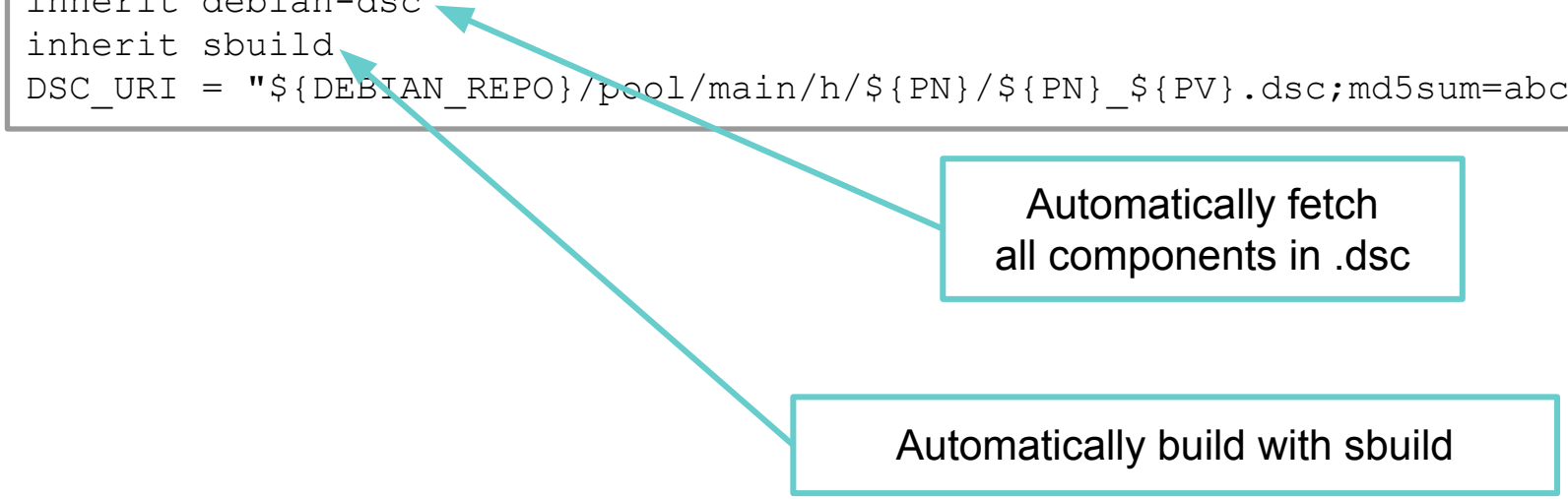

Examples: Build non-Debianized pacakge

- foo_git.bb

```
inherit debianize
inherit sbuild

PV = "1.0"
SRC_URI = "git:/github.com/zuka0828/${PN}.git;protocol=https"
SRC_REV = "abc..."

S = “${WORKDIR}/git”

DEPENDS += "baz"
DEB_DEPENDS = "libssh-dev"
DEB_RDEPENDS = "bc"
```

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```

Automatically Debianize source with dh_make

Dependency on another recipe in meta-eid

Dependencies on Debian packages

Both go into Build-Depends

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Next steps

- **rootfs and SDK generation**
  - Current approach: debootstrap
  - Evaluate existing Debian and Yocto image generation tools
- **apt repository management**
  - Reuse binary packages generated in previous builds
- **'Raw' building of non-debianized source**
  - Writing commands in recipes without debianizing sometimes preferred
- **Easy customization**
  - do_patch() or hook function to unpacked sources
- **Cross-sbuilding**
  - Debian multiarch and cross-toolchain
- **Reproducibility**
  - Metadata and package management

Conclusion

- Customizing Debian-based root filesystems with bitbake is possible
- We want to rely on Debian's cross-building features
- Building Debian packages (dsc) should be possible without having a recipe
- A PoC for build dependency resolution is available
- We need to support options for doing the same thing in different ways
  - E.g., cross-build, native build, non-debianized build
- Many projects with similar goals exist - welcome to join

How to Join

- **GitHub**
  - used to host code and track issues / travis for testing
  - https://github.com/eid-project/meta-eid

- **Mailing List**
  - Used for patch review and technical discussions
  - meta-eid@googlegroups.com
  - Subscribe: meta-eid+subscribe@googlegroups.com
  - Archive: https://groups.google.com/d/forum/meta-eid

- **Instant messaging in discussion**

Questions?