Building Debian-Based Products: Experiences in Collaboration

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Motivation

- **Deby and Isar :**
  - Both use Debian
  - Have common goals
- **Seek working with community**
- **Benefits**
  - Avoid effort duplication
  - Achieve more

Contents

- What is Deby
- What is Isar
- Comparison
- What we do
- Summary

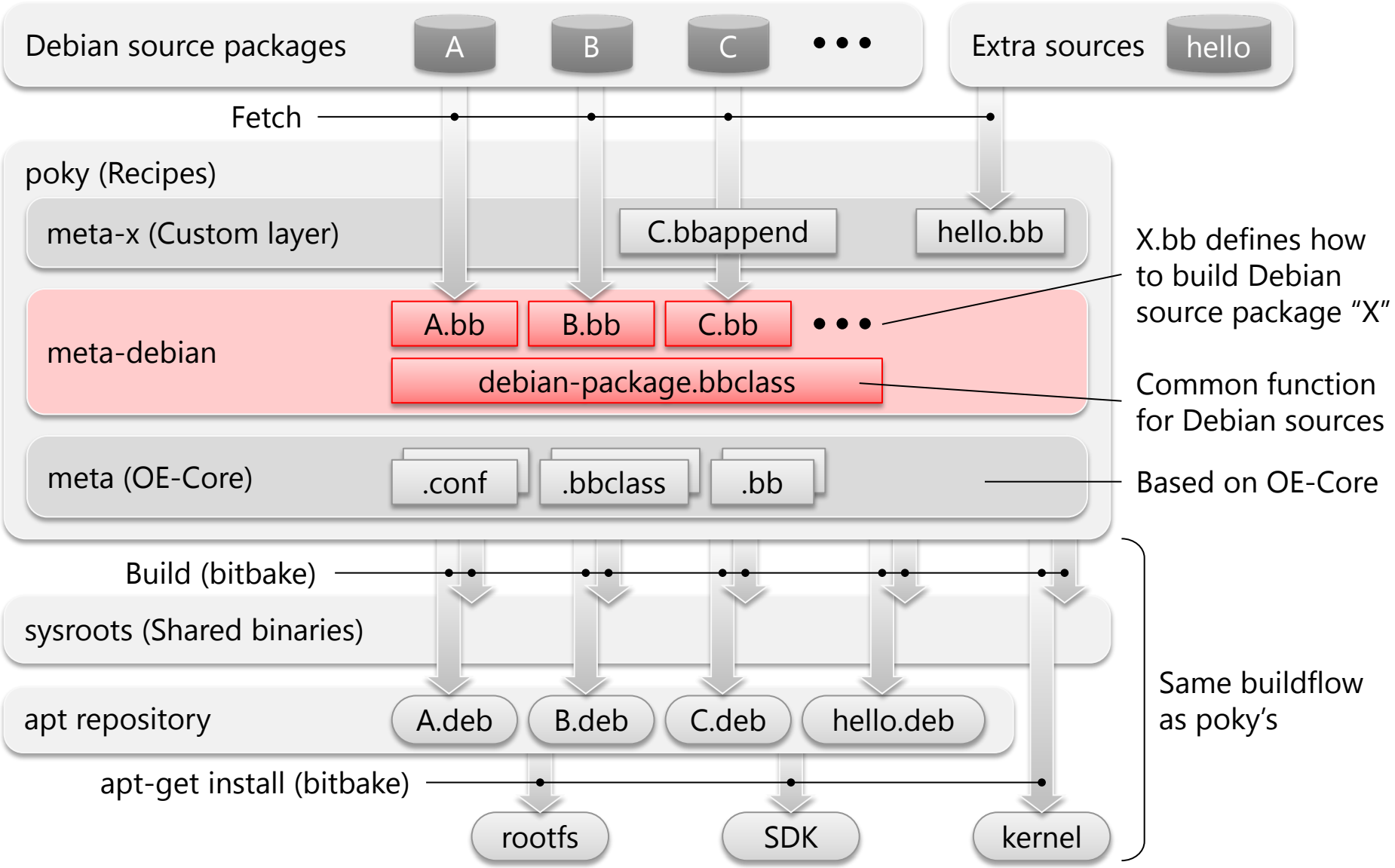
What is Deby?

- **A reference Linux distribution for embedded system**
- **“Shared Embedded Linux Distribution” project**
  - One of the activities of CELP (Core Embedded Linux Project)
    - https://www.linuxfoundation.jp/projects/core-embedded-linux
  - Goals
    - Create an industry-supported embedded Linux distribution
    - Provide supports for long term
- **Based on the two projects**
  - Debian GNU/Linux
    - Cross-built from Debian source packages
  - Yocto Project
    - Cross-built with **Poky** build system and metadata for Debian source packages (**meta-debian**)
- **Origin of the name**
  - **Deb**ian + Pok**y**
  - **Deb**ian**-like**

Deby: Purposes

- **Providing features required in embedded systems, including civil infrastructure**
  - Stability
    - Well-tested software set
  - Long-term support
    - 10+ years, especially for security fixes
  - Customizability
    - Changing configure options, compiler optimizations, etc.
  - Wider hardware support
- **Contribution and collaboration with other communities**
  - Debian, Debian-LTS
  - Yocto Project
  - Similar Debian-based projects like **Isar**

