Collaboration with LTSI Testing

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Overview

- Basic requirements
- What do we need to test?
  - Case studies
- Collaboration with LTSI Testing
Basic requirements for Linux kernel

- Stable
- Able to run as long as possible
- Able to migrate from one version to another
Basic requirements for Linux kernel

- Stable
  - No bug
  - Continue to fix bugs

- Able to run as long as possible
  - Already have some experience

- Able to migrate from one version to another
  - Evaluated migration effects
  - Fixed all compatibility issues
Required test case

- Categories of test case
  - Functionality (APIs)
  - Performance
  - Quality
  - Compatibility

- Example of test case
  - Functionality
    - LTP
    - . . .
  - Performance test
    - Cyclic test, lozone
    - . . .
  - Quality test
    - Hardware resource isolation
    - Data reliability
    - Heat run
  - Compatibility
    - . . .
Case study: Backport Zynq support for LTSI-3.10

- Posted Xilinx Zynq (ZC702) support patches to LTSI-3.10
  - Patches available on upstream
  - Patches available on Xilinx’s repository

- Preparation
  - Backported required patches for Zynq to 3.10
  - Ask to Xilinx developer
Case study: Backport Zynq support for LTSI-3.10

- The following test has been done on ZC702
  - LTP
  - POSIX Testsuite
  - Devices
    - Ethernet
    - General Purpose I/O
    - I2C Controller
    - QSPI Flash Controller
    - SD Card
    - Timer
    - UART
    - Watchdog

- The following tests has not been done yet
  - Performance test
  - Cyclic test
  - Compatibility test

- Required test cases depend on the usage of the kernel
(Required test case)

- Categories of test case
  - Functionality (APIs)
  - Performance
  - Quality
  - Compatibility

- Example of test case
  - Functionality
    - LTP
    - ...
  - Performance test
    - CyclicTest, lozone
    - ...
  - Quality test
    - Hardware resource isolation
    - Data reliability
    - Heatrun
  - Compatibility
    - ...
Results of LTP on multiple kernels

- **Evaluation environment**
  - LTP
  - Userland from Debian 4.0

- **Results**

<table>
<thead>
<tr>
<th>Version</th>
<th>Number of errors</th>
<th>Test case name</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.6.18</td>
<td>1</td>
<td>Cron2</td>
</tr>
<tr>
<td>2.6.26</td>
<td>3</td>
<td>getcpu01, stime01, cron02</td>
</tr>
<tr>
<td>2.6.32</td>
<td>7</td>
<td>execve04, getcpu01, swapon03, sched_cli_serv, clock_gettime03, timer_create04</td>
</tr>
</tbody>
</table>

- **Reference:** Moving Forward: Overcoming from Compatibility issues BoFs, ELC2011
Overview of data reliability test

This test case available at the following URL:
https://github.com/ystk/fs-test

Target Host

Writer processes (N procs)

Target files

Log Host

logger

write() system call

Reset at random timing

Each writer process

- writes to text files (ex. 100 files)
- sends progress log to logger

This test case available at the following URL:
https://github.com/ystk/fs-test
Verifying the data reliability

Verify the following metrics

- file size
- file contents

Estimated file contents

OK
- AAAAAA
- BBBBBB
- CCCCCC
- DDDDD
- EEEEEE

NG
- AAAAAA
- BBBBBB
- CCCCCC
- DDDDD
- AAAAA

Estimated file size

LOG file

OK
- AAAAAA
- BBBBBB
- CCCCCC
- DDDDD
- EEEEEE

NG
- AAAAAA
- BBBBBB
- CCCCCC
- DDDDD
- ?

Target file

Checker

data mismatch

size mismatch
Results of data reliability test

kernel 2.6.18

Error rate [%]

file size mismatch
data mismatch

kernel 2.6.31

Error rate [%]

kernel 2.6.33

Error rate [%]

Reference: Evaluation of Data Reliability on Linux File Systems, ELC2010
Results of data reliability test

**Point 1:**
A file system has different characteristics of data reliability

- Reference: Evaluation of Data Reliability on Linux File Systems, ELC2010
Results of data reliability test

**Point 1:**
A file system has different characteristics of data reliability

**Point 2:**
Some Results depends on kernel version

- **Reference:** Evaluation of Data Reliability on Linux File Systems, ELC2010
# Results of data reliability test

## Point 1:
A file system has different characteristics of data reliability

## Point 2:
Some Results depends on kernel version

## Point 3:
EXT4-Journal and BTRFS has a nice result

- **Reference:** Evaluation of Data Reliability on Linux File Systems, ELC2010
Linux Kernel Acceleration for Long-term Testing

Issues

- Long-term testing takes really long time
  → We want results as fast as possible

Things that cannot be accelerated

- CPU clock
- I/O access speed (ex. SSD)
- Network bandwidth
- etc.

Focus to accelerate clock

Try to detect errors that caused by clock

Reference: Linux Kernel Acceleration for Long-term Testing, ELC2010
Example of acceleration (A screenshot)

Xdaliclock works as a stopwatch

Returned an incorrect value after about 450 days.
(It takes about 6 hours in 1000 times acceleration)

Reference: Linux Kernel Acceleration for Long-term Testing, ELC2010
Performance compatibility issues between 2.4 and 2.6

- **Slow to run**
  - context switches up to 96% slower
  - local communication latencies up to 80% slower
  - file system latencies up to 76% slower
  - local communication bandwidth less than 50% in some cases.

- **Reference:** [http://www.denx.de/wiki/Know/Linux24vs26](http://www.denx.de/wiki/Know/Linux24vs26)
Requirement for LTSI Testing

- **Test set**
  - OSS test suites like LTP, lozone, Imbench
  - Deta reliability test
    - Runs on multiple file systems
    - Compare the results
  - Compatibility test
    - Aspects
      - API
      - Performance (I/O, Network and more)
      - Service quality

- **How to test?**
  - User land
    - Same user land for all kernel version
    - The latest version
  - Multiple CPU architectures
    - ARM, PowerPC, X86_32, X86_64
Issues

- **Test result sharing**
  - Each test result has deferent output format
  - Need to have the following features
    - Test result upload
    - Regression problem detection

- **Device driver test cases**
  - How to make common test sets
Collaboration with LTSI kernel/LTSI Testing

- Open all test results for basic test set
- Keep transparency of the test results
  - Open the specs of testing environment
- Run same tests on multiple environment
  - User can be refer the nearest setup to choose a hardware
- Give some aspects for long term support
  - Super long term support (ex. 20 years)
  - kernel migration to newer version
    - Compatibility test

- Merge RT-preempt to LTSI
  - LTSI-RT
    - https://github.com/ystk/linux-ltsi/tree/ltsi-3.0.y-rt
    - https://github.com/ystk/linux-ltsi/tree/ltsi-3.4.y-rt
    - https://github.com/ystk/linux-ltsi/tree/ltsi-3.10.y-rt (available soon)
Questions?