



**Primer: Testing Your
Embedded System -
What is a ptest, Lava,
Fuego, KernelCI and...?**

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Overview / Scope

Frameworks to test your embedded ...

- Yocto Project / ptest
- Fuego
- LAVA
- KernelCI
- labgrid
- r4d
- of course there
are more



Image: public domain

Yocto Project's ptest

ptest – Fact sheet

- Name: ptest
- Project: The Yocto Project (www.yoctoproject.org)
- URL: <https://wiki.yoctoproject.org/wiki/Ptest>
- TLDR: Packaging and Execution of
'make test' style testsuites on the DUT

ptest

- ptests are
 - sub-packages (foo-ptest)
 - a output format ("\$RESULT: <testname>")
 - PASS/FAIL/SKIP
 - convention to call them (run-ptest script)
 - ptest-runner on the target to start them

ptest

```
from zlib_1.2.11.bb:  
SRC_URI += "file://run-ptest"  
inherit ptest  
do_compile_ptest() {  
    oe_runmake test  
}  
do_install_ptest() {  
    install ${B}/Makefile      ${D}${PTEST_PATH}  
    install ${B}/example       ${D}${PTEST_PATH}  
    install ${B}/minigzip      ${D}${PTEST_PATH}  
    install ${B}/examplesh     ${D}${PTEST_PATH}  
    install ${B}/minigzipsh    ${D}${PTEST_PATH}  
  
    # Remove buildhost references...  
    sed -i -e "s,--sysroot=${STAGING_DIR_TARGET},,g" \  
        -e 's|${DEBUG_PREFIX_MAP}||g' \  
        ${D}${PTEST_PATH}/Makefile  
}  
RDEPENDS_${PN}-ptest += "make"
```

wrapper script for target

compilation procedure
for testsuite

install test binaries

adapt scripts/path
to target execution
if necessary

declare (undetectable)
runtime dependencies
for tests (e.g. make)

ptest

- To add package testing to your build, set the **DISTRO_FEATURES** and **EXTRA_IMAGE_FEATURES**

```
DISTRO_FEATURES_append = " ptest"
```

```
EXTRA_IMAGE_FEATURES += "ptest-pkgs"
```

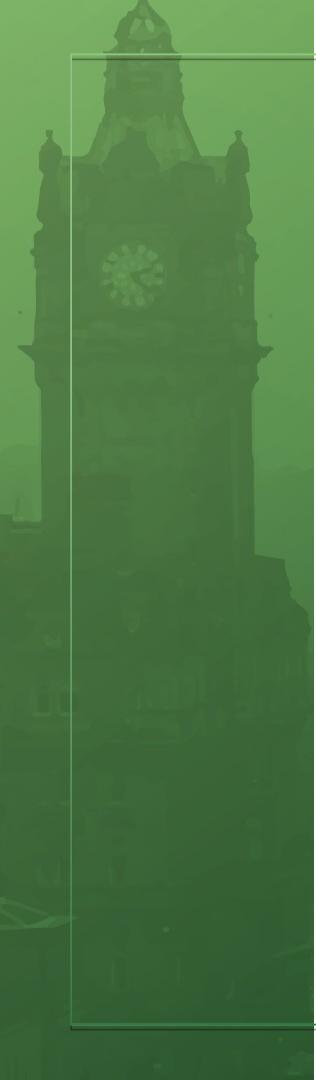
-

ptest

- + supports cross-compilation of the test-suite ahead of time
- + well integrated into the bitbake procedures
- + can be combined with the "testimage" class
- large log output, full run takes quite long
- Result visualization needs postprocessing

ptest

- **References:**
 - <https://wiki.yoctoproject.org/wiki/Ptest>
 - <http://bit.ly/2S5JNtA>



Fuego



Fuego – Fact sheet

- Name: Fuego
- Project: Fuego Test System
- URL: <http://fuegotest.org/>
- TLDR: automated testing of embedded targets from a host system with 100 pre-packaged tests

Fuego

- Fuego is
 - a Jenkins instance preloaded with
 - a lot of tests (ranging from LTP to)
 - scripts to compile the test for the target
 - upload and run on the target
 - grab the results and parse them
 - partially visualize the results

Dashboard [Jenkins]

localhost:8080/feugo/

Jenkins

2 search DISABLE AUTO REFRESH

New Item People Build History Manage Jenkins

Build Queue No builds in the queue.