Deby: How it works



Deby: How to use

- **Repository**
  - https://github.com/meta-debian/meta-debian
- **Quick start**
  - https://github.com/meta-debian/meta-debian/blob/morty/README.md
- **Example: Build the minimal images and run on QEMU**

```
$ git clone -b morty git://git.yoctoproject.org/poky.git
$ cd poky
$ git clone –b morty https://github.com/meta-debian/meta-debian.git
$ cd ..
$ export TEMPLATECONF=meta-debian/conf
$ source ./poky/oe-init-build-env
$ bitbake core-image-minimal
$ runqemu qemux86 nographic
```

Deby: Current development status

Debian version	8 jessie (the latest stable)
Yocto Project version	2.2 morty (stable) 2.3 pyro (development)
Kernel	4.4 LTS / 4.4 CIP
BSP	QEMU: x86 (32bit, 64bit), ARM, PowerPC, MIPS BeagleBoard, PandaBoard, MinnowBoard BeagleBone Black, Raspberry Pi 1/2, Intel Edison
init manager	busybox, systemd
Package manager	dpkg / apt
Supported packages	Approx. 600

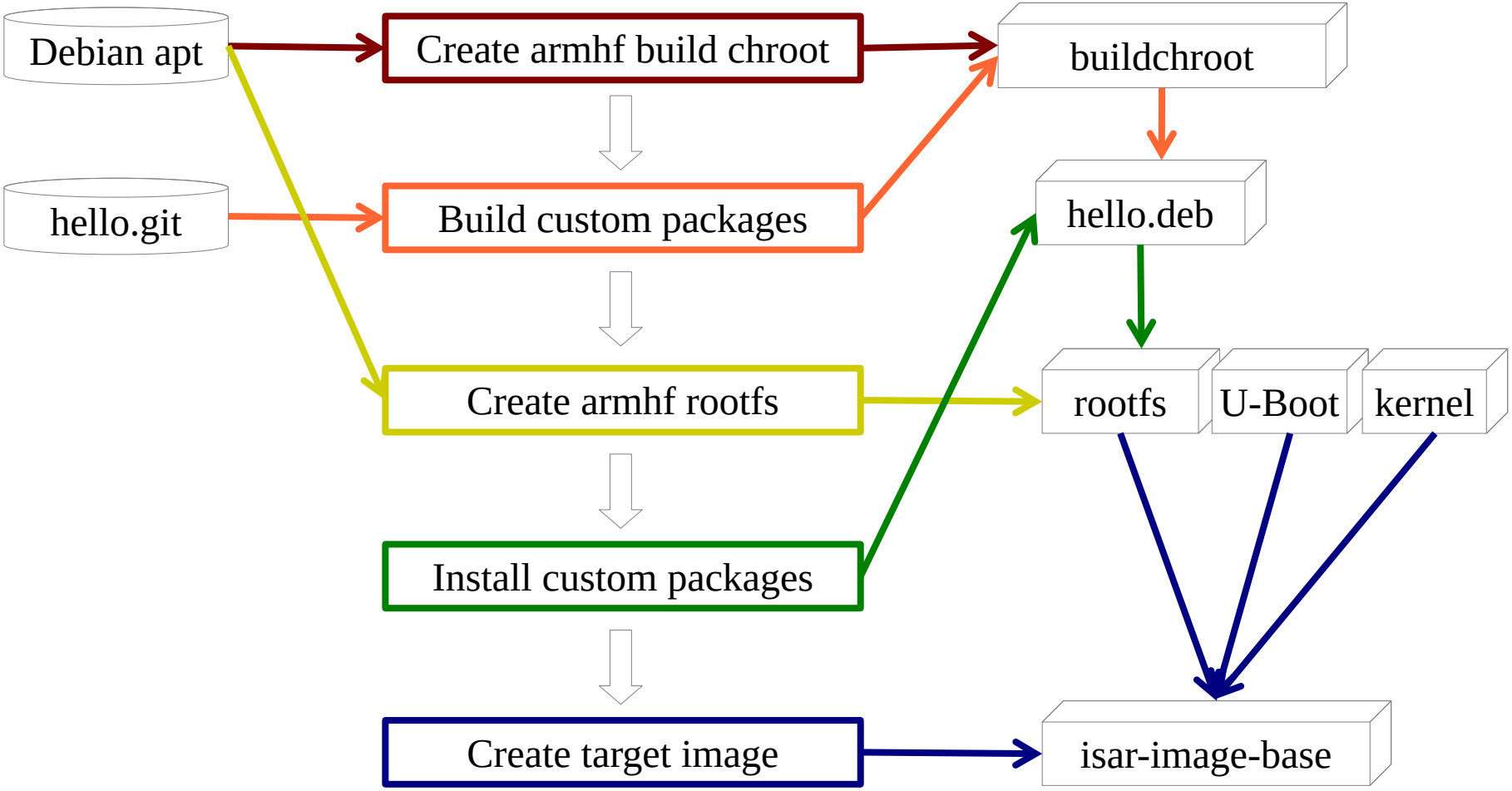
What is Isar?

