Speeding up GS Drawing

Sony Computer Entertainment Inc.

Introduction

- The Graphics Synthesizer (hereafter, GS) can perform high speed drawing that makes good use of the bus bandwidth of the Embedded DRAM (integrated LOGIC DRAM, hereafter, EDRAM).

- However, because pages exist as DRAM, page breaks will cause an internal drop in speed. A method of avoiding page breaks is described on the following slides.

GS Drawing Overview (1)

- Page size for PSMCT32 is 64 pixels (w) X 32 pixels (h).

- Writes to the FRAME BUFFER --> high speed when within the same page.

- Texture buffer size is 1 page.

- A DRAM access is generated when there is a miss in the texture page buffer.

- Reading the texture will not disrupt the current page in the frame buffer.

GS Drawing Overview (2)

- Texture (image data) transfers --> texture buffer is not disrupted but it is necessary to clear the page buffer. (TEXFLUSH instruction)

- Reading CRTC --> Fixed. Error range.

- Parallel transfers of PATH1,2 and PATH3 may generate page breaks.

Basic Strategy

- As much as possible, perform READ/WRITE so that page breaks in the GS EDRAM will not occur.

- For instance, with PSMCT32, the EDRAM page size is 64 pixels (w) X 32 pixels (h). (see the GS Manual)

- Since DDA runs in the horizontal direction, it is easy to cause frequent page breaks in the width direction when drawing.

Measuring Drawing Speed

- It is difficult to accurately measure the beginning and end times of GS drawing.

- There is a GIF FIFO, a GS FIFO, and the GS itself forms a long PIPELINE.

- For example, to measure drawing time, a drawing LOOP can be executed 1000 times and obtaining its average value will be accurate.
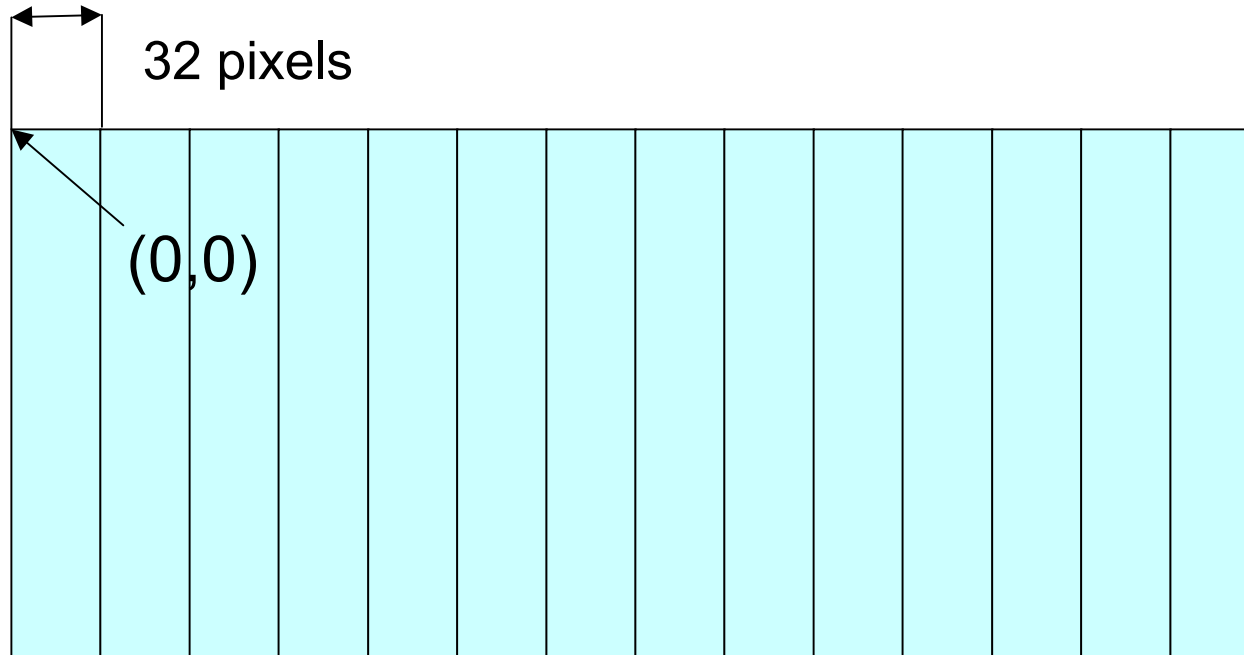
For a Clear Screen (Draw)

