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Mobile VDI Performance Optimization with Hybrid Parallel Computing and System Level Hooking

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Abstract The requirement of processing High Definition (HD) video or 3D application is becoming one of the major issue in mobile cloud computing. Mobile virtual desktop infrastructure (mVDI) service needs efficient data processing ability to provide Quality of Experience (QoE) in mobile cloud computing. In this paper, we propose and discuss the mVDI service optimization method using OpenMP and CUDA. We propose, in addition, system level hooking method using mirror driver for reducing the latency of system and comparing performance.

Keywords: Mobile Cloud, mVDI, Thin Client

1. Introduction

Recently, the requirement of processing HD video or 3D application on low resource and mobile devices have been expanded and quantity of contents data have been increased. So mVDI services need more efficient data processing ability for providing HD video and 3D application.

In this paper, we propose and discuss the mVDI service optimization method in CPU and GPU mixed environment using OpenMP [2] and CUDA [3]. To reduce, furthermore, system latency during hooking, we suggest the system level hooking method with mirror driver [4].


A mobile Thin-Client made it possible for mVDI service to be provided to multiple devices without location constraints. The mobile device receives display image from the application which is running on the server side. We developed, beside, called Hybrid Remote Display Protocol for a mobile Thin-Client.

A HRDP uses a combination of RFB - a classic thin-client protocol - and MJPEG to send the graphical output of an application. A HRDP uses a motion detector to separate high motion section and low motion section.

When low motion is detected, the RFB module will be used as the remote display protocol since it consumes less resource at the server. In high motion scenario, the MJPEG module is responsible for real time encoding.

With HRDP, we can provide high quality of mVDI service within low mobile bandwidth. But HRDP needs more reducing system latency to provide HD video or 3D application. In next session, we propose optimization method with hybrid parallel processing and kernel level hooking.

3. Optimization Method

The HRDP splits the work with 4 threads and supports parallel process basically. Assigned tasks to each thread are as follows.

- Thread1: Screen capturing, Motion detection
- Thread2: MJPEG encoding
- Thread3: RFB encoding, Data combination
- Thread4: Data transmission

In our test result, we found a lot of time consumption on screen capturing module (Thread1). We analyzed the screen capturing module and allocated suitable thread to each work using OpenMP.

And we were also using Multi GPU processing in CUDA architecture to improve the potential performance. JPEG compression is a computing intensive task that can be slow on current CPUs, using CPU codec will cause long delay due to the long compression time.

A mirror driver is a display driver for a virtual device that mirrors the drawing operations of one or more additional physical display devices [4]. It is improved faster than GDI procedure, so we modify screen capturing method with mirror driver. Figure 1 is our proposed HRDP architecture. The bold box has been modified and added in current work.
4. Simulation Environment & Result

For these experiments, we measured the performance on the physical machine as the following hardware environment:

Table 1. Simulation Environment

<table>
<thead>
<tr>
<th>Name</th>
<th>mVDI Server</th>
<th>mVDI Client</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>3.30GHz (Quad Core)</td>
<td>2.93GHz (Quad Core)</td>
</tr>
<tr>
<td>GPU</td>
<td>GeForce GTX 460</td>
<td>GeForce 9300 GS</td>
</tr>
<tr>
<td>OS</td>
<td>Windows</td>
<td></td>
</tr>
<tr>
<td>Network</td>
<td>Ethernet</td>
<td></td>
</tr>
<tr>
<td>Display Screen</td>
<td>640*480</td>
<td></td>
</tr>
</tbody>
</table>

The results are presented in Figure 2 and 3. We observed the better performance. In Figure 2, we classified according to application type such as word processor, browser, game, video and measured performance. The Figure 3 shows performance graph regarding three simulation types (SLI [5], MCUDA, mixed) using video application.

5. Conclusion

In this paper, we proposed method for optimization HRDP mVDI service. We used 3 methods OpenMP, MCUDA, Mirror Driver for optimization and analyzed each result. We will measure the performance on the integrated system with OpenMP, MCUDA and Mirror driver in the future.

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References