CE Workgroup

Introduction to the Fuego Test System

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Architecture Group Chair

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Outline

Introduction

Architecture

Customization

Vision

Introduction

Fuego = Jenkins +

Introduction

Fuego = Jenkins +
abstraction scripts +

Introduction

Fuego = Jenkins + abstraction scripts + pre-packed tests

Introduction

Fuego = (Jenkins + abstraction scripts + pre-packed tests) inside a container

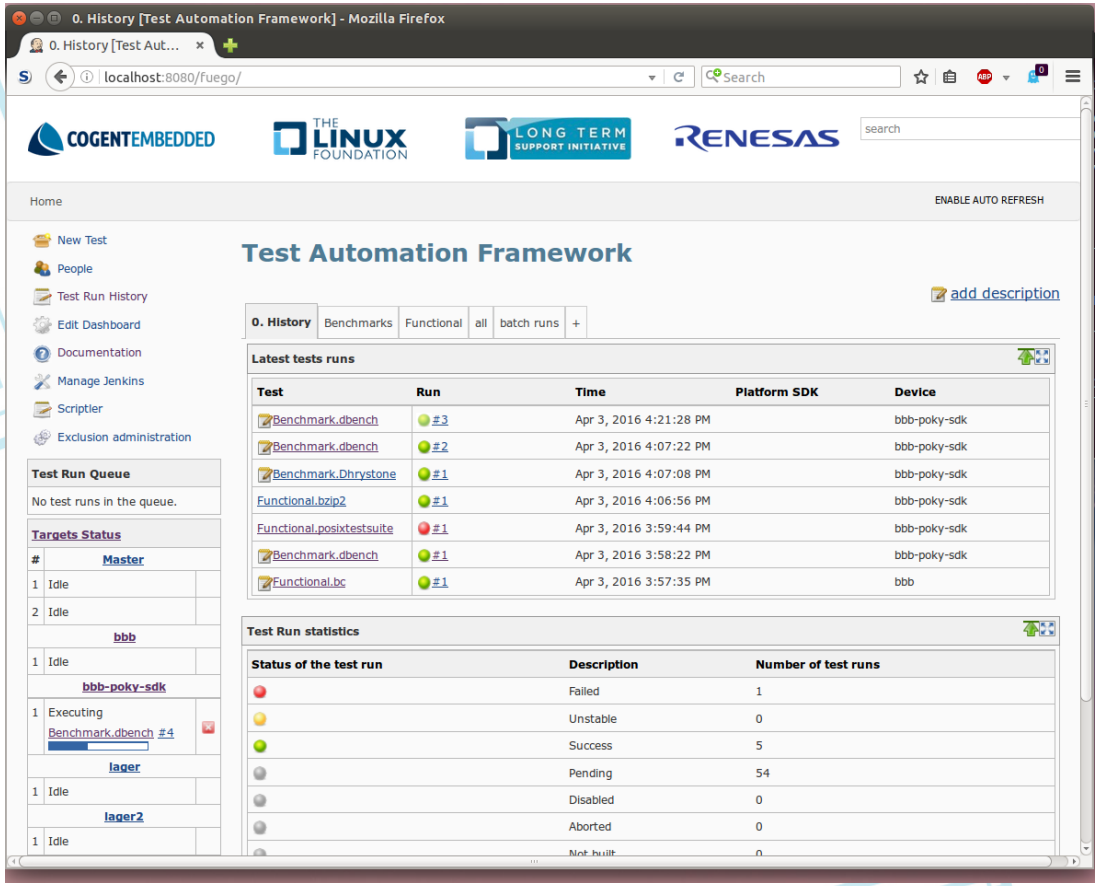
Jenkins

- Is a Continuous Integration system
- Handles all of that “continous integration-y” type stuff
  - Launches test jobs based on various triggers
  - Shows test results
  - Has an ecosystem of plugins for all kinds of extended functionality
    - E-mail notifications
    - Plotting of results
    - Integration with different source code management systems
- Is too big a system to describe in detail here