- **Image generation for embedded systems**
  - Installs Debian binary packages as a base system
  - Builds and installs product's software packages
  - Creates ready-to-use firmware images
  - Just a build system, **not a distribution**
- **Origin**
  - Predecessor system at Siemens
  - Developed by ilbers GmbH
  - Sponsored by Siemens
- **Uses:**
  - BitBake: Recipes for building and installing packages
  - Yocto: Structure, layering, workflow (**doesn't rely on poky** code base)
  - Debian: Binary packages (**not included in Isar**)
- **Name**
  - **I**ntegration **S**ystem for **A**utomated **R**oot filesystem generation
  - A river in Munich

Isar: Goals

- **Product build system**
  - **One-command, on-demand** building
  - Reproducibly create ready-to-use firmware images
  - Integrate product applications and customizations
  - Multiple upstreams, **multiple products**, strong reuse
  - Easy for beginners, **familiar and powerful** for advanced
- **Customer requirements**
  - Low effort: Native builds, **no massive changes** to upstream packages
  - Scale from small to big
  - Security updates
  - Maintenance: 10+ years
  - Legal clearing

Isar: How it works



Isar: How to use

- **Repository**
  - https://github.com/ilbers/isar
- **Quick start**
  - https://github.com/ilbers/isar/blob/master/doc/user_manual.md
- **Example: Build a minimal image and run under QEMU**

```
$ su -c "apt-get install dosfstools git mtools multistrap parted
python3 qemu qemu-user-static sudo"
$ su -c "echo –e $USER\\\\tALL=NOPASSWD:\ ALL >>/etc/sudoers"
$ git clone https://github.com/ilbers/isar
$ cd isar
$ . isar-init-build-env ../build
$ bitbake isar-image-base
$ start_armhf_vm  # User: root, password: root
```

Isar: Current development status

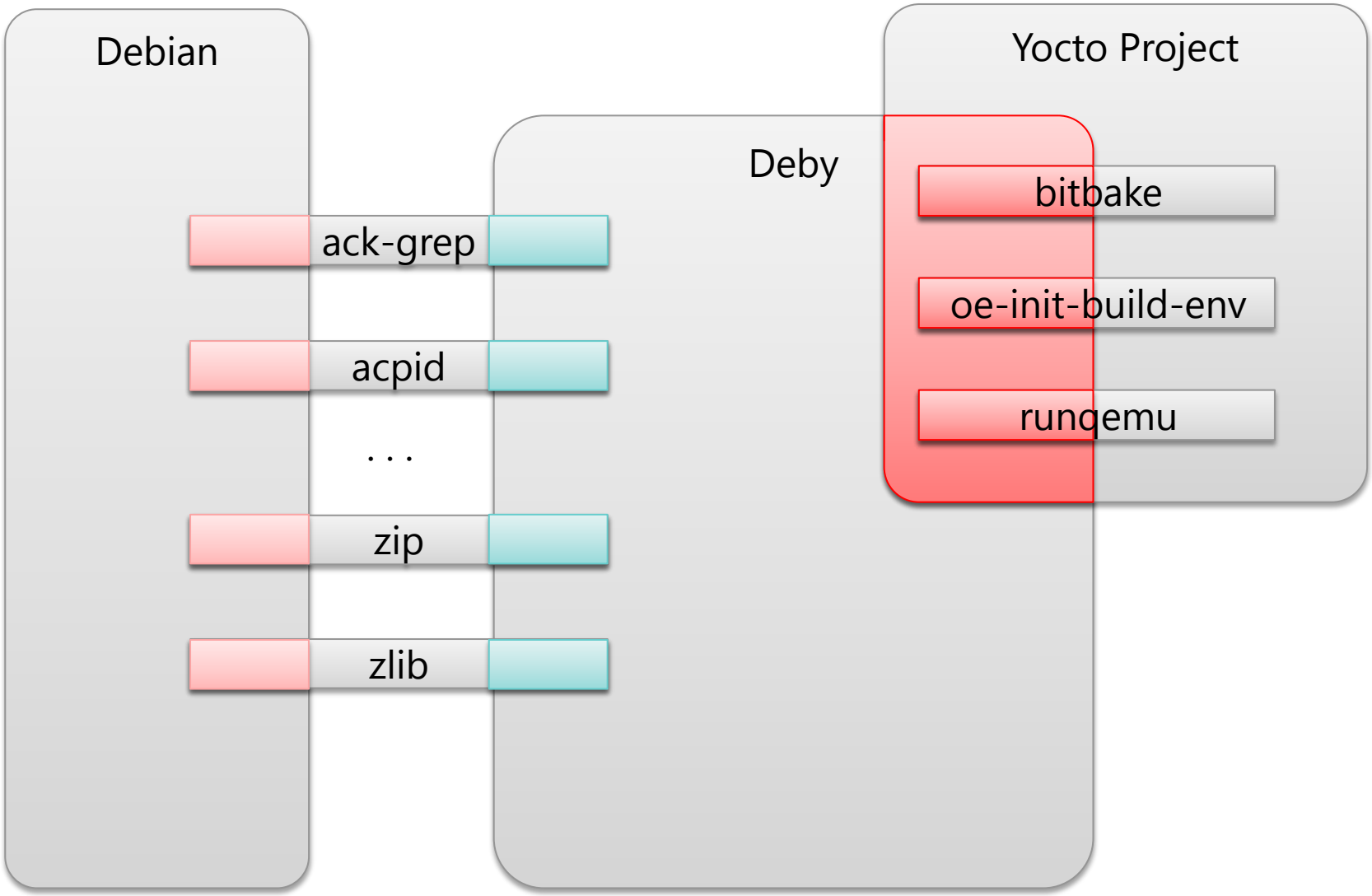
Debian versions	8 “Jessie”, **9 “Stretch”**
Architectures	**i386**, **amd64**, armhf
Boards	QEMU: **pc** (i386, amd64), virt (armhf) Raspberry Pi, **Siemens Nanobox**
Boot	**U-Boot, grub**, rpi boot loader, **UEFI**
Output	Disk image, filesystem image, …

