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# Introduction of AGL's approach to Fuego

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AGL ALL Member Meeting, Tokyo

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# Self Introduction

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- Kyohei Oki(kyohei.oki@jp.fujitsu.com)
- Automotive Software Engineer (2015 ~ )
- AGL CIAT Member (2016 ~ )
  - engaging on CIAT for AGL
  - especially Fuego

# Agenda

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- **What** is Fuego
- **How** to use Fuego
- **Introduction** to Fuego test results report
- **Introduction** to Fuego LTP network test
- **Fuego Roadmap**
- **Our Future Work**

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# What is Fuego

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- A test system specifically designed for embedded Linux testing. （Refer to: http://fuegotest.org/）

- Automated test framework for Kernel's LTSI

- Features
  - source code management
  - test code build & deploy
  - tests executing & results report

- Advantages
  - highly customizable & unified test outputs
  - flexible test configuration & running tests in batches
  - board setup is simple & flexible
  - 50 pre-packaged tests & do tests with command lines

# What is Fuego

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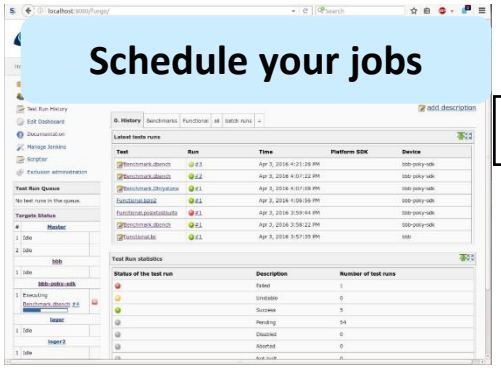
## ➢Have a look at the interior of Fuego




Start

Web control interface

**Host Machine:**

Container build system

2 repositories:

-fuego(e.g. docker build scripts)

-fuego-core

**Docker container:**

- **Jenkins**
- **Test programs**
- **Scripts(Shell/Python)**

**Volume Mount**

-pre-packaged tests

-builds & logs

-configs

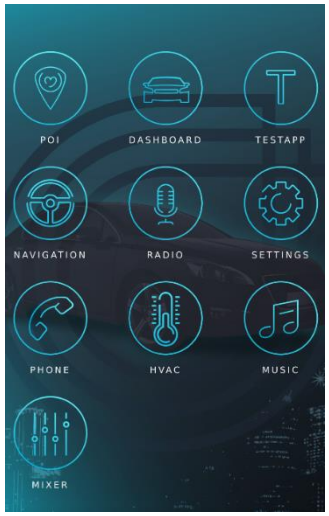
Run

SSH Connect

Get results

R-Car M3

+




Show results

# What is Fuego

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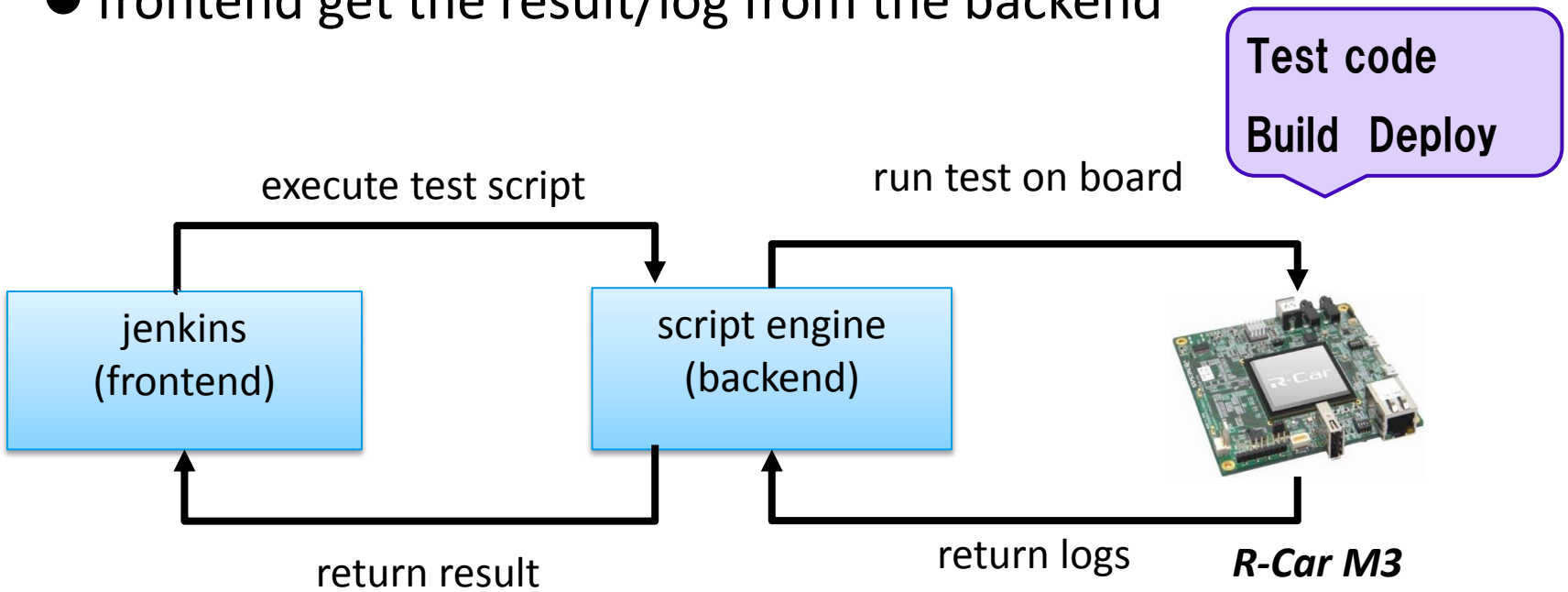
## ➢Have a look at Fuego work flow

- frontend(jenkins) call backend(script engine) to run test cases
- backend do the works
  - Build test cases for the target board
  - Run test cases on target board
  - Parse test logs and show the summary to users
- frontend get the result/log from the backend



# How to use Fuego

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1. Build the Fuego container
2. Add board file to Fuego
3. Add a yocto project toolchain
4. Add board to Jenkins Interface
5. Add some jobs to Fuego
6. Run tests with Fuego

Each step will be explained in detail

# How to use Fuego

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## 1.Build the Fuego container