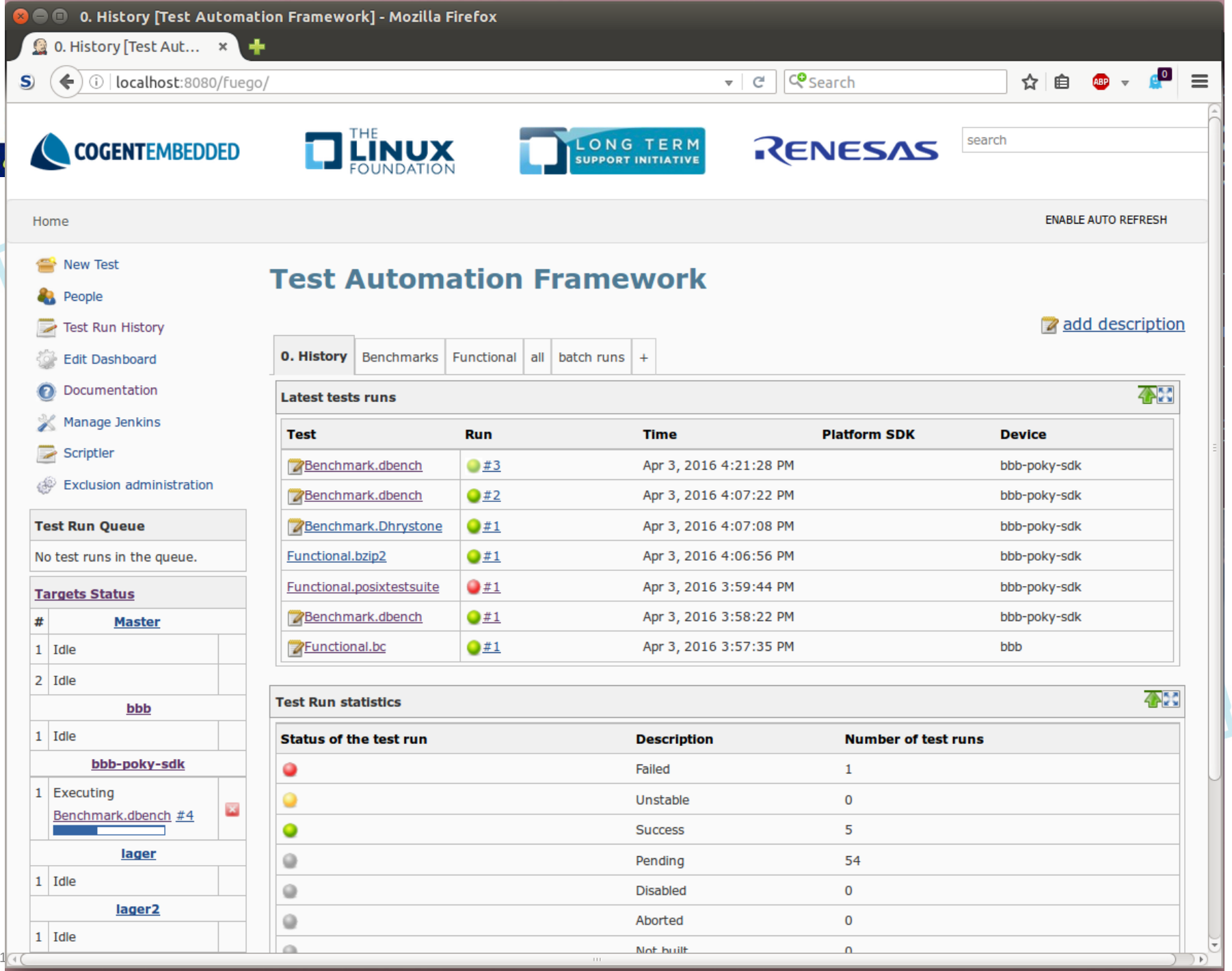
Jenkins

- Base interface:

Test history and test selection dashboard



- Fuego includes customizations to Jenkins to support host/target configurations
- Pre-install plugins for plotting and other stuff


0. History [Test Automation Framework] - Mozilla Firefox
0. History [Test Aut...
localhost:8080/fuego/
Search
COGENTEMBEDDED
THE LINUX FOUNDATION
LONG TERM SUPPORT INITIATIVE
RENESAS
search
Home
ENABLE AUTO REFRESH
New Test
People
Test Run History
Edit Dashboard
Documentation
Manage Jenkins
Scriptler
Exclusion administration
Test Run Queue
No test runs in the queue.
Targets Status
Master
1 Idle
2 Idle
bbb
1 Idle
bbb-poky-sdk
1 Executing
Benchmark.dbench #4
lager
1 Idle
lager2
1 Idle
Test Automation Framework
add description
0. History
Benchmarks
Functional
all
batch runs
+
Latest tests runs
Test
Run
Time
Platform SDK
Device
Benchmark.dbench
#3
Apr 3, 2016 4:21:28 PM
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bbb
Test Run statistics
Status of the test run
Description
Number of test runs
Failed
1
Unstable
0
Success
5
Pending
54
Disabled
0
Aborted
0
Not built
0