Build Executor Status master 1 Idle 2 Idle beaglebone 1 Idle

| All | +/- | S | W | Name ↓ | Last Success | Last Failure | Last Duration | Action |
|-----|-----|---|---|---|--------------|--------------|---------------|--------|
| | | ● | ☀ | beaglebone.default.Benchmark.cyclitest | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.dbench | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.Dhrystone | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.hackbench | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.himeno | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.Interbench | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.linpack | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.lmbench2 | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.netperf | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.OpenSSL | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.reboot | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.signaltest | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Benchmark.Whetstone | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Functional.bc | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Functional.crashme | N/A | N/A | N/A | |
| | | ● | ☀ | beaglebone.default.Functional.hello_world | N/A | N/A | N/A | |

beaglebone.default.x

localhost:8080/feugo/job/beaglebone.default.Benchmark.Dhrystone/

Jenkins

Jenkins > beaglebone.default.Benchmark.Dhrystone >

- Back to Dashboard
- Status
- Changes
- Workspace
- Build Now
- Delete Project
- Configure

Build History

trend =

find

#5 Apr 6, 2017 6:55 PM

log plot

RSS for all RSS for failures

Project beaglebone.default.Benchmark.Dhrystone

[Workspace](#)[Recent Changes](#)

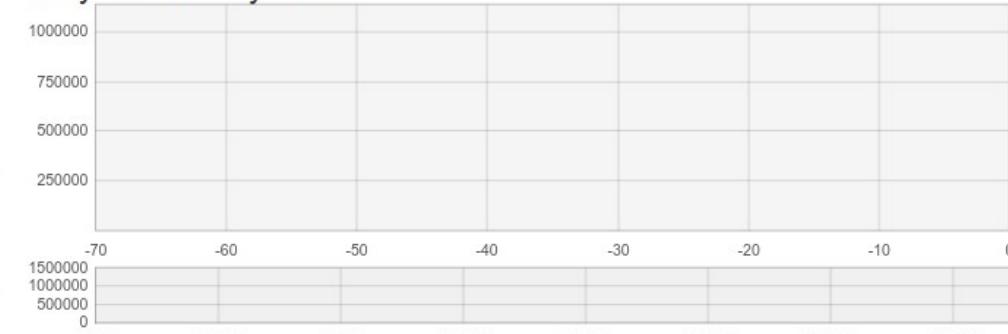
Upstream Projects

beaglebone.testplan_smoketest.batch

Permalinks

- [Last build \(#5\), 1 min 16 sec ago](#)
- [Last stable build \(#5\), 1 min 16 sec ago](#)
- [Last successful build \(#5\), 1 min 16 sec ago](#)
- [Last completed build \(#5\), 1 min 16 sec ago](#)

Dhrystone / Dhrystone



Legend:

beaglebone-default-Dhrystone.Dhrystone beaglebone-default-Dhrystone.Dhrystone.ref

All devices: All firmware:
 beaglebone 3.8.13-bone50

Fuego

- + Large set of tests out of the box !!
- + No prerequisites on the target beside ssh
- + Result parsers so graphing is possible
- Assumes board is local (ssh)
- Assumes board is deployed with filesystem
- Each board needs a separate configuration

Fuego

- References:
 - <http://fuegotest.org/wiki/FrontPage>
 - <http://bit.ly/2q4aPEK> - LCJ 2016 slides
 - http://fuegotest.org/wiki/Fuego_Quickstart_Guide



LAVA

LAVA

- Name: **LAVA**
- Project: **LAVA Software Community Project**
- URL: **<http://www.lavasoftware.org/>**
- TLDR: **Device automation and test execution framework**

LAVA

- LAVA does
 - manage deployment of the filesystem
 - power-on & booting & test exec on the DUT
 - support multiple devices of the same type
 - have templates for ≥ 150 types of boards
 - support devices to be remote (master/worker)

