Fetching, Configuring and Building Your Bitbake Project with Just One Command

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Who Are We, Who am I?

Embedded Linux Competence Center / Linux Expert Center @ Siemens Technology

- In-house embedded Linux consultants
- Linux enablers in many Siemens products
- Gateway to upstream communities (not exclusively!)
- Maintainers for several OSS projects

Jan Kiszka

- Crew member for almost 16 years
- Navigating that ship technically
- Maintainer of (too?) many OSS projects

Quick Survey

Who knows kas?

Who is using it already?

Who is using it via kas-container?

Who is using it for isar layers?

Time warp to 2017:
How to replicate a Yocto-based build?

1. **Fetch a few repos**
   - manually according to some README
   - with the help of some custom script
   - using the repo tool
2. **Create bblayer.conf and local.conf**
   - manually according to some README
   - with the help of some custom script
   - using the right template during oe-init-build-env (see README)
3. **Initialize the build env**
4. **bitbake my-target** (please consult the README on which one)

5. *Pray that you didn't miss anything*
6. *Find out that host distro and user settings can matter...*

And that is...

Kas, der

Aussprache: [kà:s]

1. Käse (...a Kas, a Brezn und a Mass Bier is was Guads!)
2. Blödsinn, dummes Zeug, Unsinn (...red doch ned so an Kas!)

For Non-Bavarians

1. Cheese
2. Nonsense, a silly thing

Source (with friendly permissions): https://www.bayrisches-woerterbuch.de/kas-kaes-der/

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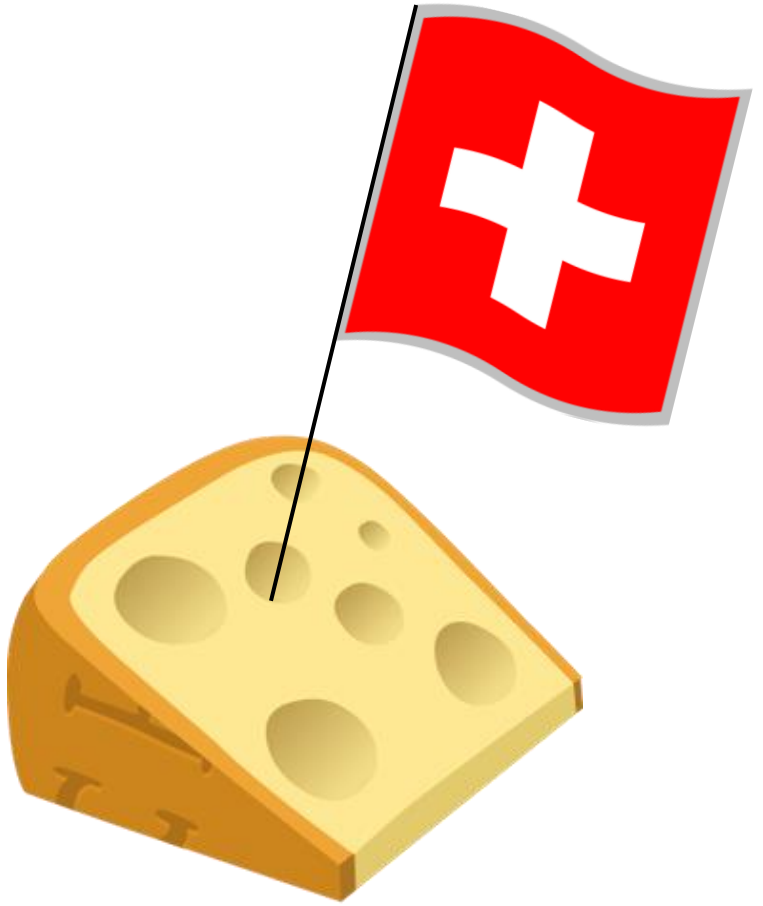
kas!



A Short History

First commit

- March 2017 – Daniel Wagner @Siemens

First public release

- June 2017 – 0.9.0

First non-Siemens contribution

- January 2018 – thanks, Georg Lutz!

"We are stable" release

- March 2019 – 1.0

First maintainer hand-over

- July 2019 – Daniel prefers Enterprise over Embedded ;-)

First larger external contributions

- 2020 – thanks, Paul Barker!

Latest release

- June 2023 – 4.0 with Debian bookworm containers

Key Idea: Single-Statement Setup & Build

```
git clone <bootstrap-repo>
```

kas build kas-target.yaml

or

kas-container build kas-target.yaml

or

kas/kas-container menu

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A Basic kas Configuration File

```
header:
  version: 14
distro: poky
machine: qemux86-64
target: core-image-minimal
repos:
  poky:
    url: https://git.yoctoproject.org/poky.git
    commit: 31dd418207f6c95ef0aad589cd03cd2a4c9a8bf2
    layers:
      meta:
      meta-poky:
local_conf_header:
  some-tweaks: |
    EXTRA_IMAGE_FEATURES ?= "debug-tweaks"
    INHERIT += "rm_work"
```

