Task driven framework for Lustre monitoring

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Agenda

1. Lustre Production Environment
2. Motivation
3. Software Architecture
4. Technical Details
5. Example for an IO-Task
6. Future Work
Lustre Production Environment

Clients

- ~1000 clients v. 2.6.92 but moving to v. 2.10
- Running on Debian Jessie

Servers

- Total storage capacity of 14.7PB
- Pair of active/passive meta data server v. 2.5.3.90 with manual failover
- 78 file server v. 2.5.3.90 with ZFS v. 0.6.3
- 546 OSTs - 7 OSTs per one OSS
- Running on Debian Wheezy

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Motivation

- Monitoring the availability of the file servers
- Measuring IO performance per OSTs continuously
- Collecting measurement results for later analysis per OSS/OST
- Scheduling and execution of generic tasks
Software Architecture

- Based on a master-client architecture
- Clients are divided into a controller with multiple workers
- Bottom-Up communication model via message passing
The Master Component

- Creates tasks within a specific measure interval for all OSTs
- Schedules tasks to controller on demand when tasks are available
- Keeps track of scheduled tasks for rescheduling
The Client Component

Controller

- Creates a pool of workers
- Requests tasks from master
- Provides tasks to workers over a shared queue

Worker

Responsible for executing tasks from the shared queue.
Technical Details

Free available as open source project on GitHub at: https://github.com/GSI-HPC/lustre_task_driven_monitoring_framework

It is still under development...

Mandatory Requirements

- Python Standard Library
- ZeroMQ for distributed messaging
- lctl from Lustre utils for determining OSTs and OSSs

Optional Requirements for running Sample Task

- Python interface to MySQL (MySQLdb) / MySQL database server
- lfs from Lustre utils for setting file stripes
Example for an IO-Task (1)

Measure interval is 15 minutes in this example.

Task Implementation

A task implements an interface method of the generic task class.

1. Checks if OST is in active state for doing IO tests
2. Writes data in 1MB blocks to a target OST with a total of 8MB payload
3. Reads the file content block-wise from the target OST back
4. The measured metrics are pushed to the database proxy

Collecting and Storing Measurements

- This is done outside and independently of the framework.
- A proxy buffers incoming messages and does bulk inserts into a database.
Example for an IO-Task (2)

Simplified database table schema for storing IO measurements:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>Primary key</td>
</tr>
<tr>
<td>read_timestamp</td>
<td>Timestamp for start of the read operation</td>
</tr>
<tr>
<td>write_timestamp</td>
<td>Timestamp for start of the write operation</td>
</tr>
<tr>
<td>ost</td>
<td>Target OST name</td>
</tr>
<tr>
<td>ip</td>
<td>IP address of the OSS</td>
</tr>
<tr>
<td>size</td>
<td>Total payload size in bytes</td>
</tr>
<tr>
<td>read_throughput</td>
<td>Average read throughput in bytes per seconds</td>
</tr>
<tr>
<td>write_throughput</td>
<td>Average write throughput in bytes per seconds</td>
</tr>
<tr>
<td>read_duration</td>
<td>Total read duration in seconds</td>
</tr>
<tr>
<td>write_duration</td>
<td>Total write duration in seconds</td>
</tr>
</tbody>
</table>
Example for an IO-Task (3)

As a first step query the database for file server where write duration or read duration >= 10 seconds:

<table>
<thead>
<tr>
<th>Date</th>
<th>IP</th>
<th>max write duration</th>
<th>max read duration</th>
<th>write count</th>
<th>read count</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>2017-09-15</td>
<td>1.2.3.17</td>
<td>15</td>
<td>35</td>
<td>4</td>
<td>54</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

Further investigation of the 15th of September 2017 for the file server with IP '1.2.3.17' can be done by more precise database query...
Example for an IO-Task (4)

As a second step query the database for the date '2017-09-15' and IP '1.2.3.17' for the following information:

- Target OST
- Min and max timestamps(ts)/durations(dur) for reads
- Count of measurements

<table>
<thead>
<tr>
<th>OST</th>
<th>min_ts</th>
<th>max_ts</th>
<th>min_dur</th>
<th>max_dur</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
<td>OST001f</td>
<td>13:37:56</td>
<td>15:23:07</td>
<td>12</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>OST0022</td>
<td>13:37:56</td>
<td>15:23:07</td>
<td>15</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>OST0021</td>
<td>13:37:56</td>
<td>15:23:07</td>
<td>10</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>OST0020</td>
<td>13:37:56</td>
<td>15:23:07</td>
<td>15</td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td>OST001c</td>
<td>13:37:56</td>
<td>15:23:07</td>
<td>10</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>OST001e</td>
<td>13:52:58</td>
<td>15:23:07</td>
<td>12</td>
<td>32</td>
<td>7</td>
</tr>
</tbody>
</table>

-> Read throughput is less then 1MB/s
Visualizing Collected Information

- Collected IO-Wait metrics from Ganglia
- Calculated ratio of average OSS read/write throughput to its maximum
Future Work

- Task description language
- Creation of different tasks at runtime
- Providing a complete documentation
Thank you!