All Devices

[All Devices](#)[Active Devices](#) [Online Devices](#) [Maintenance Devices](#)Show entries

| Hostname ↴ | Worker Host ↴ | Device Type ↴ | state ↴ | Health ↴ | Submissions restricted to | Tags ↴ |
|--------------------|----------------------|------------------|---------|----------|--|--------|
| arndale01 | dispatcher01.lavalab | arndale | | Retired | Retired: no submissions possible. | |
| arndale02 | dispatcher02.lavalab | arndale | | Retired | Retired: no submissions possible. | |
| arndale03 | dispatcher03.lavalab | arndale | | Retired | Retired: no submissions possible. | |
| arndale04 | dispatcher04.lavalab | arndale | | Retired | Retired: no submissions possible. | |
| arndale05 | dispatcher05.lavalab | arndale | | Retired | Retired: no submissions possible. | |
| b2260-01 | dispatcher01.lavalab | b2260 | | Bad | Health check failed: no test jobs will be scheduled. | |
| b2260-02 | dispatcher02.lavalab | b2260 | Idle | Good | group kernel-ci | |
| beaglebone-black01 | dispatcher01.lavalab | beaglebone-black | Idle | Good | | |
| beaglebone-black02 | dispatcher01.lavalab | beaglebone-black | Idle | Good | | |
| beaglebone-black03 | dispatcher02.lavalab | beaglebone-black | Idle | Good | | |
| beaglebone-black04 | dispatcher02.lavalab | beaglebone-black | Idle | Good | | |
| beaglebone-black05 | dispatcher03.lavalab | beaglebone-black | | Retired | Retired: no submissions possible. | |

LAVA

- + Multiple instances for each DUT-type
- + Master/Worker split allows multiple labs
- + Scales up
- Initial setup (improved by lava-docker)
- Less detailed parsing and presentation of results compared to Fuego

LAVA

- References
 - lava documentation:
 - <https://validation.linaro.org/static/docs/v2/>
 - lava-docker:
 - <https://github.com/kernelci/lava-docker>

KernelCI

KernelCI

- Name: KernelCI
- Project: KernelCI project
- URL: <http://kernelci.org>
-
- TLDR: Test aggregation and visualization

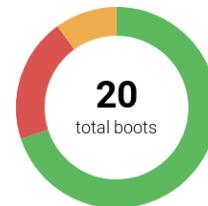
KernelCI

- KernelCI
 - is a database and webfrontend
 - lets you upload results in json
 - visualizes the results

Details for Tree «mainline» - v4.19-rc8-109-gc7b70a641df2

| | |
|-------------------|---|
| SoC | omap2 |
| Tree | mainline - - |
| Git branch | master |
| Git describe | v4.19-rc8-109-gc7b70a641df2 - - |
| Git URL | http://git.kernel.org/pub/scm/linux/kernel/git/torvalds/linux.git |
| Git commit | c7b70a641df26002e8f26e2b8122fc6a1d815a1 |
| Date | 2018-10-19 |
| Unique boards | 5 |
| Unique SoCs | 1 |
| Unique defconfigs | 3 out of 199 |

14 / 4 / 2



Conflicting Boot Reports

Boot report conflicts have been detected.

These are likely not failures since other boot labs are reporting a successful state: they need to be reviewed.

| Architecture | Defconfig | Board | Results | |
|--------------|--------------------|-----------------|---------|--------------------------|
| arm | multi_v7_defconfig | omap3-beagle-xm | 2 | <input type="checkbox"/> |

Boards Tested

All Successful Failed Unknown

Filter the results

Lab «lab-baylibre» (6 - 2 / 4 / 0) (1 architecture / 2 boards / 1 SoC / 3 defconfigs)

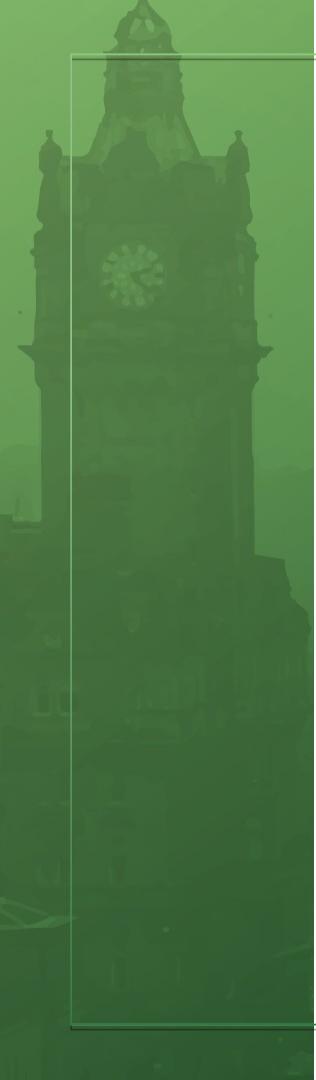


KernelCI

- + can aggregate results from multiple sources
- + multiple tools can upload results (LAVA/Fuego)
- setup (but kernelci-docker)
- UI adaptations not easy