Interacting with bitbake

Building a specific target

```
# kas build kas.yaml --target other-target
```

Running up to a specific task

```
# kas build kas.yaml --target some-target --cmd compile
```

Forwarding additional bitbake arguments

```
# kas build kas.yaml -- --environment
```

Dropping into the build environment

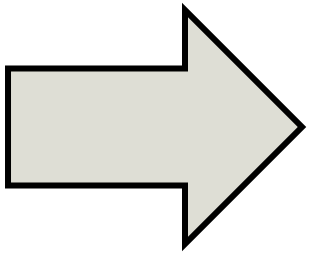
```
# kas shell kas.yaml
```

Including and Overriding with kas

```
header:
  version: 14
  includes:
    - base.yaml
machine: my-machine
repos:
  poky:
    layers:
      meta-yocto-bsp:
```

[base.yaml]

```
header:
  version: 14
machine: qemux86-64
repos:
  poky:
    url: ...
    layers:
      meta:
      meta-poky:
```



```
...
machine: my-machine
repos:
  poky:
    url: ...
    layers:
      meta:
      meta-poky:
      meta-yocto-bsp:
```

Merging and overriding of includes happen top to bottom and depth first.

Ad-hoc Inclusion

```
[main.yaml]
header:
  version: 14
distro: poky
machine: qemux86-64
target: core-image-minimal
repos: ...

[machine-a.yaml]
header: ...
machine: my-machine-a

[feature-b.yaml]
header: ...
local_conf_header:
  feature-b: |
    FEATURE_B = "1"
```

```
# kas build main.yaml:machine-a.yaml:feature-b.yaml
```

Equivalent to rewriting `main.yaml`:

```
header:
  version: 14
  includes:
    - machine-a.yaml
    - feature-b.yaml
distro: poky
target: core-image-minimal
repos: ...
```

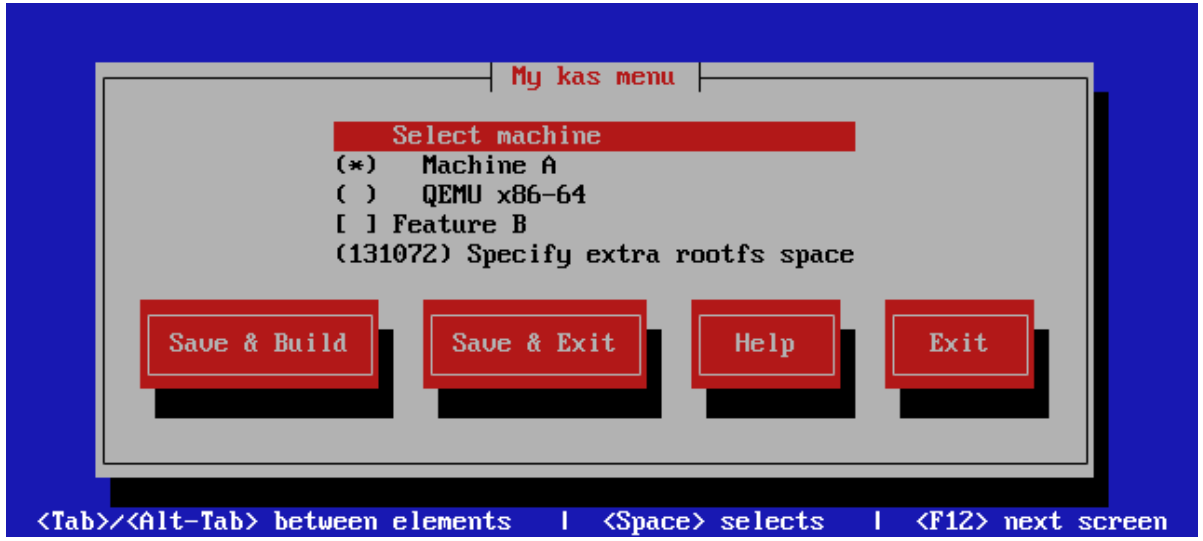
Interactive Inclusion / Basic Configuration via Kconfig

Problem

- How to make available options discoverable?
- How to guide to supported combinations?

kas menu plugin

- Build up menu using Kconfig language
- Add mimimal extra semantic to generate a kas config file: `.config.yaml`
- Build `.config.yaml` directly



The pros

- Reuse of an existing, powerfull language and library
- Proved to resolve above problems

The cons

- Kconfig mapping on kas not "native", not fully intuitive
- Misuse possible – limit the number of knobs!