Base system	Debian-based distro (not a part of Isar), e.g.:
	• Debian:
	  • Init: sysvinit, busybox, systemd
	  • Package manager: dpkg, apt
	  • Source packages: 25432 (Stretch)
	• Raspbian: …
	• …

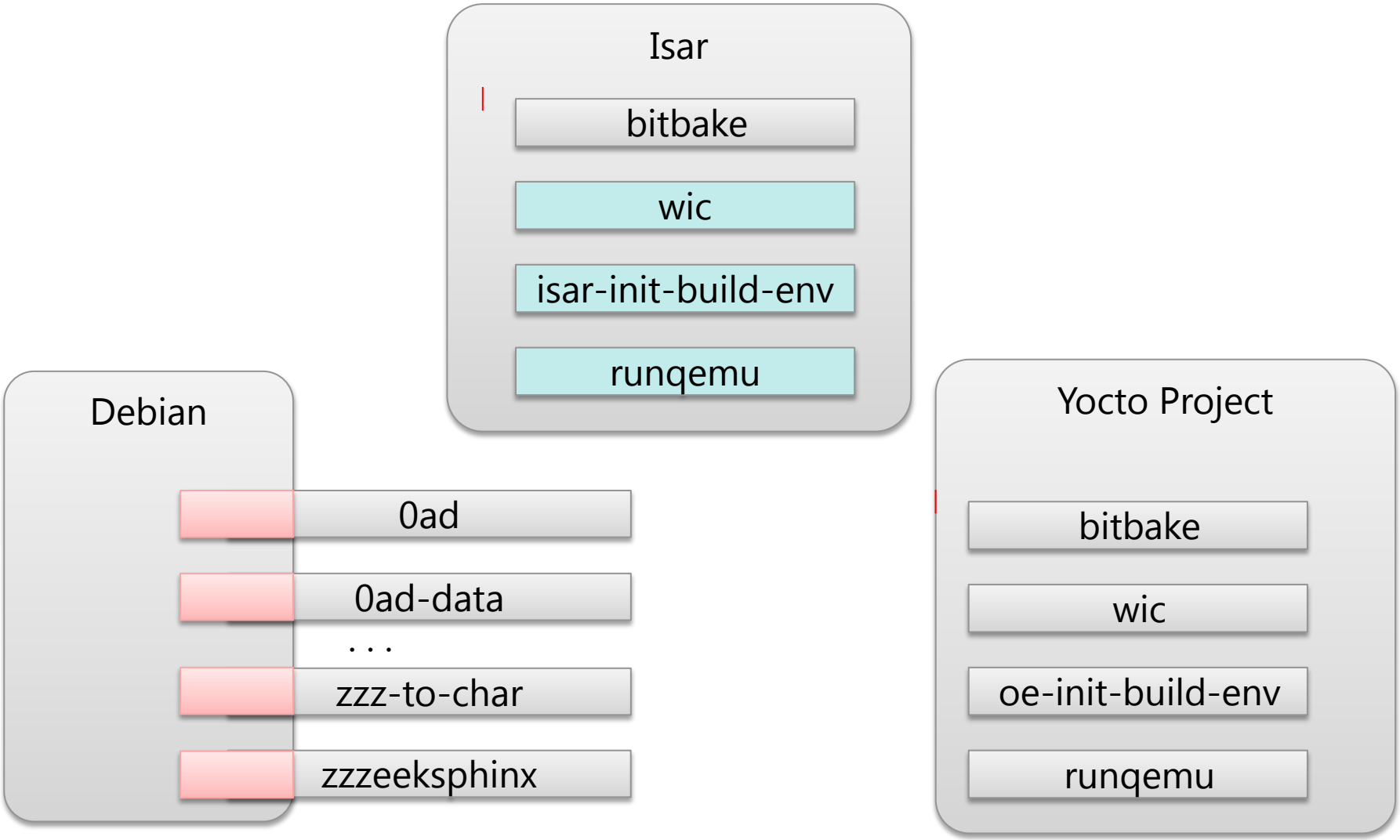
Comparison of Isar and Deby

	Isar	Deby
Base system	Debian **binary** packages (**no rebuilding)**	Binary packages **cross-built** from Debian **source** packages
Build system	**bitbake**	**poky** (bitbake + OE-Core)
Host tools	**Debian**: multistrap, dpkg-buildpackage, qemu	**poky**
Metadata (bitbake recipes)	✓ Class and recipes for building product packages ✓ Recipes for image generation ✓ Debian packages **not included**	✓ Common function to unpack Debian source packages (debian-package.bbclass) ✓ **Full recipes** for cross-building every Debian source package
Compilation	Native	Cross
Benefits	✓ Re-use Debian binaries and QA ✓ Fast (re-use, parallel builds) ✓ Lower development costs	✓ Affinity with Poky recipes ✓ Fully customizability ✓ No need to keep binary pkgs
Common features	✓ Based on Debian packages (stability, long-term maintenance) ✓ Build packages and images with bitbake recipes ✓ Generate images by installing binary packages ✓ Manage multiple products as a set of layers	