### 1.1 download the latest code from Fuego repository

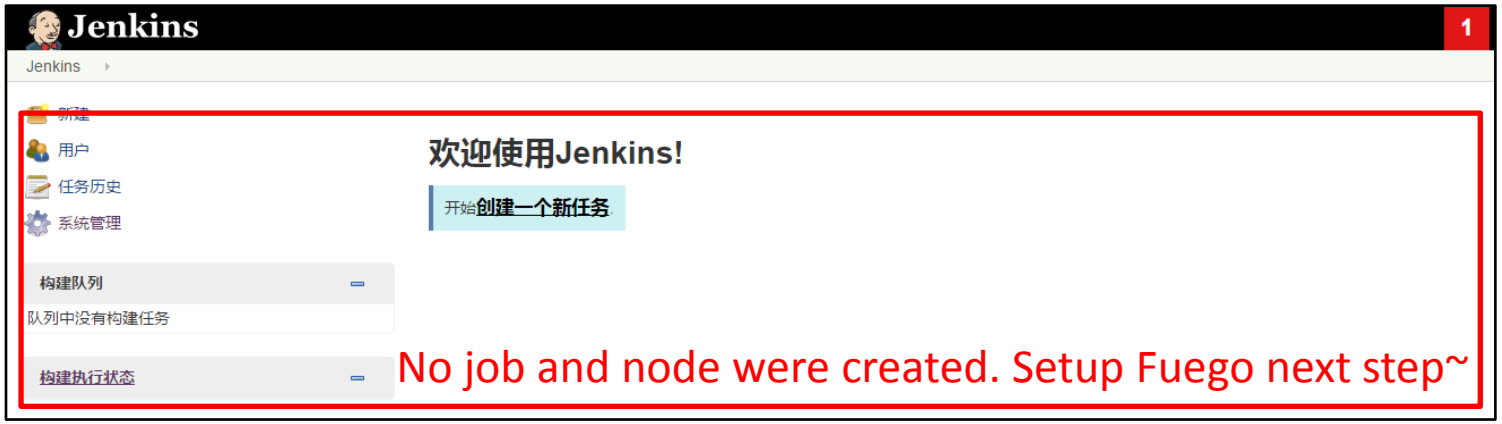
```
$ git clone https://bitbucket.org/tbird20d/fuego.git
$ git clone https://bitbucket.org/tbird20d/fuego-core.git
```

### 1.2 create the docker image

```
$ cd fuego ; ./install.sh
$ fuego-host-scripts/docker-create-container.sh
$ fuego-host-scripts/docker-start-container.sh
```

### 1.3 Now, the container build step is done

```
# We can access to the web control page with the URL below.
$ firefox http://localhost:8080/fuego
```



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# 2.Add board file to Fuego

Customize your own board file(example with R-Car M3)

```
# cd fuego-ro/boards
$ cp template-dev.board m3ulcb.board
# change the value according to your own env.
$ cat m3uclb.board
……
IPADDR="192.168.10.6"
LOGIN="root"
BOARD_TESTDIR="/home/a"
PASSWORD=""
#SSH_KEY="path/to/id_rsa"
PLATFORM="m3ulcb"
TRANSPORT="ssh"
ARCHITECTURE="arm64"
SATA_DEV="/dev/sdb1"
SATA_MP="/mnt/sata"

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

IP address or hostname of the target machine.

Decide which toolchain will be used.

Change this to one of “arm ia32 x86_64 arm64 other”

Next, we need to add a yocto toolchain to Fuego.

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# 3.Add a yocto project toolchain(example with R-Car M3)

## 1. generate toolchain

```
# build yocto sdk
$ bitbake agl-demo-platform -c do_populate_sdk
# toolchain will be generated at “./tmp/deploy/sdk/”
```

## 2. install the toolchain inside the container

```
$ ./poky-agl-glibc-x86_64-meta-toolchain-aarch64-toolchain-*.sh
# install the toolchain to “/opt/poky-agl/m3ulcb” in container.
```

## 3. Create a ${PLATFORM}-tools.sh file for the toolchain

```
$ cat fuego/fuego-ro/toolchains/m3ulcb-tools.sh
# this script should be sourced by ${FUEGO_RO}/toolchains/tools.sh
SDKROOT=/opt/poky-agl/m3ulcb/sysroots/aarch64-agl-linux
# the Yocto project environment setup script changes PATH so that python uses
# libs from sysroot, which is not what we want, so save the original path
# and use it later
ORIG_PATH=$PATH
PREFIX=aarch64-agl-linux
#export_tools

source /opt/poky-agl/m3ulcb/environment-setup-aarch64-agl-linux
HOST=aarch64-agl-linux
```

Note: we can also install debian-based toolchain with “install_cross_toolchain.sh”.

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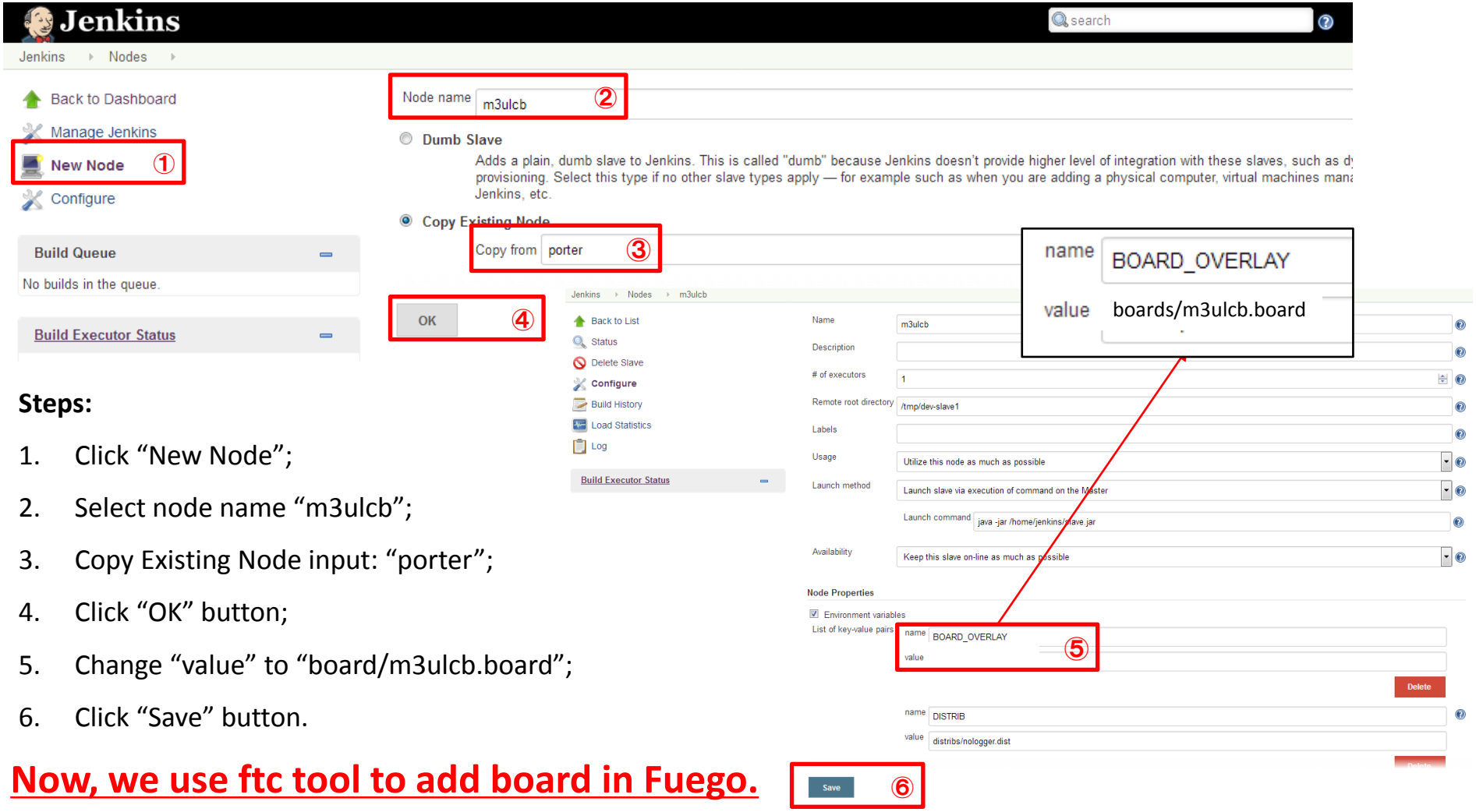
# 4.Add board to Jenkins Interface

Before, how to add boards to **AGL-JTA**? (example with R-Car M3)




**Steps:**

1. Click “New Node”;
2. Select node name “m3ulcb”;
3. Copy Existing Node input: “porter”;
4. Click “OK” button;
5. Change “value” to “board/m3ulcb.board”;
6. Click “Save” button.

**Now, we use ftc tool to add board in Fuego.**

# How to use Fuego

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We can use ftc tool to add board in Fuego.

What is ftc tool:

- FTC is the "fuego test control" tool.
- a command line tool used to perform various functions in the fuego system.

## What we can do with ftc tool:(example with R-Car M3)

Use ftc tool to add board(called “node” in Jenkins interface)

