Building Yocto Project at scale with TuxSuite

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Agenda

● About Linaro and me
● What is TuxSuite?
● TuxSuite Use cases last year
● TuxSuite YP/OE support
● Build definition Template
● TuxBake
● Building a single YP/OE distro image with TuxSuite
● Building multiple YP/OE distro images with TuxSuite Plans
Linaro

- Driving open source software development on Arm since 2010, providing the tools, Linux kernel quality and security needed for a solid foundation to innovate on.
- Working with member companies and the open source community to maintain the Arm software ecosystem and enabling new markets on Arm architecture.
- Linaro Developer Services: Helping build, deploy and maintain your products on Arm
- Software Services that accelerate development and testing of open source Operating System software.
- Linaro projects:
  - Linux kernel
  - toolchains
  - security
  - continuous integration testing
  - Automotive
  - IoT & Edge Devices, Client Devices
  - Cloud Computing & Servers.
About Me

- Senior Engineer in Linaro as part of Tuxsuite Team, developing cloud solutions to build various open source software products.
- 14 years of experience designing and building CI/CD solutions for a variety of embedded software stacks.
- Have worked on various components of the stack
  - u-boot
  - edk2
  - AOSP
  - Yocto
What is TuxSuite?

• On-demand APIs and tools executing in parallel at scale in the cloud.
  • Building Linux kernels
  • Testing Linux kernels on Qemu
  • Building Yocto Project / OpenEmbedded and derivatives
• TuxSuite can scale to more than 1000 builds or tests in parallel within minutes
• tuxsuite cli is a python cli application to talk to the API endpoint
• Easily Reproducible in the cloud and locally thanks to OSS tools:
  • Linux Kernel - TuxMake
  • Boot Testing with Qemu - TuxRun
  • Build YP/OE - TuxBake
TuxSuite Usecases Last Year

- **LKFT**
  - Linux Kernel build, boot and LTP tests
  - OE builds for building userspace for kernel testing
  - Peak usage in a day
    1. 2000+ hrs ~= 40+ 8 core machines doing the builds for 24 hrs.
    2. 9500+ builds
  - 136,995 builds in April 2022
  - 1,203,113 kernel built in 2021
- Individual Linux Kernel maintainers use it to build test
- ClangbuiltLinux - Linux kernel build tests with different Clang versions
  - Peak Usage in a day: 1000+ hrs for 2000+ builds
  - 54,043 builds in the month of April 2022
  - More details are available here: Deepdive Into ClangBuiltLinux
- Morello - Running Linux and Android tests on FVP in the cloud
TuxSuite Applications

- Easily integrated with any modern CI systems and Code Review tools:
  - Gerrit
  - Gitlab CI
  - Github Actions
  - Jenkins
  - Travis CI
- Developers can use it for wider build/boot test locally
TuxSuite YP/OE Support

- TuxSuite supports building YP/OE
  - Supported backends:
    - TuxBake
    - kas
- Per project caching:
  - shared SSTATE Mirror.
  - shared DL_DIR.
TuxSuite YP/OE Support

- Publish build artifacts at a non-guessable URL

<table>
<thead>
<tr>
<th>Filename</th>
<th>Last Modified</th>
<th>Size</th>
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</thead>
<tbody>
<tr>
<td>Parent Directory</td>
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<tr>
<td>images/</td>
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<tr>
<td>licenses/</td>
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<tr>
<td>rpm/</td>
<td></td>
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</tr>
<tr>
<td>bitbake-environment</td>
<td>2 hours ago</td>
<td>1M</td>
</tr>
<tr>
<td>build-debug.log</td>
<td>2 hours ago</td>
<td>498K</td>
</tr>
<tr>
<td>build-definition.json</td>
<td>2 hours ago</td>
<td>806B</td>
</tr>
<tr>
<td>build.log</td>
<td>2 hours ago</td>
<td>454K</td>
</tr>
</tbody>
</table>