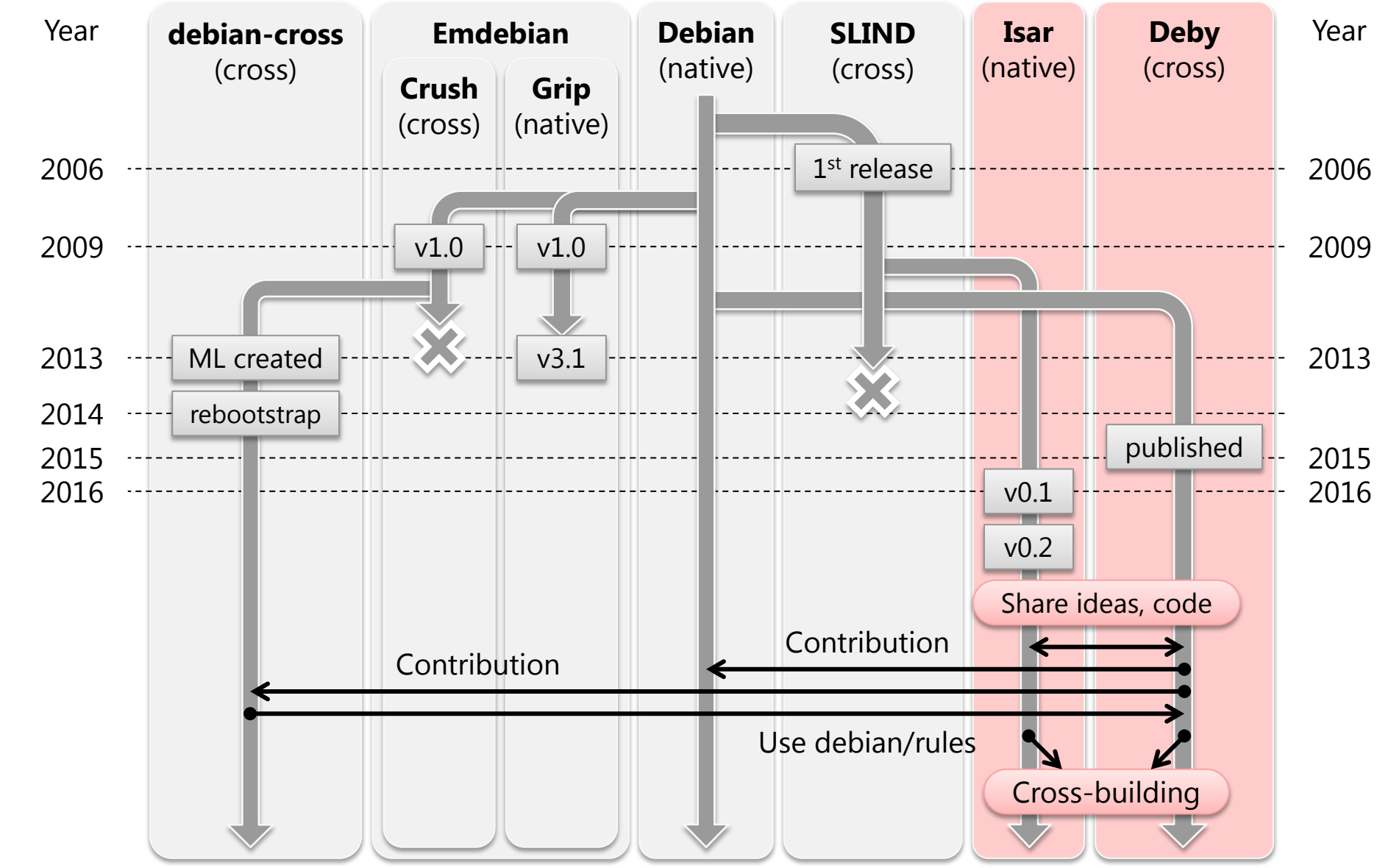
Deby: Interaction points



Isar: Interaction points



History of Debian-based projects



Ideas for collaboration

- **As the first step**
  - Share the current benefits and issues of the both projects
  - Find features that could be shared
  - Create a proof of concept of the common features
  - List up issues, then define the next iteration
- **Main topics**
  - Both projects build Debian packages. Build time for subsequent builds can be improved by re-using previous build results
    - **Binary package caching**
  - Massive changes like cross-building is better done as a community
    - **Cross-building of packages**
  - Both projects require features to summarize license information in generated images
    - **Support license clearing**