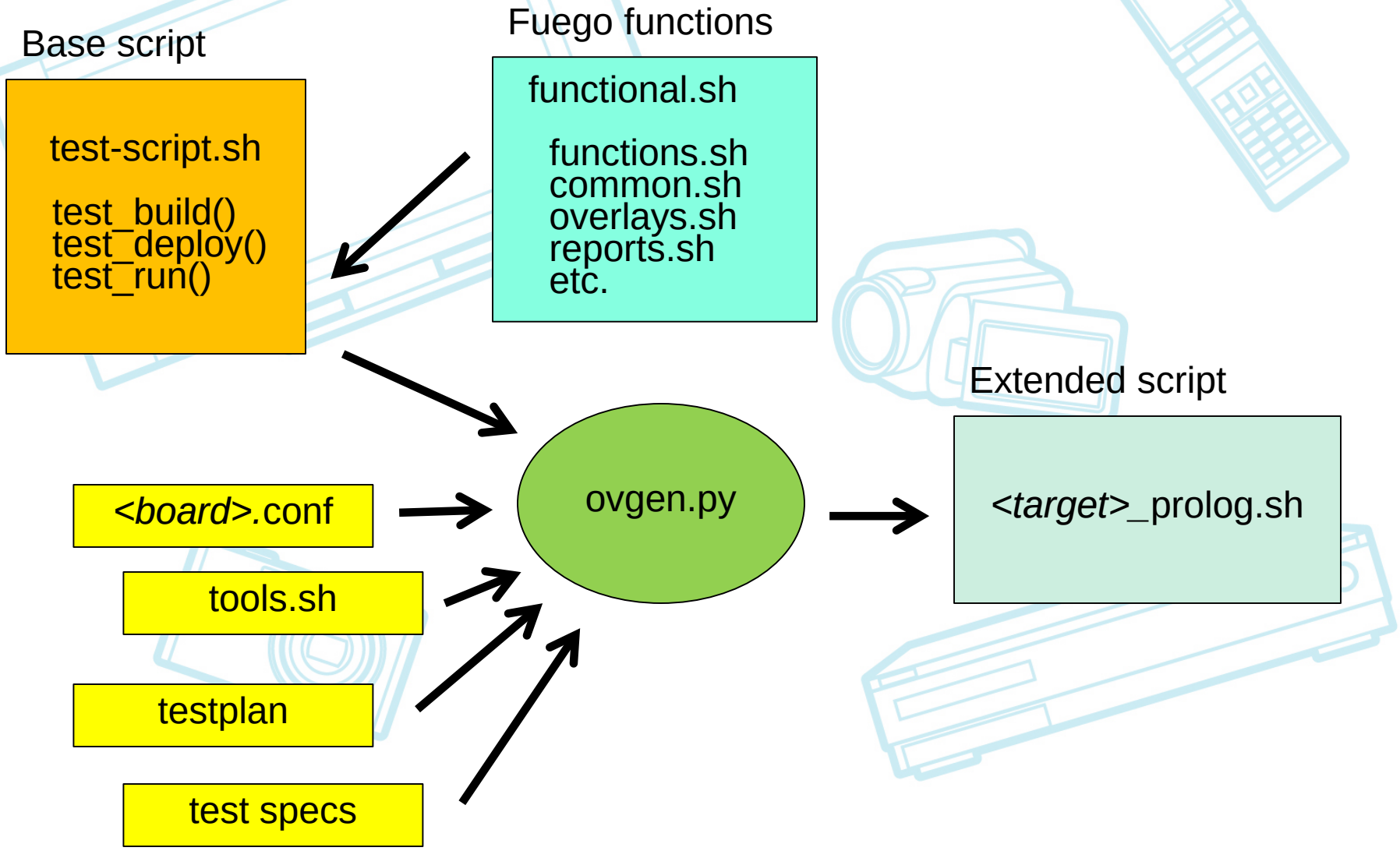
Abstraction scripts

- User defines a few variables in shell scripts, to allow system to interact with target boards
- Fuego provides shell functions for command and control of target:
  - Put/get files, execute commands, collect logs, etc.
- Fuego generates a full test script at runtime, based on board configuration, toolchain variables, and test variables
  - This allows all aspects of tests to be abstracted
    - This is a bigger deal than it sounds like

Overlay generation

- Four areas of overlayed functions and variables
  - Functions to interact with target
  - Board definitions
  - Toolchain variables
  - Test parameters
- Indirection for test program parameters
- Tests have a simple shell program wrapper
- This wrapper is expanded using an overlay generator at runtime, into a full script to execute the test and collect results

Overlay processing



Test parameter abstraction

- Being able to write tests that run in multiple configurations is important
- Fuego abstracts target access methods
- Fuego also abstracts:
  - Platform for software builds
  - Filesystem device
  - Filesystem mount points
- User can easily add new items to be abstracted
- Test plan system allows a single test to be run in multiple configurations

Pre-packaged tests

- Comes with over 50 tests, already integrated
  - aim7, blobsalad, bonnie, cyclitest, dbench, dhrystone, ebizzy, ffsb, fio, GLMark, gtkperf, hackbench, himeno, Interbench, IOzone, iperf, Java, linpack, lmbench2, nbench, netperf, netpipe, OpenSSL, reboot, signaltest, Stream, tiobench, whetstone, x11perf, aiostress, arch_timer, bzip2, cmt, crashme, expat, fontconfig, glib, ipv6connect, jpeg, libpng, linus_stress, LTP, netperf, posixtestsuite, rmaptest, scifab, scrashme, sdhi_o, stress, synctest, zlib
- Includes functional, benchmark and stress tests

Test building

- Tests are built from source
- You can use your own toolchain (/sdk)
  - Or use a pre-installed generic arm toolchain
- There's an Open Embedded meta-layer available, to help you build your own SDK in YP/OE
  - Generated SDK will have libraries and headers needed for building all tests

Inside a container

- Fuego builds a docker container
- This avoids a lot of install issues
  - Fuego can run on any Linux distro
- Builds of the test programs are 100% reproducible

Outline

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Architecture

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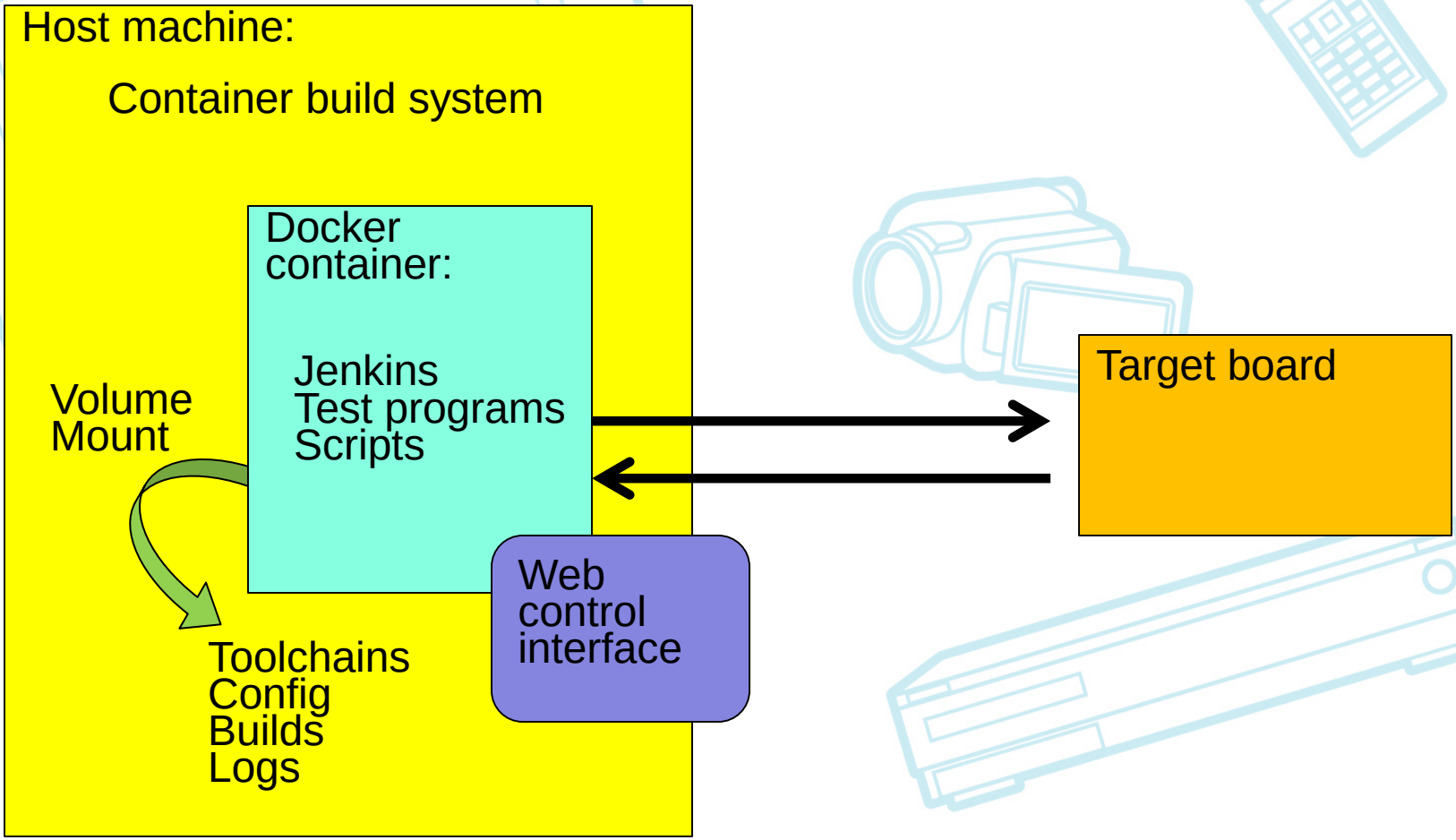
Architecture

