Streaming and storing CineGrid data:
A study on optimization methods

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Mission statement

“CineGrid’s mission is to build an interdisciplinary community focused on the research, development, and demonstration of networked collaborative tools, enabling the production, use and exchange of very high-quality digital media over high-speed photonic networks.”
Media Formats (1)
Media Formats (2)

- **4K**
  - 4096 × 2160
  - 4.3× 1080p HD
  - 36 bpp Color
  - One frame = 40 MB
  - Uncompressed 7.6 Gb/s

- **SHD\(^1\)**
  - 3840 × 2160
  - 4× 1080p HD
  - 24 bpp Color
  - One frame = 25 MB
  - Uncompressed 6 Gb/s
  - Mostly used in CineGrid, because of hardware limitations

\(^1\)Super High-Definition also known as Quad HD
SAGE vs NTT jpeg2000 codec

- **SAGE**
  - Software implementation
  - Performance may depend on hardware
  - Used for tiled displays
  - DXT compression technique
  - Compression ratio 6:1

- **NTT jpeg2000 codec**
  - Hardware implementation, 4 jpeg2000 codec boards
  - Stream is not influenced by hardware
  - jpeg2000 compression technique
  - Compression ratio 12:1

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SAGE\(^2\) Scalable Adaptive Graphics Environment
Research question 1

**Streaming**
A streaming tool is an essential part in CineGrid.

**Streaming question**
How do SAGE and NTT jpeg2000 codec compare against each other, regarding network streams?
Test Material

7Bridges
Length: 138 secs
Size: 4.3 GB
Rate: 30 fps

PragueTrain
Length: 97 secs
Size: 2.5 GB
Rate: 24 fps
Experiments

Tools:
- top, measure CPU load
- tcpdump, capture packets send/received
- SAGE manager log, application layer measurements
Bandwidth Results

SAGE Manager log

L: UDP stream 218.4 Mb/s, R: TCP stream 208.1 Mb/s
CPU load SAGE Manager

CPU usage on SAGE Manager/Renderer

fsManager: window manager SAGE | bplay-noglut: compresses video and sends
CPU load SAGE Display

CPU usage on SAGE display

L: UDP stream, R: TCP stream
Research question 2

Storage

Local Filesystem does not meet demand storage space.
NFS does not meet requirement of scalability and read speed.

Storage question

Can GlusterFS improve the performance of the CineGrid storage?
GlusterFS

- GlusterFS is a Cluster Filesystem
- Aggregates “storage bricks” → parallel network file system
- Several translators, i.e., clustering translators and performance translators
Experiments

Tools:
- dd, block level measurement
- iozone, file level measurement

Methods:
- Read performance
- Striping translator
- Filesize 7GB
Results (1)

4KB test results used for these percentages.
4KB was used because it is the standard block size in most Linux filesystems.

<table>
<thead>
<tr>
<th>Filesystem</th>
<th>Read speed</th>
<th>dd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>85.9</td>
<td></td>
</tr>
<tr>
<td>NFS</td>
<td>73.8</td>
<td>14.1%</td>
</tr>
<tr>
<td>GlusterFS 1 brick</td>
<td>56</td>
<td>34.8%</td>
</tr>
<tr>
<td>GlusterFS 2 bricks</td>
<td>56.3</td>
<td>34.5%</td>
</tr>
<tr>
<td>GlusterFS 3 bricks</td>
<td>104</td>
<td>21%</td>
</tr>
</tbody>
</table>

Absolute Read speed, percentage loss or gain in comparison with Local Filesystem

Bottleneck 1Gb/s interface.
Tests with more than three servers were not possible.
Results(2)

Upgraded to 10 Gb/s connection to client.
Also used Read Ahead Translator and Threaded I/O Translator.

<table>
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<tr>
<th>Filesystem</th>
<th>Read speed</th>
<th>dd</th>
</tr>
</thead>
<tbody>
<tr>
<td>GlusterFS 1 brick</td>
<td>86.6</td>
<td>0.8%</td>
</tr>
<tr>
<td>GlusterFS 2 bricks</td>
<td>103</td>
<td>19.9%</td>
</tr>
<tr>
<td>GlusterFS 3 bricks</td>
<td>294</td>
<td>242.3%</td>
</tr>
<tr>
<td>GlusterFS 4 bricks</td>
<td>306</td>
<td>256.2%</td>
</tr>
<tr>
<td>GlusterFS 5 bricks</td>
<td>315</td>
<td>266.7%</td>
</tr>
</tbody>
</table>

Absolute Read speed, percentage loss or gain in comparison with Local Filesystem
Future work

- NTT jpeg2000 codec measurements
- SHD instead of 1080p HD SAGE setup
- Test setup GlusterFS for long term stability
- Investigate Translators
## Conclusions

### Streaming

The SAGE performance was as expected. The video player is CPU-bound. Performance easily influenced by running processes.

### Storage

GlusterFS increases the read performance for streaming from CineGrid storage.