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Examplery Kconfig File

```
mainmenu "My kas menu"
config KAS_INCLUDE_MAIN
    string
    default "main.yaml"
choice
    prompt "Select machine"
    default MACHINE_A
config MACHINE_A
    bool "Machine A"
    help
      This is machine A.
config MACHINE_QEMUX86_64
    bool "QEMU x86-64"
endchoice
config KAS_INCLUDE_MACHINE
    string
    default "machine-a.yaml" if MACHINE_A
```

```
config FEATURE_B
    bool "Feature B"
    depends on !MACHINE_QEMUX86_64
config KAS_INCLUDE_FEATURE_B
    string
    default "feature-b.yaml"
    depends on FEATURE_B
config IMAGE_ROOTFS_EXTRA_SPACE
    string "Specify extra rootfs space"
    default "131072"
```

```
[.config.yaml]
header:
  includes:
  - main.yaml
  - machine-a.yaml
  - feature-b.yaml
  version: 14
local_conf_header:
  __menu_config_vars: IMAGE_ROOTFS_EXTRA_SPACE = "131072"
...
```

Repository Update Workflows

Option A: manual update

- Bump repo revisions based on relevant upstream changes
- Works will for smaller number or well-known repos
- Common pattern in Isar ecosystem (so far)

Option B: ride branches, lock-down tested states

- Leave out repo commits, specify `branch`
- Lock down checkout via
  `# kas dump <my-kas>.yaml --lock --inplace`
- Check in generated `<my-kas>.lock.yaml`
- Update revisions via
  `# kas dump <my-kas>.yaml --lock --inplace –update`

Repo patching

- Helps testing to-be-upstreamed patches
- Not for abuse!

```
...
repos:
  poky:
    url: ...
    branch: mickledore
    layers: ...
  meta-openembedded:
    url: ...
    branch: mickledore
    layers: …
    patches:
      01-some-class-fix:
        path: upstream-fix.patch
```


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Repo Integrity Protection

Problem: `refspec` was not sufficient if attacker hijacks repo

- On collision, old kas preferred branches over commit hashes
- Attacker may also remove commit and create branch instead
- SHA1 collisions?

Multiple attempts to address this in kas

1. `git archive | sha256sum`
2. Massaged "git archive"
3. Own, stable "archive" format – but proprietary

Postponed after community discussion

- Rather an upstream SCM problem?
- How realistic are SHA1 collisions for git/hg already?

From kas 3.3 onward

- Split `refspec` into `commit` and `branch`
- Keep `refspec` for now for backward compatibility

kas and The Containers

kas comes with two build containers

- `ghcr.io/siemens/kas/kas`
  adds OE build dependencies
- `ghcr.io/siemens/kas/kas-isar`
  adds isar build dependecies
- All contain kas plus some support tools
  for connectivity & downloads

Self-contained wrapper script `kas-container`

- Basically, behaves like kas
- Decouples host distro from build environment
- Locks-down build env version,
  e.g., by carrying kas-container in bootstrap repo
- Works with docker and podman, of course!
- Works on arm64 hosts as well

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The kas Sandbox

Strong decoupling from host

- Separate /home to build from, even without container
- Only declared environment variables are forwarded, check
  - https://kas.readthedocs.io/en/latest/command-line.html#environment-variables
  - https://kas.readthedocs.io/en/latest/userguide.html#project-configuration, `env` property
- Only weakened when doing
  `# kas shell/for-all-repos --preserve-env`
- Maybe the most disliked kas feature?

Background

- Host contamination was easy with OE in 2017...
- Foster easy migration between local and CI builds
- Also needed to maintain `kas` <=> `kas-container`

How About `bitbake-layer` Extensions?

`create-layers-setup`

- Generates out of configured and check-out layers
  - `setup-layers.json`
  - `setup-layers` (self-contained check-out script)

`save-build-conf`

- Generates template files for `oe-init-build-env`

Pros

- Embeds into native Yocto/OE workflows

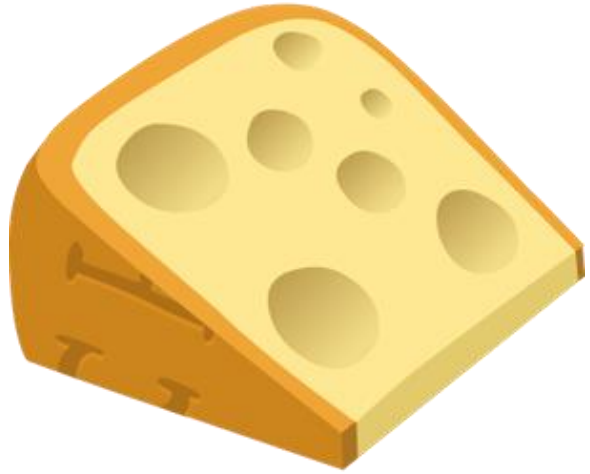
Cons

- Doesn't address coarse-grained & interactive configurations (yet?)
- No cross-layer reuse of configuration bits
- No layer patching support
- No support for older OE / isar
- Host OS decoupling not in scope

Summary and Outlook

kas makes your bitbake builds easier portable

- Single line bootstrap & build
- Stronger decoupling from host
- Stable build containers
- Interactive coarse-grained build configuration



What's next?

- Test containers?
- Scope down where bitbake-layer can take over?
- Your call!

Resources

- https://github.com/siemens/kas
- https://kas.readthedocs.io
- kas-devel@googlegroups.com

Some examples

- https://git.yoctoproject.org/meta-arm/tree/kas
- https://gitlab.com/cip-project/cip-core/isar-cip-core
- https://github.com/siemens/meta-iot2050

Contact

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