- 2 major parts used for configuration:
  - Jenkins front-end
  - Script back-end
- Back-end is (mostly) shell-script based
  - Main interface between Jenkins and test programs is a single shell script
  - Shell is lowest common denominator language
- Very small files (glue layer) required for:
  - Log parsing
  - Results plotting

Architecture Diagram



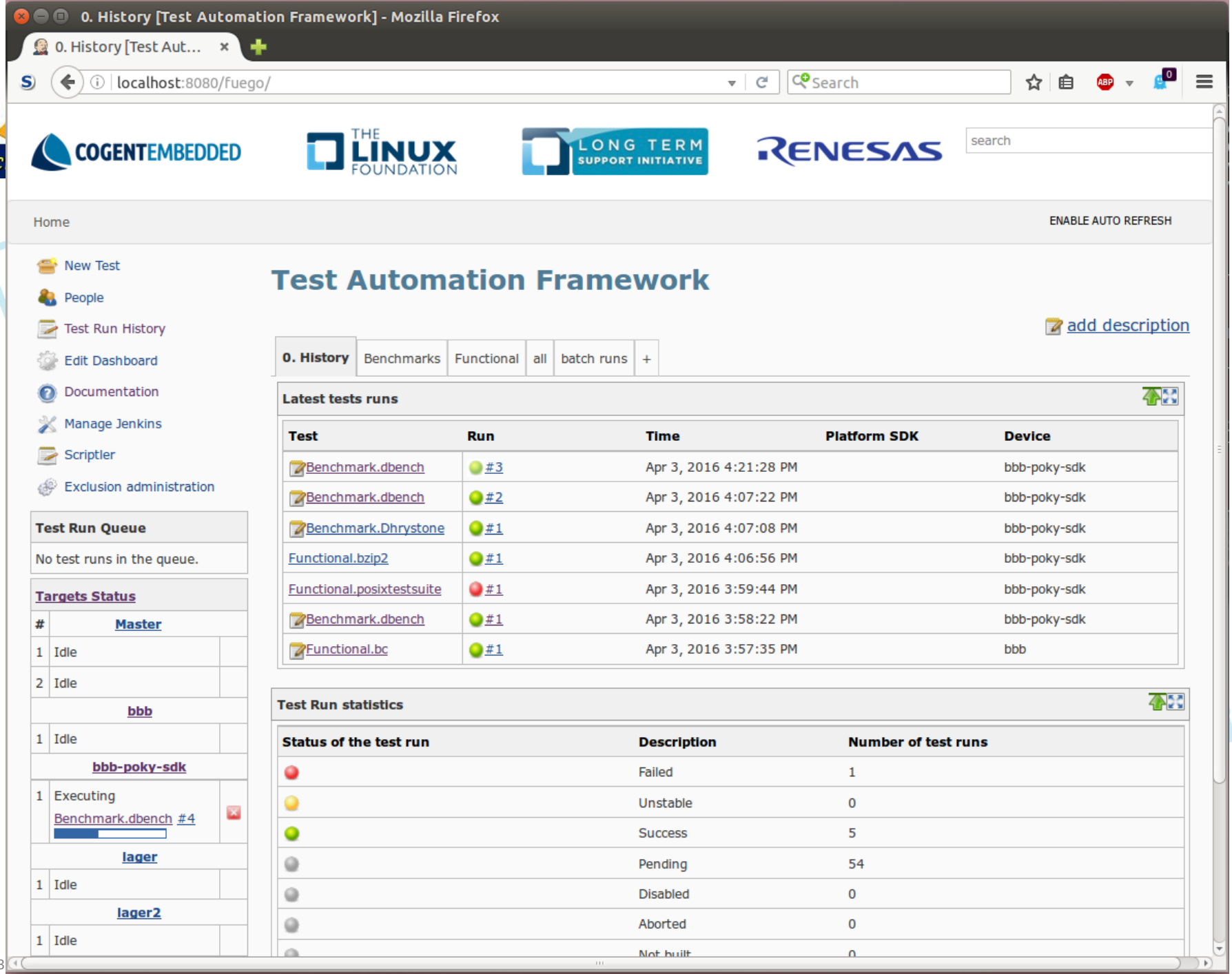
How deployed

- Comes as 2 git repositories:
  - ‘fuego’ repository - Stuff outside the container
    - Container build system
      - Including some Jenkins plugins
    - Default config and boards
    - Host scripts for controlling the container
    - Documentation
  - ‘fuego-core’ repository - Stuff inside the container
    - Script and overlay engine
    - Pre-packaged tests
    - More jenkins extensions
- Fuego-core is downloaded for you during the container image build