```
$ ftc add-nodes m3ulcb
```

Add specified jobs for specified target

```
$ ftc add-jobs –b m3ulcb –t Functional.bc –s bc-add
Or
$ ftc add-jobs –b m3ulcb –p testplan_agl
```

Run tests

```
$ ftc run-test -b m3ulcb -t Functional.bc –p dr
```

Those ftc commands above will be used in next steps.

# How to use Fuego

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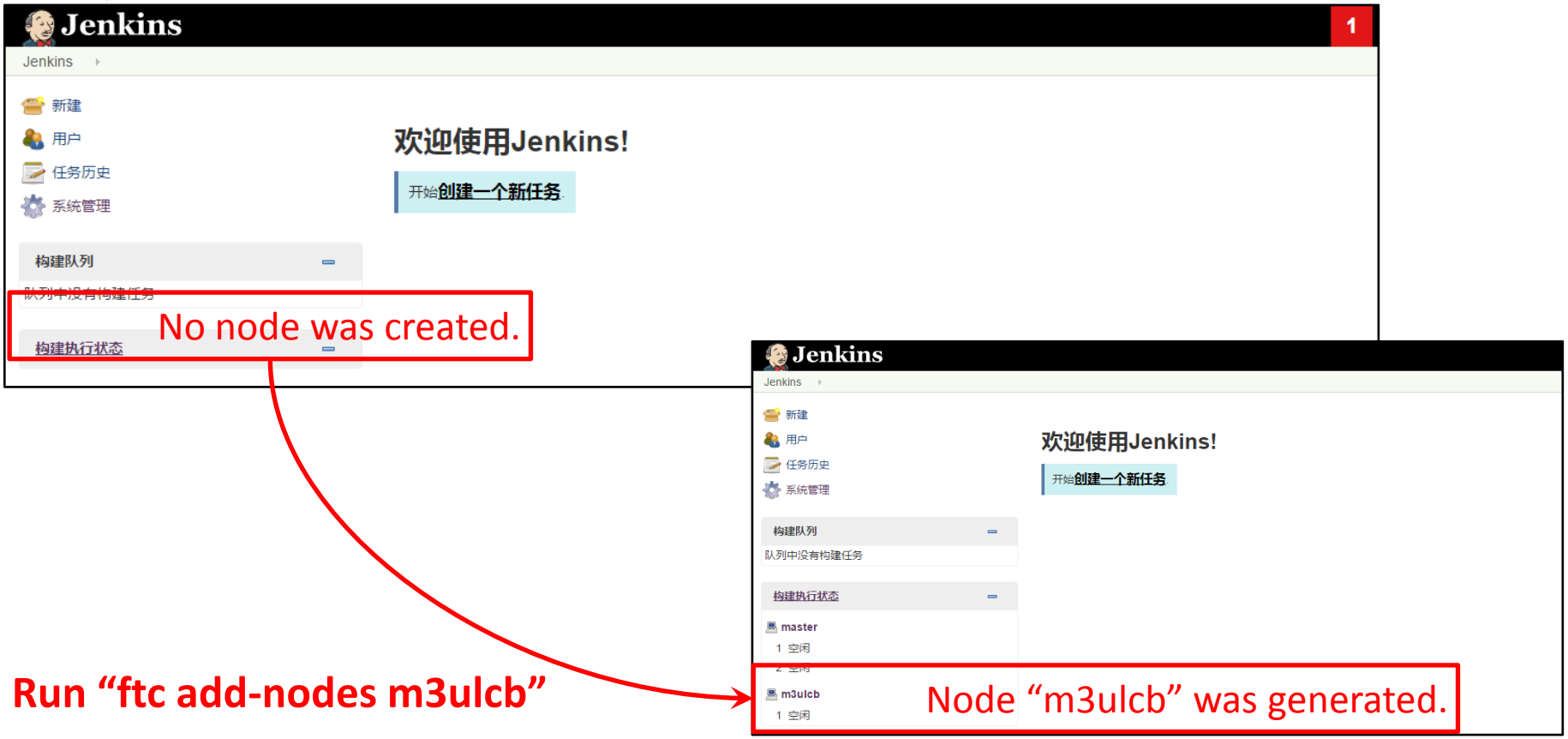
Now, add node to **Jenkins** interface as below