_tuxpub 0.1.10, by Linaro._
Tip: If ?export=json is appended to the URL, a json representation of the page will be provided.
TuxSuite + TuxBake

- TuxBake is an Open Source Python3 Application to build YP/OE.
- Containerized build environment.
  - Ubuntu-<16.04/18.04/20.04/22.04>
  - Debian-<buster/bullseye/stretch>
  - Centos-8
  - Fedora-<33/34>
  - opensuse-leap-<15.1/15.2>
- Uses Docker/Podman for providing the containerized environment.
- Uses build-definition Template.
- Git / Android Repo tool to manage sources.
- Allows users to define local.conf, bblayers.conf, environment variables, sstate_mirror, dl_dir, distro, machine, container.
Build definition fields

- **sources** (dictionary with a single item): could be one git_trees, repo or kas
  
  a. **git_trees** (list of dictionaries): url, branch and optionally commit ids/refs
  
  b. **repo** (a dictionary): branch, manifest file name and manifest repo url
  
  c. **kas** (a dictionary): url, branch, kas yaml and optionally ref.

- **envsetup**: path to the script, relative to the source directory, sourced to setup bitbake environment

- **distro, machine, target**: variables passed to the bitbake command

- **container**: the container used by Docker to do the build.

- **local_conf, bblayers_conf** (list of strings): each entry corresponds to a line in local.conf file.

- **environment** (dictionary of environment variables)
build-definition examples - Yocto Project / Poky

```bash
$ # Install tuxsuite
$ pip3 install tuxsuite
$ cat yocto.json
{
  "container": "ubuntu-20.04",
  "envsetup": "poky/oe-init-build-env",
  "distro": "poky",
  "machine": "qemux86-64",
  "target": "core-image-minimal",
  "sources": {
    "git_trees": [
      {
        "url": "git://git.yoctoproject.org/poky",
        "branch": "kirkstone",
        "sha": "780eeec8851950ee6ac07a2a398ba937206bd2e4"
      }
    ]
  }
}
```
$ tuxsuite bake submit yocto.json

*** WARNING: BITBAKE SUPPORT IS EXPERIMENTAL ***
Building target: core-image-minimal with bitbake from {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'honister'}]} source with distro: poky machine: qemux86-64 arguments
uid: 291KafvkrqBvDt8iFO3nf2jQWjS

📍 Provisioning: {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'honister'}]} with poky qemux86-64 for core-image-minimal:
https://oebuilds.tuxbuild.com/291KafvkrqBvDt8iFO3nf2jQWjS/

🚀 Running: {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'honister'}]} with poky qemux86-64 for core-image-minimal:
https://oebuilds.tuxbuild.com/291KafvkrqBvDt8iFO3nf2jQWjS/

🎉 Pass: {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'honister'}]} with poky qemux86-64 for core-image-minimal:
https://oebuilds.tuxbuild.com/291KafvkrqBvDt8iFO3nf2jQWjS/
$ cat oniro.json
{
  "container": "ubuntu-20.04",
  "distro": "oniro-linux",
  "environment": {
    "TEMPLATECONF": "../oniro/flavours/linux"
  },
  "envsetup": "oe-core/oe-init-build-env",
  "machine": "qemux86-64",
  "sources": {
    "repo": {
      "branch": "kirkstone",
      "manifest": "default.xml",
      "url": "https://gitlab.eclipse.org/eclipse/oniro-core/oniro"
    }
  },
  "target": "oniro-image-base-tests"
}
build-definition examples - Oniro

```
$ tuxsuite bake submit oniro.json

*** WARNING: BITBAKE SUPPORT IS EXPERIMENTAL ***
uid: 291SyRebaz5UNPVoaWWDbwWtecI


```
$ cat kas.json
{
   "sources": {
      "kas": {
         "url": "https://git.codelinaro.org/linaro/dependable-boot/meta-ts",
         "yaml": "ci/zynqmp-starter.yml"
      }
   }
}
$ tuxsuite bake submit kas.json