Getting it and using it

- git clone https://bitbucket.org/cogentembedded/fuego.git
- cd fuego ; ./install.sh
  (wait a bit)
- fuego-host-scripts/docker-create-container.sh
- fuego-host-scripts/docker-start-container.sh
- firefox http://localhost:8080/fuego

- Optionally, to get additional shell prompts inside the container:
  - docker exec -i –t <*container_id*> bash
  - sshd <*user*>@localhost –p 2222
    - Requires that you create a user account inside the container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Test Automation Framework
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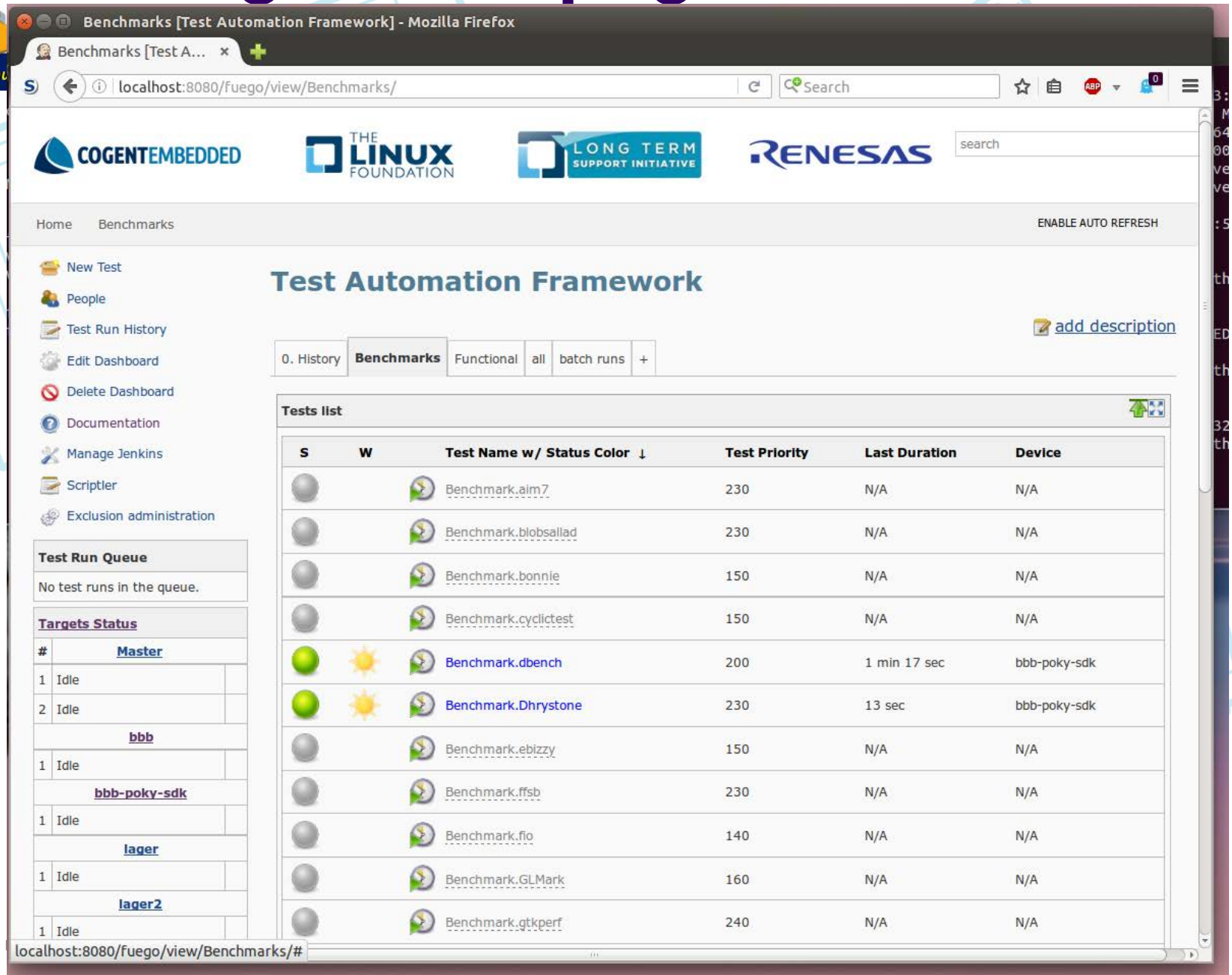
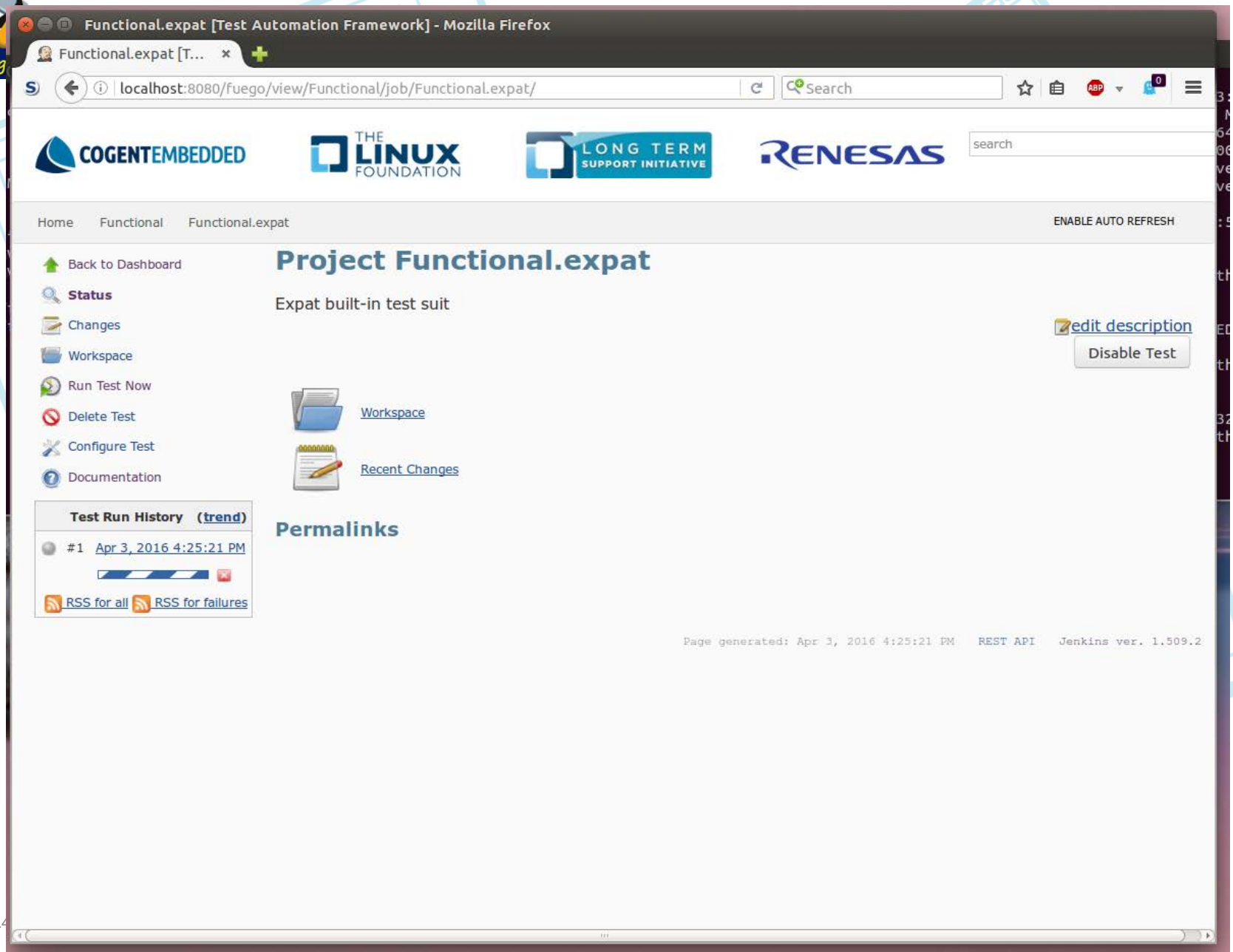
Running a test (manually)