KernelCI

- References:
 - <https://github.com/kernelci/kernelci-docker>
 - <https://github.com/kernelci/kernelci-admin>
 - <http://powerci.org>

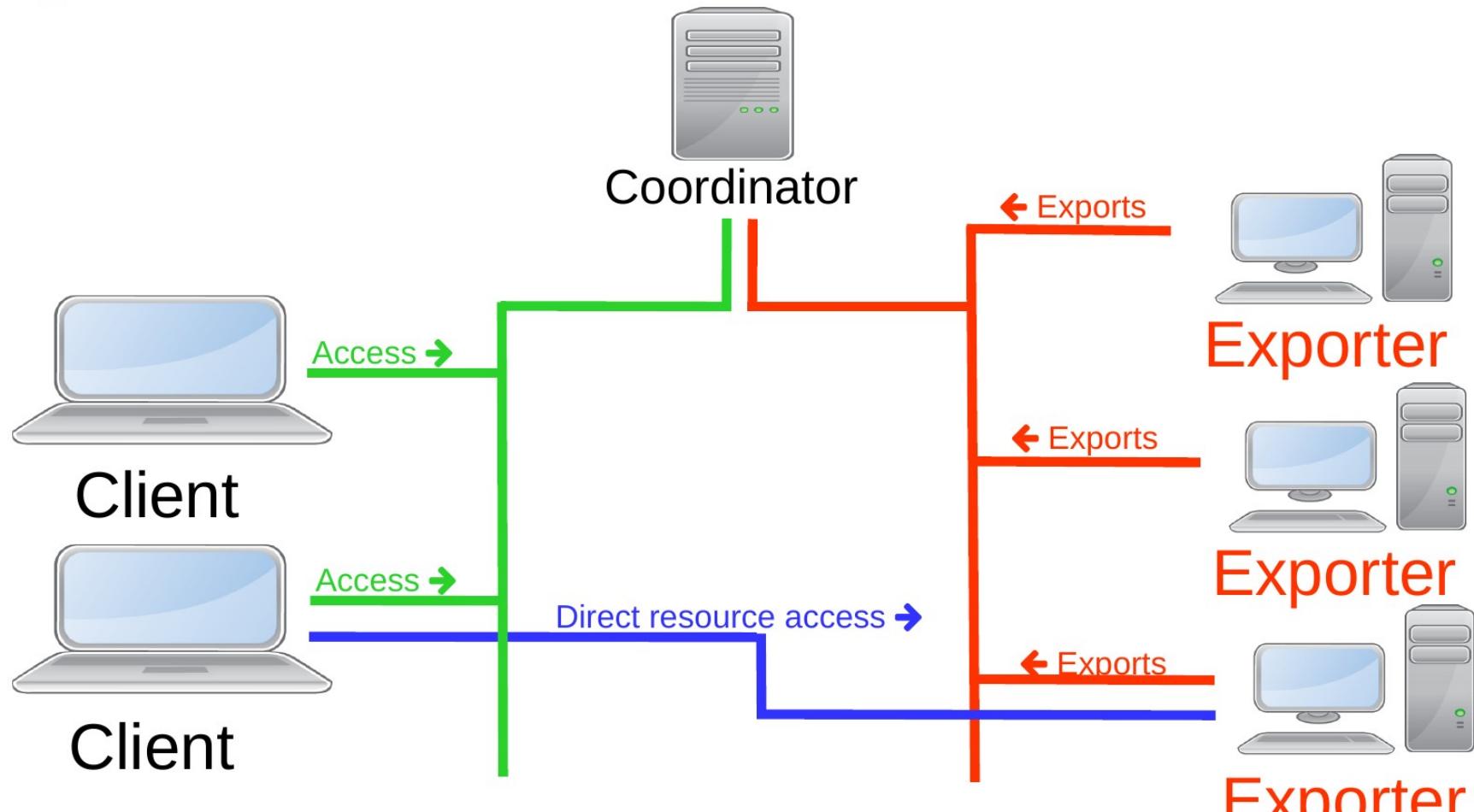


labgrid

labgrid

- Name: labgrid
- Project: labgrid-project
- URL: <https://labgrid.readthedocs.io/en/latest/>
- TLDR: abstraction of the hardware control layer needed for testing of embedded systems