```
# Now, we use ftc tool to add a node to Jenkins interface
$ ftc add-nodes m3ulcb
```

Then, we will find that a node named “m3ulcb” will be created.




**Run “ftc add-nodes m3ulcb”**

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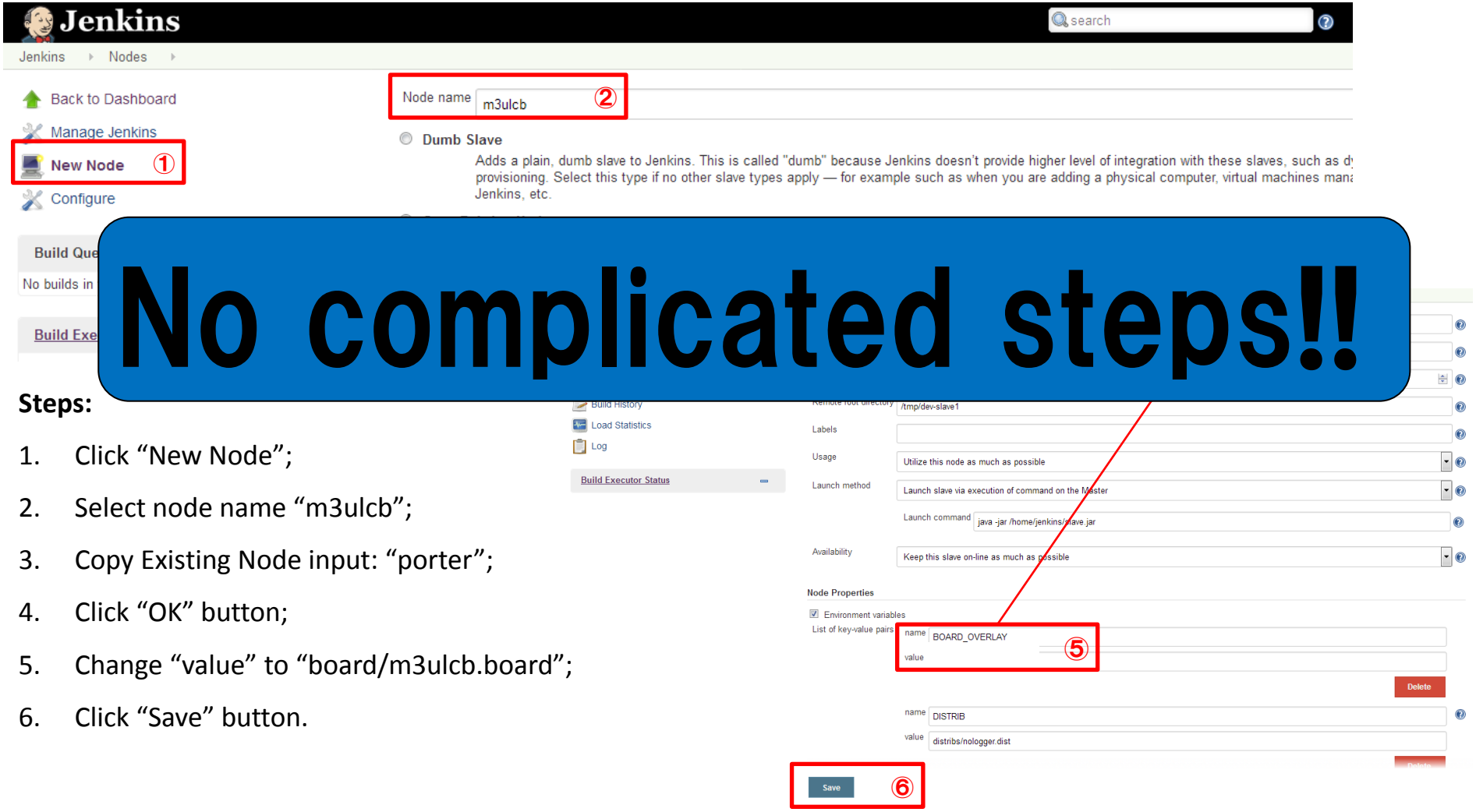
# 4.Add board to Jenkins Interface

Before, how to add boards to **AGL-JTA**? (example with R-Car M3)




**No complicated steps!!**

**Steps:**

1. Click “New Node”;
2. Select node name “m3ulcb”;
3. Copy Existing Node input: “porter”;
4. Click “OK” button;
5. Change “value” to “board/m3ulcb.board”;
6. Click “Save” button.

**Now, we use ftc tool to add board in Fuego.**

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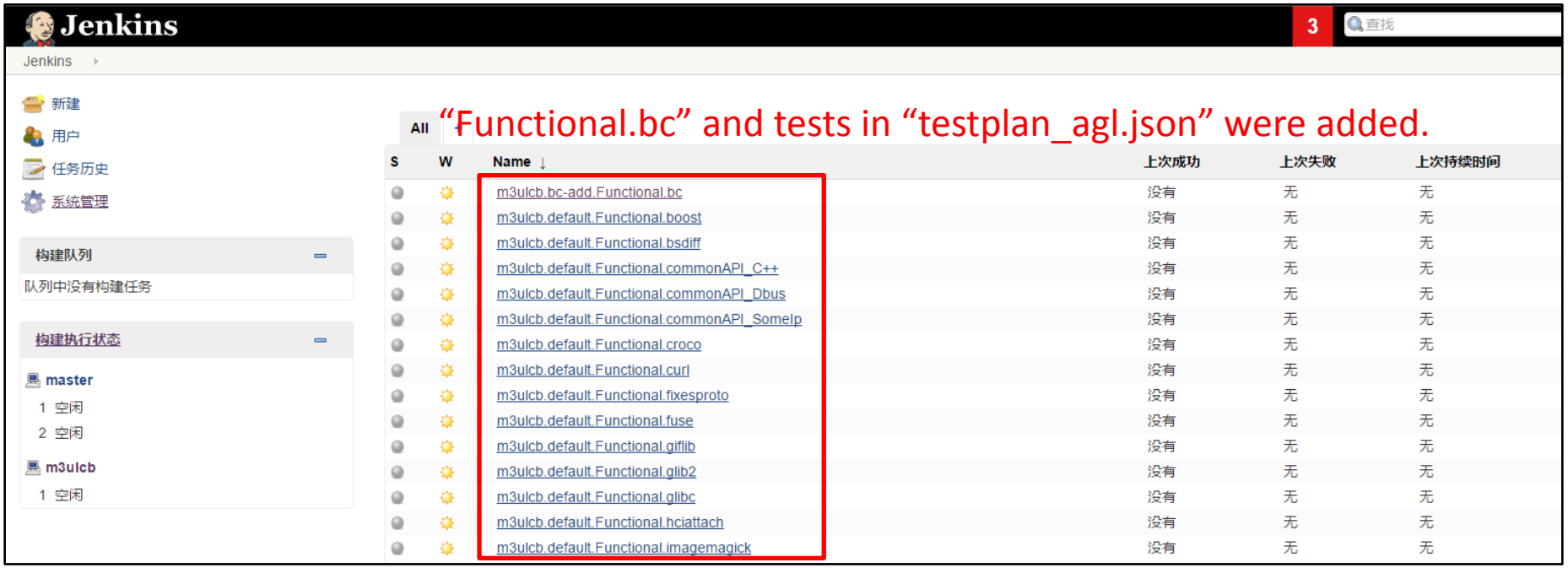
# 5.Add some jobs to Fuego(example with R-Car M3)

Add some tests to the Jenkins interface.