64 pixels

(0,0)
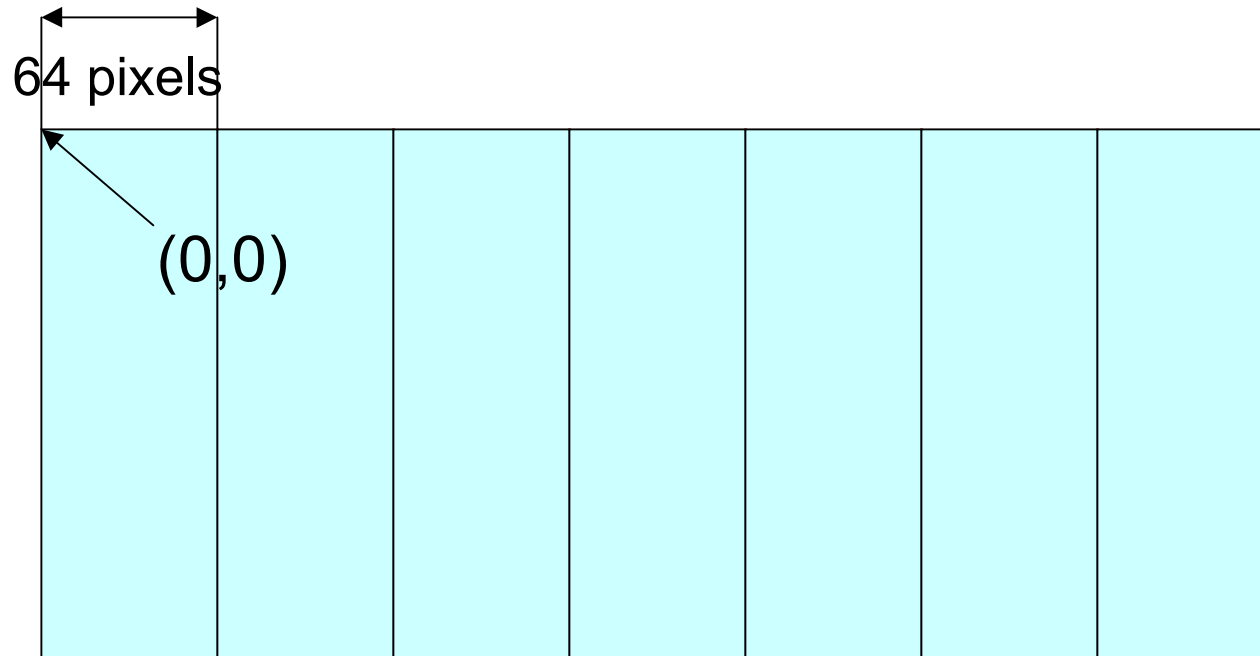
64 pixels: 2000 M pixels/s

64 pixels >: 1000 M pixels/s

For a BILINEAR Filter (Draw)

32 pixels

(0,0)

32 pixels: 740 M pixels/s

64 pixels: 470 M pixels/s

For a Texture Transfer (BITBLTBUF)

- For HostLocal, when a page break occurs for the width and the location of the transfer destination area, there are cases when the speed will be affected.

- The effect is large in 4-bit and 8-bit modes when the addresses are arranged by fine division.

- For PSMCT32, it is desirable to transfer collectively when not replacing.

- Use IMAGE mode.

- Arrange the beginning of the packet on an 8 QWD boundary.

For a Texture Transfer (BITBLTBUF)

Image mode	Width (W)	Height (H)	MB/S
PSMCT32	128	128	1013
PSMCT32	64	256	1013
PSMCT16	128	256	1013
PSMCT16	64	512	1013
PSMT8	256	256	867
PSMT8	128	512	1012
PSMT8	64	1024	1011

For a Texture Transfer (BITBLTBUF)

Image mode	Width (W)	Height (H)	MB/S
PSMT4	256	512	402
PSMT4	128	1024	584
PSMT8H	128	512	624
PSMT8H	64	1024	1012
PSMT4HH	128	1024	268
PSMT4HH	64	2048	570
PSMT4HL	128	1024	268
PSMT4HL	64	2048	570

Speed-up by Scissoring

64 pixels

Moving the Scissoring Window

(0,0)