- Select a test
- Select the target
- Select the testplan
- Push “Run the test”

Fuego tests page



Individual test page



Outline

Introduction
Architecture
Customization
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Customization

- Add a board configuration
- Add a toolchain
- Add a test

Add a board

- Overview:
  - Add a board file
  - Add the new target in the Jenkins interface

The board file

- Board file is a shell script with some variable that describe the board
- Create file in userdata/conf/boards, with filename “<target-name>.board”
  - There are examples there already
- Define IP address, ssh port, file system info (device, partitions, etc.)
- PLATFORM - indicates which SDK to use for building test programs

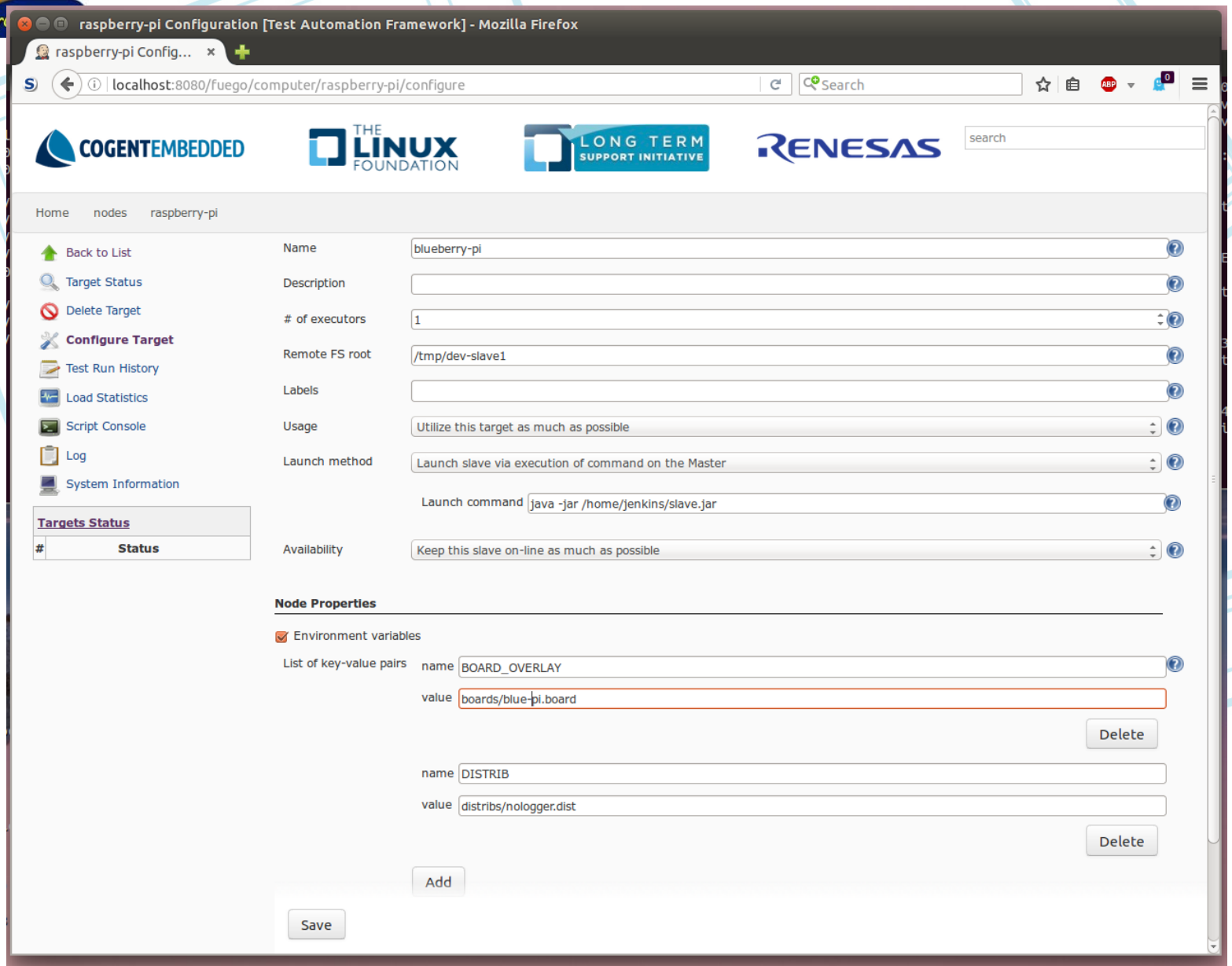
Board file sample (qemu-arm)

```
inherit "base-board"
include "base-params"

IPADDR="172.17.0.1"
SSH_PORT=5555
LOGIN="root"
FUEGO_HOME="/home/a"
PASSWORD="adm"
PLATFORM="qemu-armv7hf"
TRANSPORT="ssh"
ARCHITECTURE="arm"

SATA_DEV="/dev/sdb1"
SATA_MP="/mnt/sata"

USB_DEV="/dev/sda1"
USB_MP="/mnt/usb"

MMC_DEV="/dev/mmcblk0p2"
MMC_MP="/mnt/mmc"

LTP_OPEN_POSIX_SUBTEST_COUNT_POS="1319"
LTP_OPEN_POSIX_SUBTEST_COUNT_NEG="169"

EXPAT_SUBTEST_COUNT_POS="1769“”
EXPAT_SUBTEST_COUNT_NEG="41"
```