```
# add a job for demo
$ ftc add-jobs -b m3ulcb -t Functional.bc -s bc-add

# add a batch agl jobs
$ ftc add-jobs -b m3ulcb -p testplan_agl
```

Check that all jobs have been generated as below.



# How to use Fuego

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## 6.Run tests with Fuego(example with Functional.bc on R-Car M3)

### 6.1 Run tests with ftc tool,

```
# run job “m3ulcb.bc-add.Functional.bc”
$ ftc run-test –b m3ulcb –t Functional.bc –s bc-add
……
Notice: non-Jenkins test request detected
Running test 'Functional.bc' on board 'm3ulcb' using spec 'bc-mult'
!!! >>> Ready to run test! <<< !!!
DEBUG: python var build_number=1
Running remotely on 'm3ulcb' in workspace /fuego-rw/buildzone
DEBUG: python var command=timeout --signal=9 30m /bin/bash
……
chart_config.json not available or is wrong format, using default values
Writing chart data to /fuego-rw/logs/Functional.bc/flot_chart_data.json
+ rc=0
+ '[' 0 -eq 1 ']'
+ echo 'Fuego: requested test phases complete!'
Fuego: requested test phases complete!
+ exit 0
```

About “ftc run-test” :

- the same as running tests with Jenkins interface.
- useful to debug test during tests development.

# How to use Fuego

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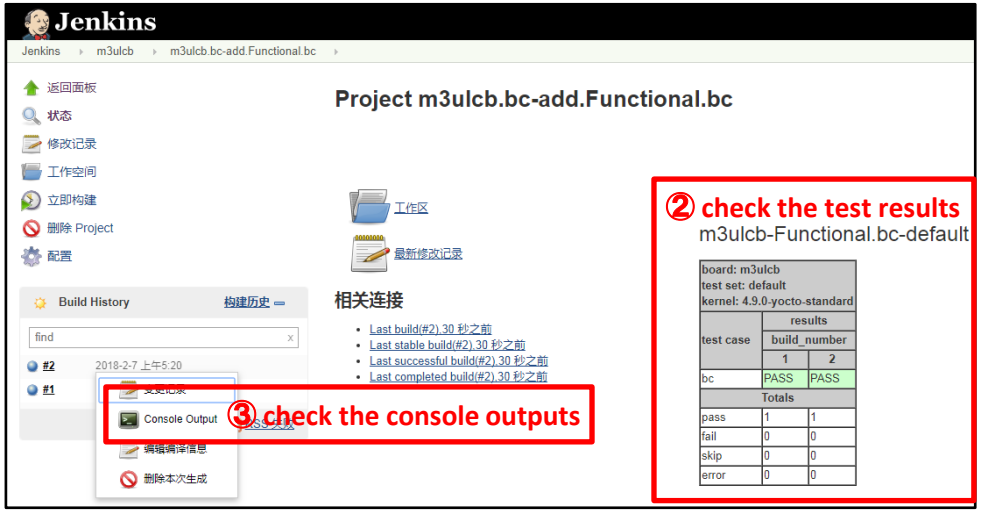
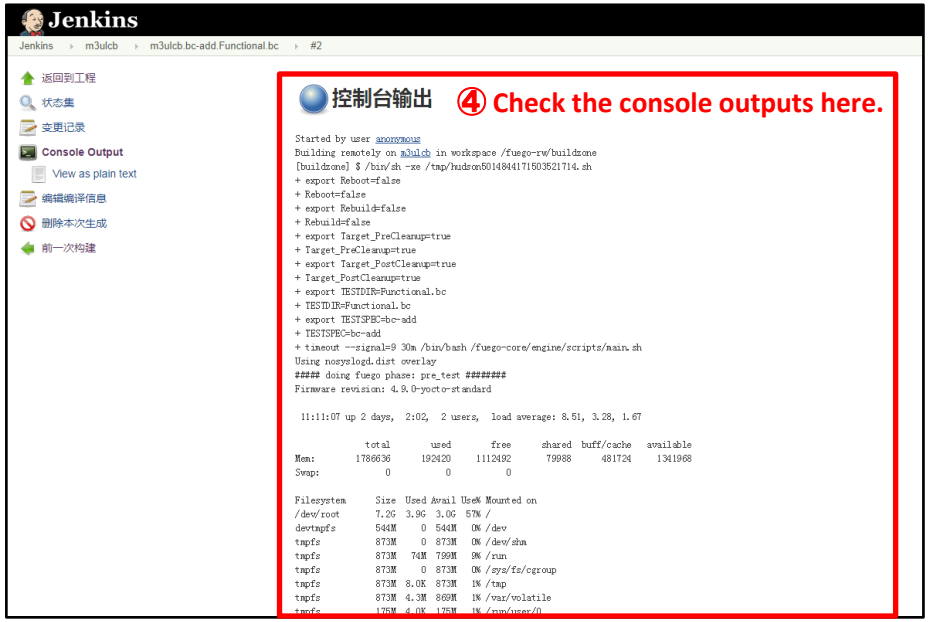
## 6.2 Run tests with Jenkins interface


**Advantages:**

**- Easy to check the output of tests and Jenkins.**

**- Clear description for Jenkins related errors.**

**But for tests that have heavy logs, it will be hard for us to locate the error output easily.**

**So, let's make some changes.**

# Introduction to Fuego test results report

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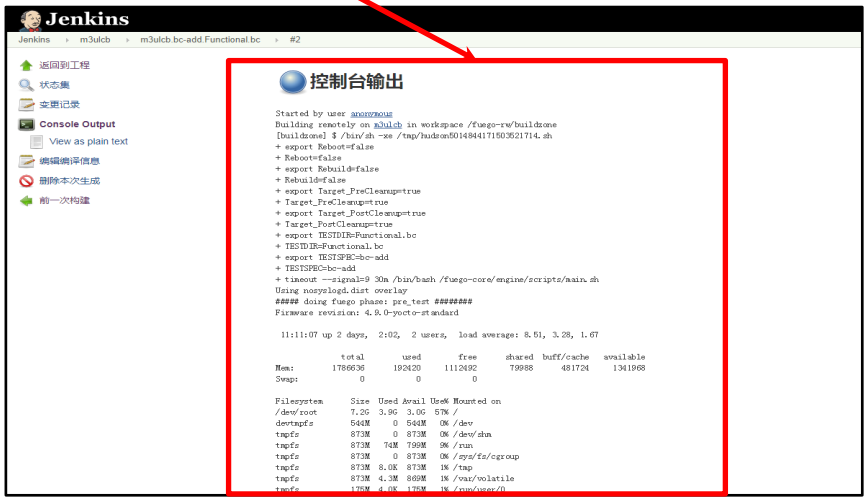
About the test results, what we want is as below.
How should we?

m3ulcb-Functional.LTP-net.multicast

| board: m3ulcb<br>test set: net.multicast<br>kernel: 4.9.0-yocto-standard | | |
|---|---|---|
| test case | results | |
| | build_number | |
| | 1 | 2 |
| mc_cmds | PASS | PASS |
| mc_commo | PASS | PASS |
| mc_member | PASS | PASS |
| mc_opts | PASS | PASS |
| Totals | | |
| pass | 4 | 4 |
| fail | 0 | 0 |
| skip | 0 | 0 |
| error | 0 | 0 |


**Advantage:**
- Compare the results of different build.

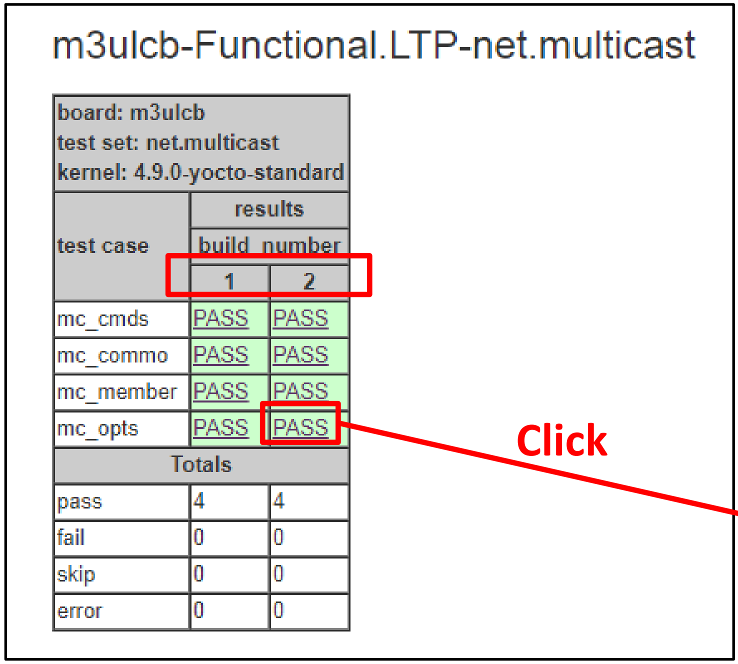
**Disadvantage:**
- Check the error log difficulty

**We need to search error points.**

# Introduction to Fuego test results report

About the test results, what we want is as below.

How should we?

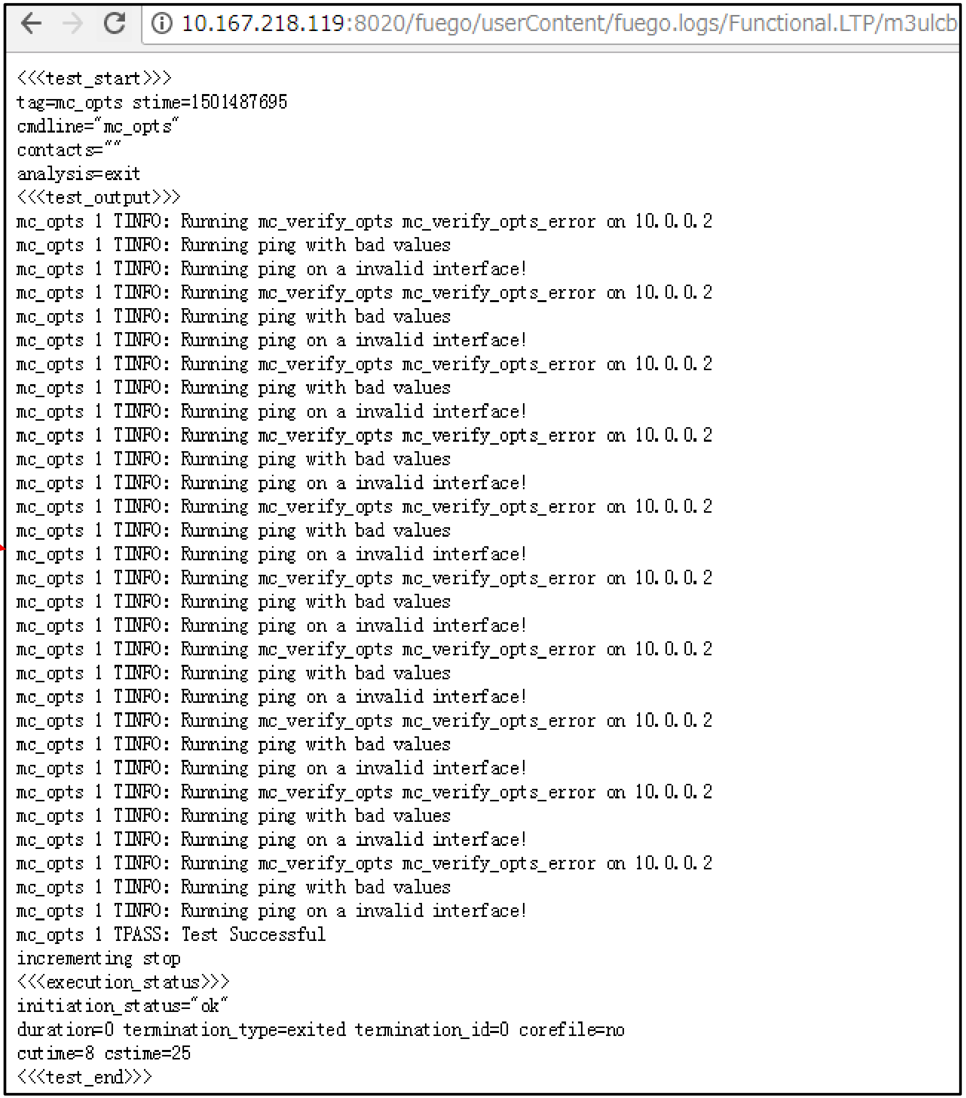


## m3ulcb-Functional.LTP-net.multicast

**board: m3ulcb**
**test set: net.multicast**
**kernel: 4.9.0-yocto-standard**

| test case | results | |
|---|---|---|
| | build_number | |
| | 1 | 2 |
| mc_cmds | PASS | PASS |
| mc_commo | PASS | PASS |
| mc_member | PASS | PASS |
| mc_opts | PASS | PASS |
| Totals | | |
| pass | 4 | 4 |
| fail | 0 | 0 |
| skip | 0 | 0 |
| error | 0 | 0 |

Click



10.167.218.119:8020/fuego/userContent/fuego.logs/Functional.LTP/m3ulcb