*** WARNING: BITBAKE SUPPORT IS EXPERIMENTAL ***
Building target: None with bitbake from {'kas': {'url': 'https://git.codelinaro.org/linaro/dependable-boot/meta-ts', 'yaml': 'ci/zynqmp-starter.yml'}} source with distro: None machine: None arguments
uid: 291T4fWMaux9zNIZdAVQAFw1m8s

🔍 Provisioning: {'kas': {'url': 'https://git.codelinaro.org/linaro/dependable-boot/meta-ts', 'yaml': 'ci/zynqmp-starter.yml'}} with None None for None:
https://oebuilds.tuxbuild.com/291T4fWMaux9zNIZdAVQAFw1m8s/

🚀 Running: {'kas': {'url': 'https://git.codelinaro.org/linaro/dependable-boot/meta-ts', 'yaml': 'ci/zynqmp-starter.yml'}} with None None for None:
https://oebuilds.tuxbuild.com/291T4fWMaux9zNIZdAVQAFw1m8s/

🎉 Pass: {'kas': {'url': 'https://git.codelinaro.org/linaro/dependable-boot/meta-ts', 'yaml': 'ci/zynqmp-starter.yml'}} with None None for None:
https://oebuilds.tuxbuild.com/291T4fWMaux9zNIZdAVQAFw1m8s/
TuxSuite Plans for Yocto - Poky master-next

$ cat poky-next.yaml
common: &commondata
  "container": "ubuntu-20.04"
  "distro": "rpb"
  "envsetup": "setup-environment"
  "sources": {
    "git_trees": [
      {
        "url": "git://git.yoctoproject.org/poky",
        "branch": "master-next"
      }
    ]
  }
  "target": "core-image-minimal"
version: 1
name: Poky next validation
description: Build Poky for various qemu jobs:
- name: next-tracking
  bakes:
    - { <<: *commondata, "machine": "qemuarm64"}
    - { <<: *commondata, "machine": "qemuarm"}
    - { <<: *commondata, "machine": "qemuarmv5"}
    - { <<: *commondata, "machine": "qemumips64"}
    - { <<: *commondata, "machine": "qemumips"}
    - { <<: *commondata, "machine": "qemuppc64"}
    - { <<: *commondata, "machine": "qemuppc"}
    - { <<: *commondata, "machine": "qemuriscv32"}
    - { <<: *commondata, "machine": "qemuriscv64"}
    - { <<: *commondata, "machine": "qemux86-64"}
    - { <<: *commondata, "machine": "qemux86"}
TuxSuite Plans for Yocto

$ tuxsuite plan poky-next.yaml

*** WARNING: BITBAKE SUPPORT IS EXPERIMENTAL ***
Running Bake plan 'Poky next validation': 'Build Poky for various qemu'
Plan https://tuxapi.tuxsuite.com/v1/groups/tuxsuite/projects/vishal/plans/2974WYyncHQsrfgwhdDvIElLOut

uid: 2974WYyncHQsrfgwhdDvIElLOut

Provisioning: {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'master-next'}]} with poky qemuarm64 for core-image-minimal: https://oebuilds.tuxbuild.com/2974WfMW5ffFuWdMvPepMHdr0BQ/

Provisioning: {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'master-next'}]} with poky qemuarm for core-image-minimal: https://oebuilds.tuxbuild.com/2974WhiciLNQzgqRy355y0FoeeyY/

Running: {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'master-next'}]} with poky qemuarm64 for core-image-minimal: https://oebuilds.tuxbuild.com/2974WfMW5ffFuWdMvPepMHdr0BQ/

Running: {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'master-next'}]} with poky qemuarm for core-image-minimal: https://oebuilds.tuxbuild.com/2974WhiciLNQzgqRy355y0FoeeyY/