Drawing Repeated Patterns
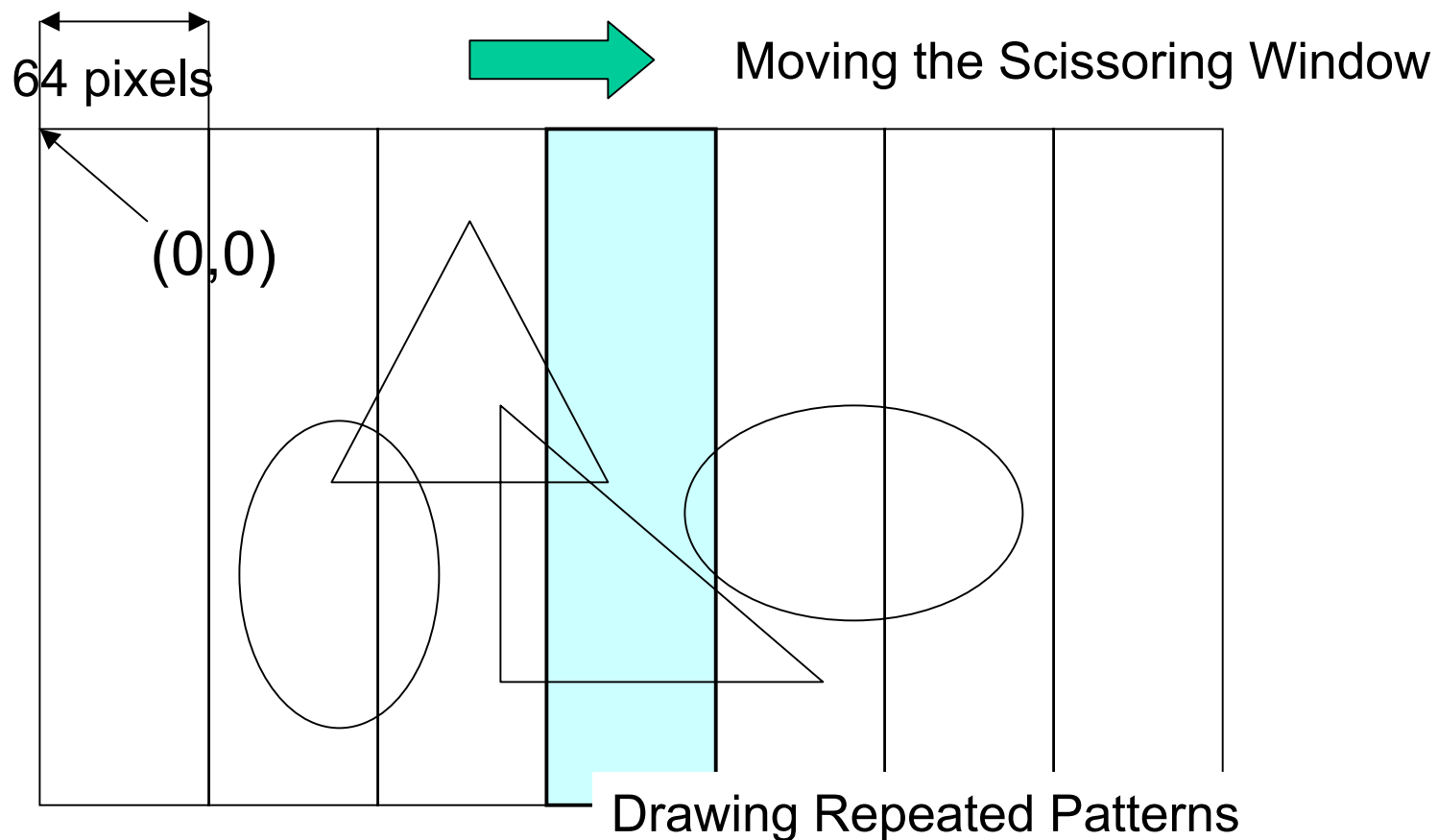
Miscellaneous

- Scissoring is most effective for large polygons.

- The speed drops with TRILINEAR because texture replacements are frequently generated. If possible, it is desirable to use BILINEAR + MIPMAP.

- When continuously drawing to the same PIXEL, the speed will decrease because of the effect of the PIPELINE.

- In many cases, polygon drawing speed can be improved by dividing the polygons into a size that fits within one page.

Summary

- Processing speed can be improved if the program takes into account GS memory page breaks.

- Whether or not page breaks occur frequently depends on the drawing content. Also, the speed will not increase if EE operations are a bottleneck.

- Page breaks occur often with TRILINEAR.