```
<<<test_start>>>
tag=mc_opts stime=1501487695
cmdline="mc_opts"
contacts=""
analysis=exit
<<<test_output>>>
mc_opts 1 TINFO: Running mc_verify_opts mc_verify_opts_error on 10.0.0.2
mc_opts 1 TINFO: Running ping with bad values
mc_opts 1 TINFO: Running ping on a invalid interface!
mc_opts 1 TINFO: Running mc_verify_opts mc_verify_opts_error on 10.0.0.2
mc_opts 1 TINFO: Running ping with bad values
mc_opts 1 TINFO: Running ping on a invalid interface!
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mc_opts 1 TINFO: Running ping on a invalid interface!
mc_opts 1 TINFO: Running mc_verify_opts mc_verify_opts_error on 10.0.0.2
mc_opts 1 TINFO: Running ping with bad values
mc_opts 1 TINFO: Running ping on a invalid interface!
mc_opts 1 TPASS: Test Successful
incrementing stop
<<<execution_status>>>
initiation_status="ok"
duration=0 termination_type=exited termination_id=0 corefile=no
cutime=8 cstime=25
<<<test_end>>>
```

**Advantages:**

- Compare the results of different build.
- Check the error log easily.

# Introduction to Fuego test results report

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## 1.Current Fuego test results report flow

Get the test outputs from the target

Generate “run.json”

① test results for each build number

Generate “results.json”

② test results for each job

Generate “flat_plot_data.txt”

③ test results for each case

Generate “flot_chart_data.json”

④ HTML test results report

m3ulcb-Functional.LTP-net.multicast

board: m3ulcb
test set: net.multicast
kernel: 4.9.0-yocto-standard

| test case | results | |
|---|---|---|
| | build_number | |
| | 1 | 2 |
| mc_cmds | PASS | PASS |
| mc_commo | PASS | PASS |
| mc_member | PASS | PASS |
| mc_opts | PASS | PASS |
| Totals | | |
| pass | 4 | 4 |
| fail | 0 | 0 |
| skip | 0 | 0 |
| error | 0 | 0 |

Final test results report,
- Test status for each case

# Introduction to Fuego test results report

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**run.json:** ① test results for each build