Add the target in Jenkins

- Go to Target Status in main screen
- Select “New Node”
  - Enter name, and copy from “template-dev”
- Reference the board file
  - Set Environment Variable BOARD_OVERLAY to “boards/<target-name>.board”

Interface for adding a board



Adding a toolchain

- Generic qemu ARM toolchain is pre-installed
- To install your own (overview):
  - Obtain or build your SDK
  - Install it inside the container in /userdata/toolchains
  - Modify /userdata/conf/tools.sh to reference it

Get SDK into the container

- To build the SDK in Yocto Project:
  - Inside your yocto build directory:
    - bitbake <*image-name*> -c do_populate_sdk
    - docker ps *(note the container id)*
    - docker cp tmp/deploy/sdk/poky-*.sh <*container-id*>:/tmp
- Install the SDK in the container:
  - At the shell inside the container:
    - /tmp/poky-....sh
      - (specify an installation path under /userdata/toolchains, like: /userdata/toolchains/poky/2.0.1)

Tell Fuego about SDK

- Add an entry to /userdata/conf/tools.sh for this toolchain
- Determine a platform name
- Add a new section to the tools.sh
  - Declare variables used by the toolchain in userdata/conf/tools.sh file
    - e.g. PREFIX, ARCH, CC, AS, LD, etc.
  - Can use a Yocto Project environment_setup script, and wrapper a few things
    - In this case, set SDKROOT variable
  - See tools.sh for examples
- Set PLATFORM environment variable in board file

Adding a test - overview

- A Fuego test consists of:
  - Actual test program (the thing that runs on the target)
    - Shipped as source
  - Test shell script
  - Results parser script (for benchmarks)
  - Results evaluator expression (for benchmarks)
  - Jenkins test declaration
- Test can be Functional or Benchmark

Functional tests

- Detects regressions
- Result is pass/fail
- Stress tests are defined as functional tests

Benchmark tests

- Integrated plotting
- Parser to obtain value from test log
- Specification for data name and threshold for pass/fail

Test program

- Usually a pre-existing, compiled test program
- Source and patches are shipped in fuego-core repository
- Is cross-compiled by fuego for each target

Test script

- Shell script describes how to:
  - Build the test program (if applicable)
  - Deploy the test to the target
  - Execute the test on target, and collect results
  - Test for success or failure, by examining the log
- Specifically define the following functions:
  - test_build, test_deploy, test_run, test_processing
- Include a fuego engine script
- Script calls fuego functions to perform operations with the target

Fuego functions

- Fuego functions available in test scripts:
  - put/get – transfer files to/from target
  - cmd – execute command on target
  - report – execute command, and put results in log
  - log_compare – check log for a pattern, to check for pass or fail
  - hd_test_mount_prepare – mount a filesystem for a test
  - hd_test_clean_umount – unmount a filesystem after a test
- There are more
  - See examples in other scripts