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TuxSuite Plans for Yocto

🚀 Running: {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'master-next'}]} with poky qemuarm for core-image-minimal: https://oebuilds.tuxbuild.com/2974WhiciLNQzgqRy355y0Foeey/
.
🎉 Pass: {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'master-next'}]} with poky qemuarmv5 for core-image-minimal: https://oebuilds.tuxbuild.com/2974Wbe9Gen3HeXg4Px4Br7mHyy/
🎉 Pass: {'git_trees': [{'url': 'git://git.yoctoproject.org/poky', 'branch': 'master-next'}]} with poky qemumips for core-image-minimal: https://oebuilds.tuxbuild.com/2974WchEEacRybPXsXAju9D9Z4W/
.
Summary: https://tuxapi.tuxsuite.com/v1/groups/tuxsuite/projects/vishal/plans/2974WYyncHQsrfghdDvIEll0Out
TuxSuite Applications - Yocto

- Layers premerge testing and tracking changes with Yocto upstream.
  - meta-rpb premerge testing: https://github.com/96boards/oe-rpb-manifest/blob/qcom/master/github/workflows/premerge-template.yml
  - upstream Poky master-next tracking: https://ci.linaro.org/job/lt-qcom-poky-master/
  - meta-qcom layer CI: https://github.com/ndechesne/meta-qcom/tree/master/github/workflows
Reproducing the build with TuxBake locally

$ tuxbake --build-definition yocto.json --src-dir $PWD/yocto
Cloning into 'poky'...
remote: Enumerating objects: 561369, done.
remote: Counting objects: 100% (1355/1355), done.
remote: Compressing objects: 100% (911/911), done.
remote: Total 561369 (delta 742), reused 685 (delta 425), pack-reused 560014
Receiving objects: 100% (561369/561369), 182.99 M1B | 524.00 K1B/s, done.
Resolving deltas: 100% (407297/407297), done.
Using default tag: latest
latest: Pulling from tuxbake/ubuntu-20.04
Digest: sha256:a4e2a7f852b53c5ba741ef0e4d459913df9a2135d0444d6ec8e211792c2ede00
Status: Image is up to date for tuxbake/ubuntu-20.04:latest
docker.io/tuxbake/ubuntu-20.04:latest
usermod: no changes
bash -c 'rm build/conf/bblayers.conf; rm build/conf/local.conf; source poky/oe-init-build-env build; cat ../extra_local.conf >> conf/local.conf; cat ../bblayers.conf >> conf/bblayers.conf || true; echo """"'Dumping local.conf...'""""); cat conf/local.conf; bitbake -e > bitbake-environment; bitbake core-image-minimal'
rm: cannot remove 'build/conf/bblayers.conf': No such file or directory
rm: cannot remove 'build/conf/local.conf': No such file or directory
You had no conf/local.conf file. This configuration file has therefore been created for you with some default values. You may wish to edit it to, for example, select a different MACHINE (target hardware). See conf/local.conf for more information as common configuration options are commented.
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TuxSuite Yocto Roadmap

- Boot Test Yocto images on Qemu with TuxTest
- no-cache option to skip sstate_cache usage
- Support to download sstate_cache objects
- Serve sstate_cache and dl_dir from TuxSuite Cloud to tuxbake
- artifacts download by CLI
- Publish Statistics for the build
TuxSuite Token

We have trial vouchers available for those interested in experimentation with the build service.

Please request a tuxsuite token via the: TuxSuite Token Request
Getting Started with TuxSuite: https://learn.tuxsuite.com
TuxSuite References

- https://tuxsuite.com
- https://tuxrun.org
- https://tuxmake.org
- https://learn.tuxsuite.com
- https://gitlab.com/Linaro/tuxsuite
- https://gitlab.com/Linaro/tuxbake
- https://gitlab.com/Linaro/tuxmake
- https://gitlab.com/Linaro/tuxrun
- https://gitlab.com/Linaro/tuxsuite/-/tree/master/examples/bitbake