```
……
  "duration_ms": 7084,
  "fuego_version": "v1.2.1",
  "name": "Functional.bc",
  "schema_version": "1.0",
  "status": "PASS",
  "test_sets": [
  {
    "name": "default",
    "status": "PASS",
    "test_cases": [
    {
      "name": "bc",
      "status": "PASS"
    }
……
```


**results.json:** ② test results for each job


```
……
"m3ulcb-bc-add-4.9.0-yocto-standard-default-bc": {
    "board": "m3ulcb",
    "build_number": [
      “1",
      “2"
    ],
    "duration_ms": [
      20198,
      14977
    ],
    "status": [
      "PASS",
      "PASS"
    ],
……
```


**flat_plot_data.txt:** ③ test results for each case


```
m3ulcb Functional.bc default 1 2018-01-15T10:00:32+0000 4.9.0-yocto-standard default.bc PASS PASS
m3ulcb Functional.bc default 2 2018-01-16T07:56:51+0000 4.9.0-yocto-standard default.bc PASS PASS
```


**flot_chart_data.json:** ④ HTML test results report


```
……
    "chart_type": "testcase_table",
    "data": "<table border==¥"1¥" cellspacing=¥"0¥"><tr style=¥"background-color:#cccccc¥">
……
```

## 2. Split the outputs

We have added the following processing in parser.py of some tests in Fuego.

```
$ cat /fuego-core/engine/tests/Functional.fuego_tguid_check/parser.py
……
import common as plib

results = {}

regex_string = '^(ok|not ok) (¥d+)
matches = plib.parse_log(regex_string)
results = collections.OrderedDict()

for m in matches:
    print("DEBUG: in parser.py: m=%s" % str(m))
    status = m[0]
    test_num = m[1]
    test_id = m[2].replace(" ",".")
    results[test_id] = 'PASS' if status ==

# split the output for each testcase
plib.split_output_per_testcase(regex_string, results)

sys.exit(plib.process(results))
……
```

Use ordered dictionary

Added generic function: “split_output_per_testcase”, that help us to split the test results.

# 3. Add log links

We have added the following processing in Fuego.

```
$ cat /fuego-core/engine/scripts/parser/prepare_chart_data.py
……
def make_testcase_table(test_name, chart_config, entries):
……
    tguid_testset = ".".join(tguid_parts[:-1])
    tguid_testcase = tguid_parts[-1]

    # get the name that contains board, spec, build number. E
    log_bts_name = '%s.%s.%s.%s' % ¥
                (entry.board, entry.spec, str(entry.build_number), str
    # separated log files, e.g. /Functional.LTP/ubuntu.math.7.7/resul /math/outputs/abs01.log
    log_file = '/userContent/fuego.logs/%s/%s/result/%s/outputs/%s.log' % ¥
                (entry.testname, log_bts_name, tguid_testset, tguid_testcase)
    # testlog files, e.g. /Functional.croco/porter.default.${BUILD_NUMBER}.${BUILD_ID}/testlog.txt
    testlog_file = '/userContent/fuego.logs/%s/%s/testlog.txt' % (entry.testname, log_bts_name)


    # check if the separated log path exist
    if os.path.exists(jenkins_root_path + log_file):
        entry.result = '<a href=¥"%s%s¥">%s</a>' % (jenkins_web_prefix, log_file, entry.result)
    elif os.path.exists(jenkins_root_path + testlog_file):
        entry.result = '<a href=¥"%s%s¥">%s</a>' % (jenkins_web_prefix, testlog_file, entry.result)
……
```

Find the separated log files for each testcase.

Add link to those separated log files.

# Introduction to Fuego LTP test

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## 1. Check the current LTP tests

About LTP test in Fuego, we can use 4 different usage scenarios

- 1) fuego builds, deploys and runs LTP on target
- 2) fuego runs an existing installation of LTP on target
- 3) fuego builds and deploys LTP, to a special location of the target
- 4) fuego builds LTP, but deploy is left to user

We have used the scenarios 2) to do all LTP tests on different AGL distro

However, we find the following tests cannot be tested properly

- LTP network related tests. (E.g. net_stress.*)

Now, we can do network related tests and we will inform you of the test result of AGL

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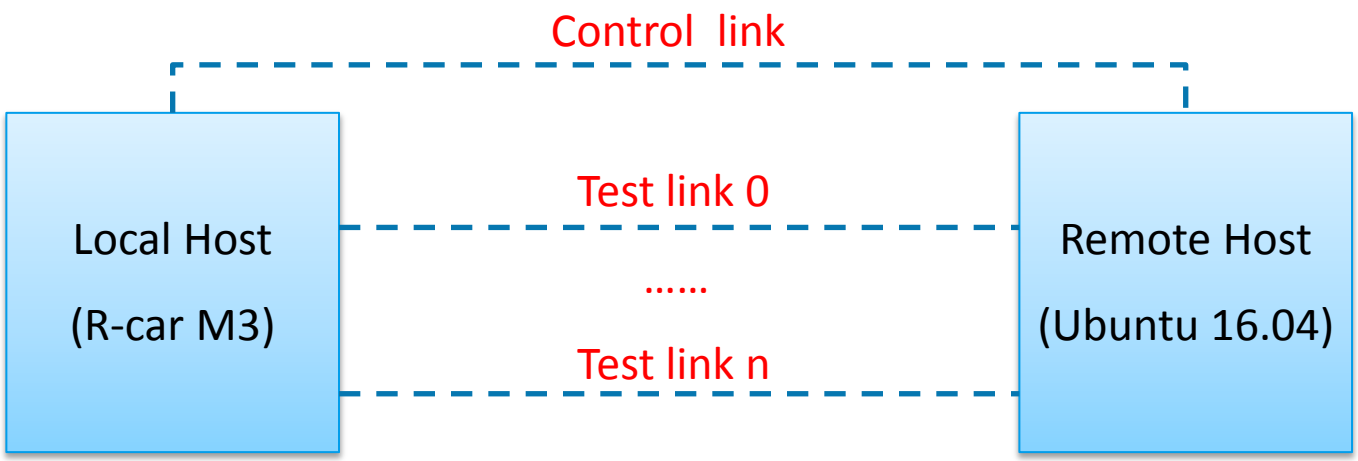
## 2. Setup the test server for LTP network tests




**Physical Topology:**

- These tests require two machines.
- Each machine needs to have 2 or more interfaces.

**Software setup on Remote Host：**

- ssh/rsh between Remote Host and Local Host
- http/ftp service
- Install LTP and add those test commands to $PATH

Details

- Refer to https://github.com/linux-test-project/ltp/blob/master/testcases/network/README.md

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# 3. Customize the spec for LTP network tests