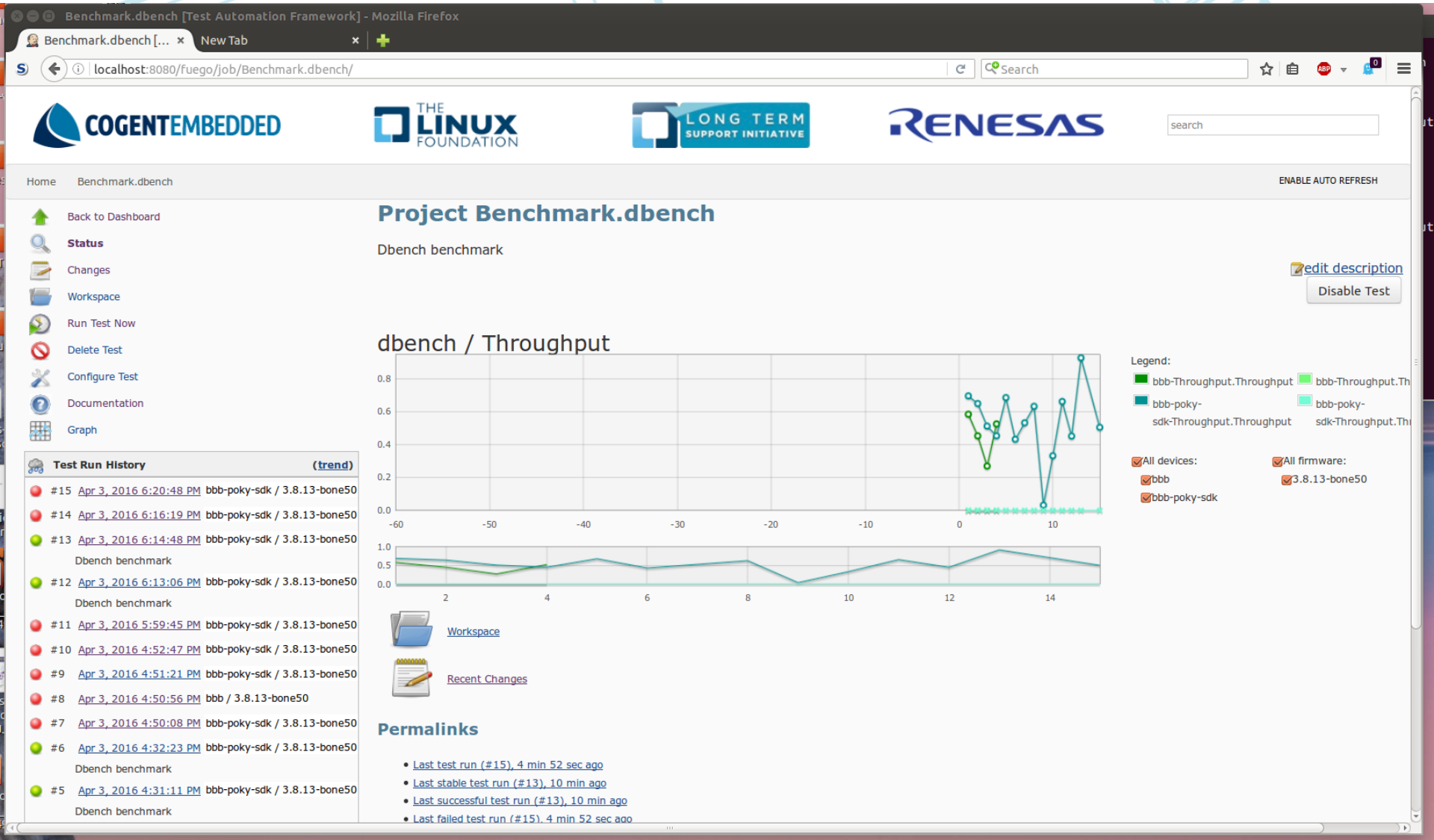
Shell script example

```
tarball=synctest.tar.gz

function test_build {
    make && touch test_suite_ready || build_error "error while building  test"
}

function test_deploy {
        put synctest  $FUEGO_HOME/fuego.$TESTDIR/
}

function test_run {
    assert_define FUNCTIONAL_SYNCTEST_MOUNT_BLOCKDEV
    assert_define FUNCTIONAL_SYNCTEST_MOUNT_POINT
    assert_define FUNCTIONAL_SYNCTEST_LEN
    assert_define FUNCTIONAL_SYNCTEST_LOOP

    hd_test_mount_prepare $FUNCTIONAL_SYNCTEST_MOUNT_BLOCKDEV \
        $FUNCTIONAL_SYNCTEST_MOUNT_POINT
    report "cd $FUNCTIONAL_SYNCTEST_MOUNT_POINT/fuego.\
        $TESTDIR; $FUEGO_HOME/fuego.$TESTDIR/synctest  \
        $FUNCTIONAL_SYNCTEST_LEN  \
        $FUNCTIONAL_SYNCTEST_LOOP"

    hd_test_clean_umount $FUNCTIONAL_SYNCTEST_MOUNT_BLOCKDEV \
        $FUNCTIONAL_SYNCTEST_MOUNT_POINT
}

function test_processing {
        log_compare "$TESTDIR" "1" "PASS : sync interrupted" "p"
}

. $FUEGO_SCRIPTS_PATH/functional.sh
```

Benchmark extras

- Extra files for plotting benchmark data
  - Parsing the test results (parser.py)
    - Extracts data from the log, using a regular expression, and formats it into a python map
  - Specifying a benchmark threshold for pass/fail
    - put an expression in reference.log file
- Modify userdata/logs/tests.info
  - Add a line describing the test and the results to plot
    - Use the name(s) emitted by parser.py

Plot example



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Vision

- Allow quick and easy setup
- Support a wide variety of configurations and build systems
  - Yocto Project/OE, Buildroot, etc.)
- Support a wide variety of target types:
  - serial, ssh, adb, ttc
- Send data to centralized repository
- Make it possible to join a decentralized test network
  - Help solve the “developer can’t test on different harware” problem

Next Steps

- De-clutter the Jenkins front end

- Improve documentation
- Handle USB connections
  - For ADB-based targets
  - For Sony debug board

Next Steps (cont.)

- More tests
  - kselftest
  - kernelci ??
  - Look for a vertical to build out the test suite
- Send results to a centralized repository

Resources

- http://elinux.org/Fuego
- http://bird.org/fuego/FrontPage
- Dedicated mail list (to come)
  - Using LTSI-dev@lists.linuxfoundation.org for now

Why “Fuego”?

- Former name was JTA (Jenkins-based Test Automation)
  - Not a very good name
- Fuego = Tierra del Fuego - one of the places on earth where penguins live
- Fuego = Fire – often associated with trials and purifying
- Fuego – it sounds neat

Fuego

It’s hot!

Come play with Fuego!