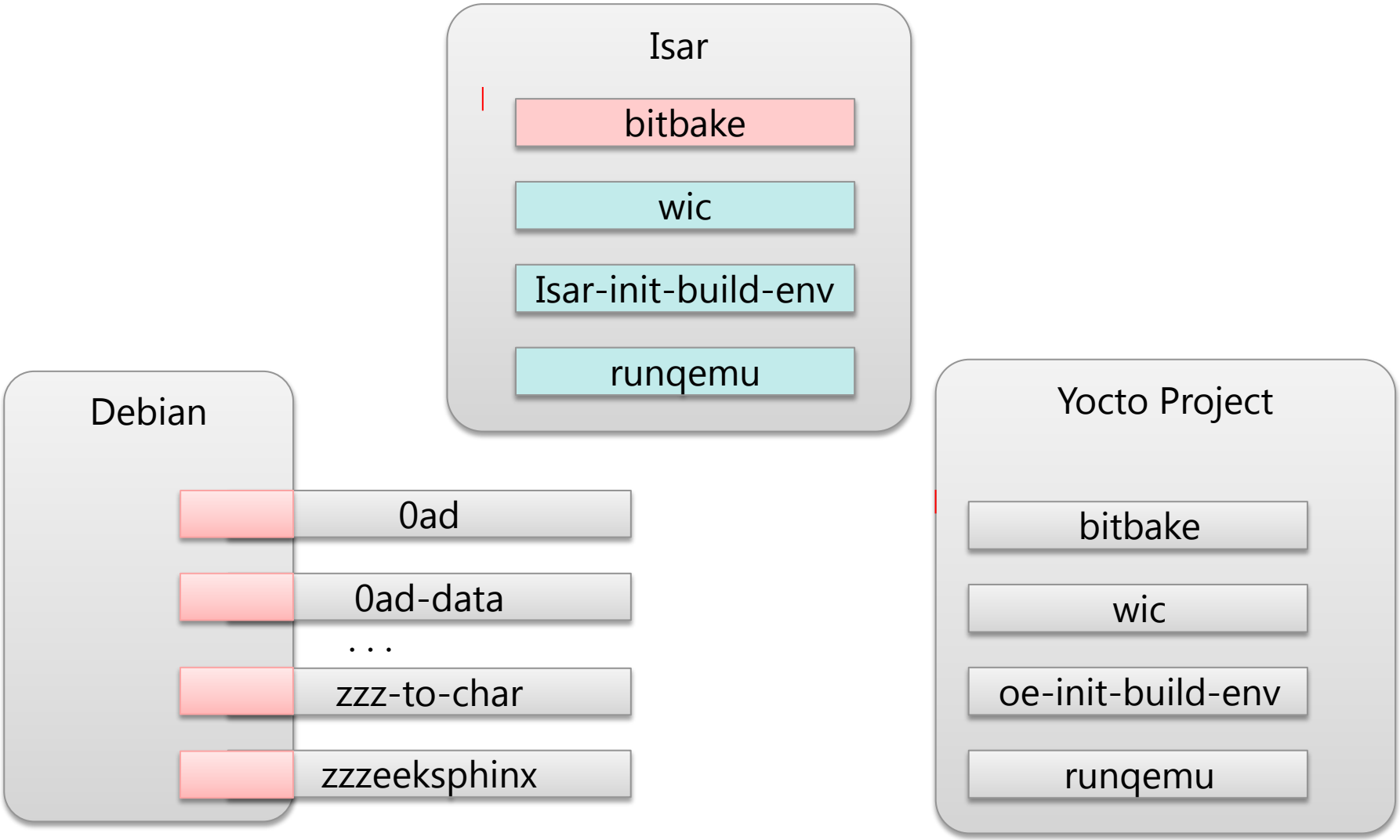
Binary package caching 1/2

- **Motivation**
  - Improve build time by re-using previous build results
- **Common features**
  - After building a package: Save built packages for later use
  - Before building a package: If a pre-built version exists, skip building
  - During package installation: Install from the project's apt repo
- **Approach**
  - Share functions to re-use built packages
  - Goal: Implement a common layer providing binary package caching
- **What we did**
  - Isar released the first implementation of binary package caching
  - Deby implemented a proof of concept of binary package caching, referring to the results of Isar

Binary package caching 2/2

- **Lessons learned**
  - Deby
    - Requires two architectures (not only target but also native)
      - Poky always builds native binaries required for cross-building
    - Need to adapt binary package caching to sysroots
      - All built binaries are shared in sysroots for building others
  - Isar: Very divergent code bases, much glue, little common code
- **Next steps**
  - Deby
    - Design ways how to support multiple architectures and adapt sysroots in binary package caching
    - Or, consider changing the current sysroot based build flow to another one which has better affinity with Debian packages
  - Isar: Propose a common layer

Isar: Scripts



Cross-building of packages 1/3

- **Motivation**
  - Isar
    - Experience in cross-building Debian packages
  - Deby
    - Developing and maintaining full recipes for cross-building Debian packages without debian/rules costs too much
    - Planning to cross-build packages with debian/rules in recipes (.bb)
      - Implement common functions to handle debian/rules
      - Create patches for debian/rules to support cross-building
  - Debian 10 (buster)
    - A lot of efforts to support cross-building in debian/rules
    - Discussed in https://lists.debian.org/debian-cross/