```
# Add those required parameters to spec.json for Functional.LTP
$ cat /fuego-core/engine/tests/Functional.LTP/spec.json
……
    "rpc": {
        "tests": "net.rpc_tests net.tirpc_tests",
        "RHOST": "192.168.10.51",
        "LHOST_HWADDRS": "00:0e:c6:c5:b2:fe",
        "RHOST_HWADDRS": "00:0e:c6:c5:c0:b4",
        "homedir": "/opt/ltp",
        ……
    },
……
```

**Some critical parameters in LTP network test:**

- RHOST: the hostname of remote host;
- LHOST_HWADDRS: local hw addr of test Link;
- RHOST_HWADDRS: remote hw addr of test Link;
- HTTP_DOWNLOAD_DIR/FTP_DOWNLOAD_DIR/FTP_UPLOAD_DIR/FTP_UPLOAD_URLDIR;
- NS_DURATION/NS_TIMES/CONNECTION_TOTAL;
- DOWNLOAD_BIGFILESIZE/DOWNLOAD_REGFILESIZE/UPLOAD_BIGFILESIZE/UPLOAD_REGFILESIZE.

Those env variables will be exported before testing on the target.

Those optional environment variables can help us to change the test pressure.

# Introduction to Fuego LTP test

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## 4. Check the test results

**Test env :** eel_5.0.0, agl-demo-platform-qa, R-Car M3.

| Tests | Result | Testcases | | | | Execute Time | Logs & Comments |
|---|---|---|---|---|---|---|---|
| | | PASS | FAIL | ALL | Failed cases | | |
| net.sctp | PASS | 41 | 0 | 41 | - | 00:01:13 | |
| net_stress.ipsec_tcp | FAIL | 34 | 36 | 70 | | 00:13:00 | All PASS with cc_3.0.0.<br>- ipv4 PASS, but ipv6 related cases failed. |
| net.rpc_tests | PASS | 49 | 0 | 49 | - | 00:20:57 | |
| net.ipv6 | PASS | 7 | 2 | 9 | sendfile601<br>dhcpd6 | 00:09:00 | sendfile601: cannot startup sendfile on server.<br>dhcpd6: port 53 already in use. |
| stress.part3 | PASS | 681 | 0 | 681 | - | 00:08:39 | |
| net.tirpc_tests | PASS | 41 | 2 | 43 | tirpc_authdes_create and seccreate | 00:18:28 | 2 failures<br>- Known issues for LTP community. |
| net_stress.ipsec_icmp | PASS | 87 | 0 | 87 | | 00:17:09 | |
| net_stress.multicast | PASS | 24 | 0 | 24 | | 00:04:11 | |
| stress.part1 | FAIL | 105 | 6 | 111 | nfs01, nfs02<br>nfs03 , nfs04<br>nfs5,nfsx-linux | 06:26:36 | All PASS with cc_3.0.0.<br>Test results:<br>- mount options "nfsv3,tcp“: FAIL.<br>Now, still under investigation. |
| net_stress.route | PASS | 8 | 4 | 12 | route4-change-if<br>route4-rmmod<br>route6-change-if<br>route6-rmmod | 00:09:49 | Not support,<br>- Ethernet0 and Ethernet1 has the same drivers which cannot be removed. |

# Introduction to Fuego LTP test

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| Tests | Result | Testcases | | | | Execute Time | Logs & Comments |
|---|---|---|---|---|---|---|---|
| | | PASS | FAIL | ALL | Failed cases | | |
| net.multicast | PASS | 4 | 0 | 4 | - | 00:15:34 | |
| net.tcp_cmds | PASS | 20 | 5 | 25 | dnsmasq<br>finger<br>ipneigh01<br>rdist<br>xinetd | 00:18:00 | All PASS with cc_3.0.0. The causes is ,<br>- dnsmasq: port 53: Address already in use.<br>- command rdist/finger not exist on the target.<br>- ipneigh01: unknown yet.<br>- xinetd: telnet on server cannot give expected output. |
| net_stress.broken_ip | PASS | 11 | 0 | 11 | - | 11:00:00 | |
| net_stress.interface | PASS | 13 | 0 | 13 | - | 01:12:00 | |
| net.nfs | FAIL | 36 | 38 | 74 | | 04:19:16 | All PASS with cc_3.0.0. Test results:<br>- ipv4 related tests FAIL..<br>- ipv6 related tests PASS.<br>Now, still under investigation. |
| net.rpc | FAIL | 2 | 2 | 4 | rpcinfo<br>rup | 00:06:14 | rpcinfo: unknown yet.<br>rup: rup: 192.168.10.51: RPC: Timed out |
| net_stress.appl | PASS | 10 | 0 | 10 | - | 00:05:56 | |
| net.features | FAIL | 11 | 16 | 27 | | 01:40:00 | All PASS with cc_3.0.0.<br>Still under investigation. |
| net.ipv6_lib | FAIL | 6 | 0 | 6 | | 00:01:01 | |
| net_stress.ipsec_udp | FAIL | 0 | 70 | 70 | | 03:46:49 | All PASS with cc_3.0.0.<br>Still under investigation. |

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# 5. Customize the criteria file

The criteria.json file is used to specify the criteria used to determine whether a test has passed or failed.

```
$ cat /fuego-rw/boards/m3ulcb-Functional.LTP-criteria.json
{
    "schema_version":"1.0",
    "criteria": [
    {
        "tguid": "syscall",
        "min_pass": 1000,
        "max_fail": 5
    },
    {
        "tguid": "net.tirpc_tests",
        "fail_ok_list": ["tirpc_authdes_seccreate", "tirpc_authdes_create"]
    },
……
```

**The criteria.json can be placed in the following locations:**

- Criteria file specified in 'FUEGO_CRITERIA_JSON_PATH';
- Criteria file in /fuego-ro/boards/;
- Criteria file in /fuego-rw/boards/;
- Default criteria file;

- What we should keep in mind is that cases in criteria are not the same with in skiplist

**We can use LTP test and some related network test.**

# Fuego Info

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About Fuego test framework:

Git repo:
- https://bitbucket.org/tbird20d/fuego.git
- https://bitbucket.org/tbird20d/fuego-core.git

Wiki:
- http://fuegotest.org/wiki/Fuego_Documentation

Fuego new website:
- http://fuegotest.org

Fuego maillist:
- fuego@lists.linuxfoundation.org

# Fuego Roadmap

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## Recent past & Near future

- Priority was stuff affecting test API or test packaging (Needed before big push for new tests)
- Documentation
- New tests for AGL, LTSI, CIP
- Testplan enhancements
- Report generator and more charting control
- System provisioning support

## Long-term

- Distributed test network
- Hardware testing

# Our Future Work

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- Fuego failed tests investigation
- Fuego pre_check improvement
- BSP tests integration
  - Those tests need some improvements
- New tests for AGL(ptest, kselftest, etc)

# Thank you!

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