Labgrid – Remote Control



labgrid

- labgrid let's you
 - expose the DUT resources
 - to \$TESTTOOL
 - to \$DEVELOPER
- in a unified manner

labgrid

- + allows automated and developer access to the DUTs
- + abstracts the HW specifics
- integration with testtools (Lava/Fuego)
- setup

labgrid

- References:
 - <https://labgrid.readthedocs.io/en/latest/>
 - <https://github.com/labgrid-project>

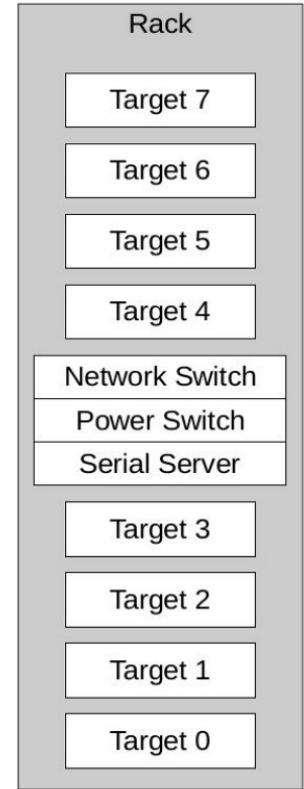
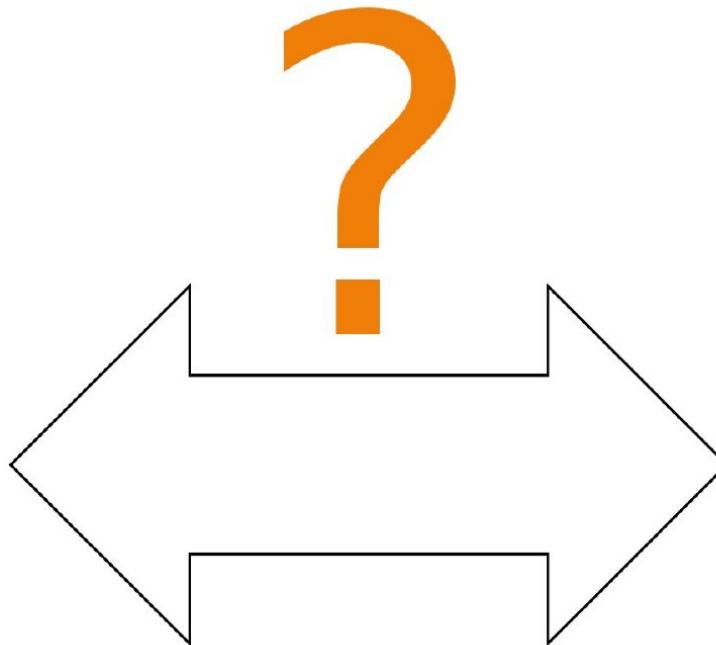


r4d

r4d

- Name: r4d
- Project: ci-rt (Real-Time LINUX)
- URL: <https://github.com/ci-rt/r4d>
- TLDR: infrastructure for power-control
and console access that plugs
into libvirt

r4d



r4d

```
$ r4dcfg --add-rack ci-rt-1 room209
```

```
$ r4dcfg --add-power ci-rt-1 pc8210 pc-ci-rt-1.lab.linutronix.de
```

```
$ r4dcfg --add-serial ci-rt-1 PS810 ds-ci-rt-1.lab.linutronix.de
```

```
$ r4dcfg --add-board ci-rt-1 6 seattle
```

r4d

- r4d
 - will manage power/serial
 - will allow remote control
 - plugs into libvirt (Jenkins!)

r4d

- + libvirt (!)
- + small
- only selected serial/power switches supported
- libvirt patches not yet upstream (but debian pkgs)

Other

For all I missed ...

- There are of course more / other frameworks
 - in the time we could just not cover all
 - please speak-up in the Q/A and lets discuss

Wrap-up and Q/A

Wrap-up

- Different frameworks have different strengths
- But what is important:
 - Collaboration
 - Test Results
 - Aggregation, Evaluation, Visualization
 - More and more boards → LABs

Q/A

- Questions ?
- Notes ?

End

- Thank you for joining!