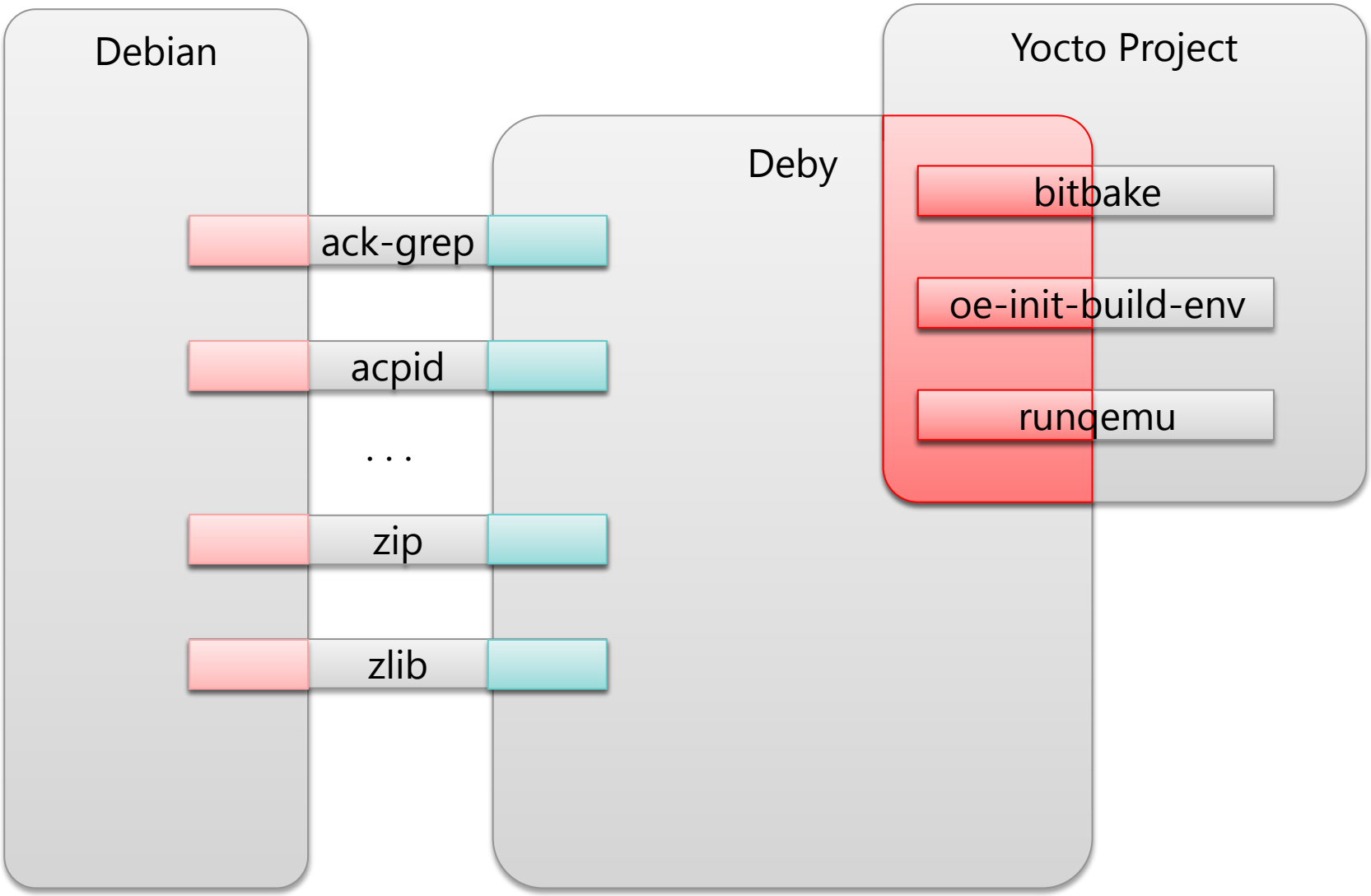
Cross-building of packages 2/3

- **Common features**
  - debian/rules based package build (Deby: planning)
  - Supporting cross-build in community makes big sense
- **Approach**
  - Share existing resources for supporting cross-building
  - Contribute to debian-cross
    - Support cross-building not in-house but in Debian community
- **What we did**
  - Isar provided examples of
    - Common function (.bbclass) to cross-build Debian package
    - Source packages with patches to support cross-building
  - Deby
    - Implemented proof-of-concept recipes which cross-build packages with debian/rules, referring to the example of Isar
    - Identified 2191 of 3035 packages that don't support cross-building
    - Added cross-building to libxinerama, reported **#861073**

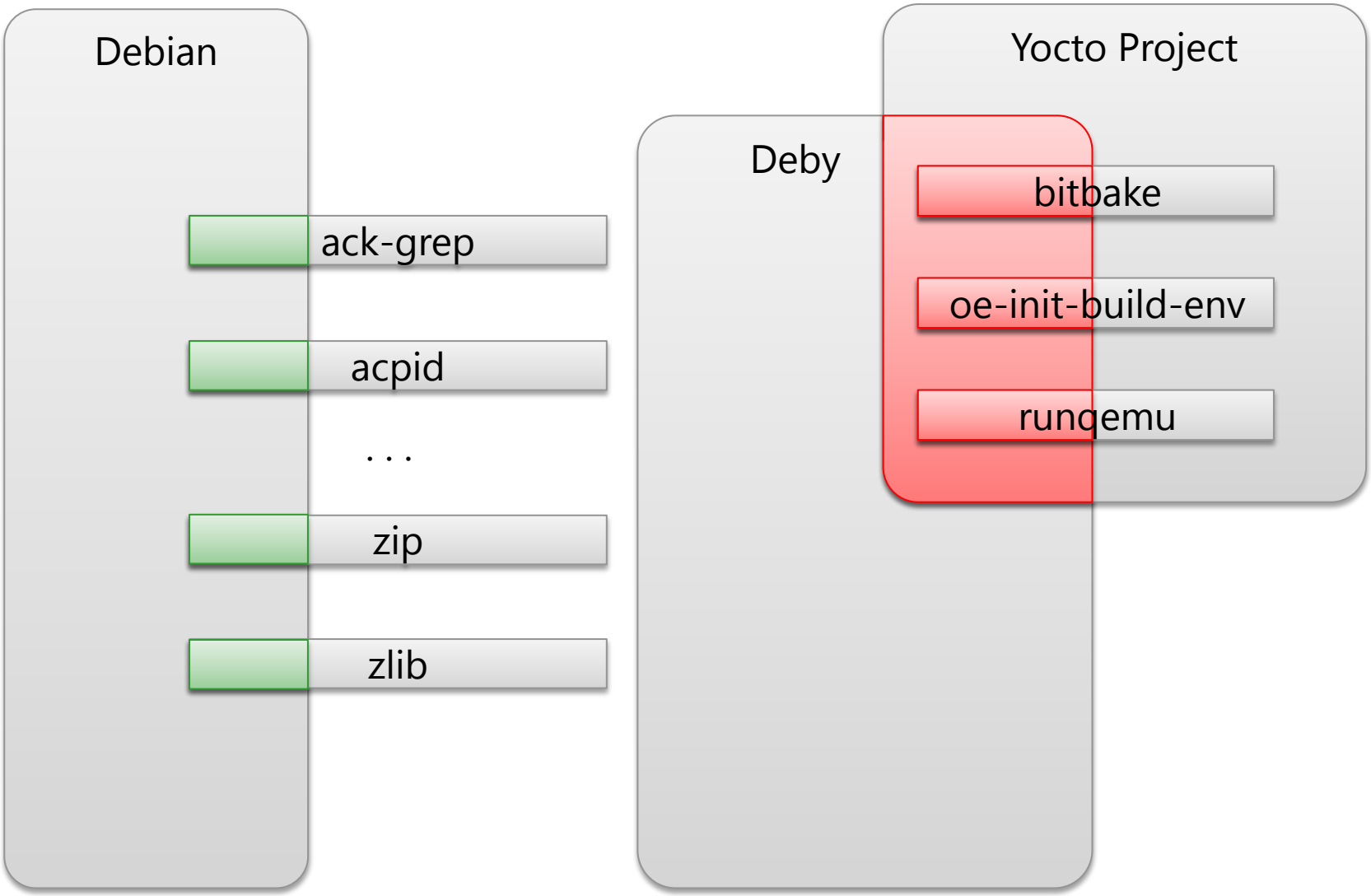
Cross-building of packages 3/3

- **Lessons learned**
  - Deby
    - debian/rules of several packages in Debian buster work with the Deby's cross toolchain without modification
    - Issue: debian/rules depends on commands and data in native system ignoring sysroots
  - Isar:
    - Initially released native building under QEMU to avoid massive changes; re-adding cross-building due to performance
    - ELBE reports issues with distcc, good experiences with icecc
- **Next steps**
  - Deby
    - Consider new design to adapt debian/rules to sysroots
    - Keep creating patches for debian/rules to support cross-building
  - Isar
    - Merge cross-building
    - Implement automatic cross-dependency installation in a Debian way

Deby: Interaction points (Current)



Deby: Interaction points (Future)



Support License Clearing 1/2

- **Motivation**
  - As general issues, examining and summarizing license information in generated images take time and require carefulness
  - As long as using the same Debian source packages, such efforts should be shared in related projects
- **Approach**
  - Share results of license examining and summarizing by using the common tools
    - Improve the quality of the output
    - Reduce costs for examining and summarizing
  - Support machine readable license data in Debian package level
    - DEP-5 formatted debian/copyright
      - https://www.debian.org/doc/packaging-manuals/copyright-format/1.0/
    - First, keep accurate license data in Debian community
      - Contribute to Debian by posting patches for debian/copyright
    - Second, effectively summarize license information according to debian/copyright by sharing common tools

Support License Clearing 2/2

- **What we did**
  - Setup tools for investigating and summarizing license information
    - Scanning & Clearing: FOSSology
    - Summarizing: sw360
  - Provided DEP-5 copyright for zlb, reported **#862260**
    - Initial output from FOSSology, manual editing
- **Lessons learned**
  - Need to clear licenses and copyright holder name in “debian” directory even if no copyright holder name is detected by scanning tool
- **Next steps**
  - Keep posting patches for debian/copyright to support DEP-5 with clarifying policies of contribution
  - Share the tools and results of license investigation for Debian packages with related projects
  - Work with sw360 and ELBE on BoM and release notes generation

Summary

- **Common goals**
  - Package building, image generation and customization, licensing support
- **Divergent goals**
  - Deby: Max customizability
  - Isar: Min modifications
- **Current and future work**
  - Converge towards debian/rules and cross-building
  - Provide tools to support license clearing
  - Cross-building: Provide patches to Debian
  - Licensing: Move to DEP-5 and provide patches to Debian
- **Lessons (re-)learned**
  - Provide an implementation
  - Upstream your work
  - Bigger changes require community work
  - Providing a common layer for disparate code bases is a challenge
  - Proper license clearing costs time
  - Performance does matter