



WASEDA UNIVERSITY

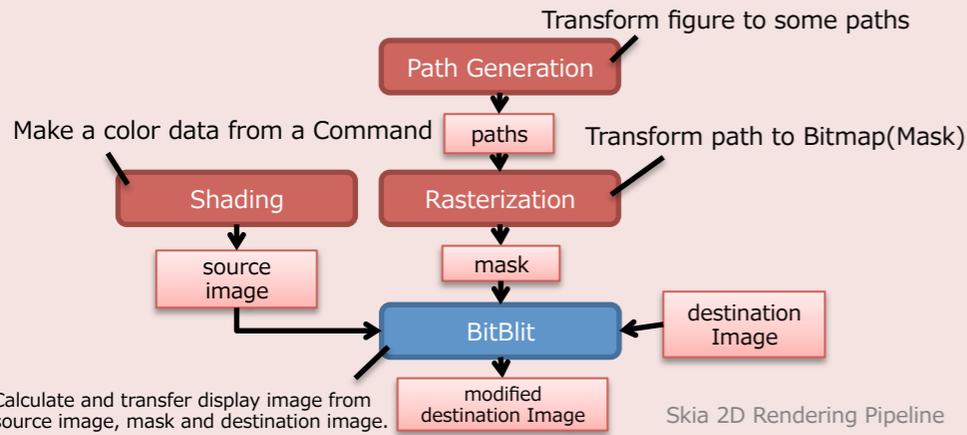
Profile-Based Automatic Parallelization and Sequential Program Tuning for Android 2D Rendering on Nexus7

Kohei Muto¹, Takashi Goto¹, Hideo Yamamoto¹, Hiroki Mikami¹, Tomohiro Hirano¹, Moriyuki Takamura², Keiji Kimura¹, and Hironori Kasahara¹
¹Green Computing Systems Research and Development Center Waseda University, ²FUJITSU LABORATORIES LTD.

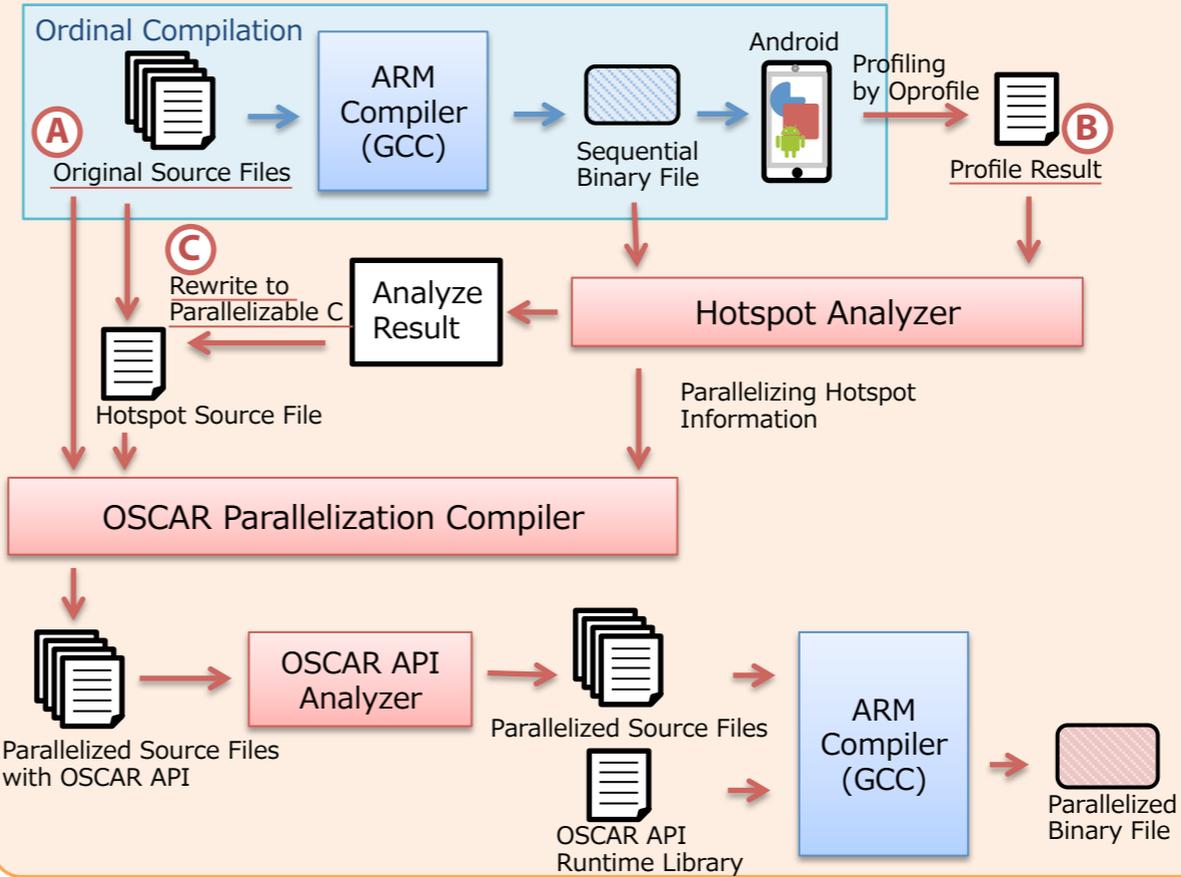
- OSCAR Compiler
- Skia
- Multicore

A Android 2D Rendering "Skia"

Standard library which performs 2D rendering on Android

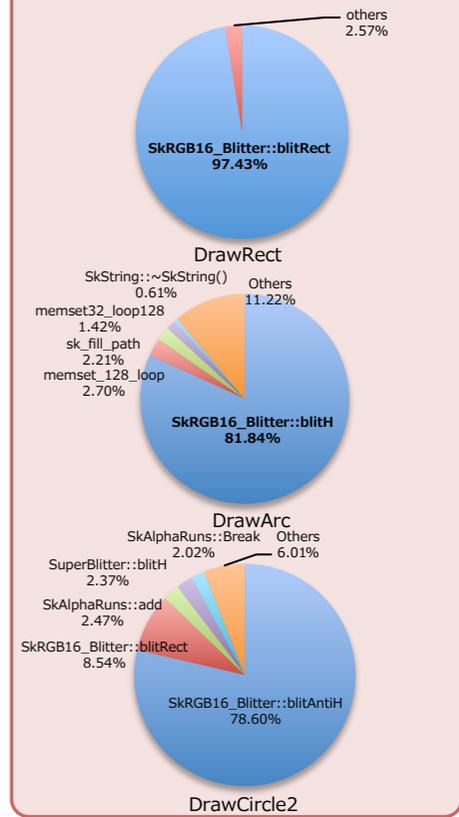


Profile-Based Automatic Parallelization



B "Skia" Profiling

Execution flow is different on each benchmark. High load on the BitBlit process.



C Tuning Method for "Skia" [DrawRect]

```
void SkRGB16_Blitter::blitRect(int x, int y, int width, int height) {
  SkASSERT(x + width <= fDevice.width() && y + height <= fDevice.height());
  uint16_t* SK_RESTRICT device = fDevice.getAddr16(x, y);
  unsigned deviceRB = fDevice.rowBytes();
  SkPMColor src32 = fSrcColor32;

```

```
while (--height >= 0) {
  blend32_16_row(src32, device, width);
  device = (uint16_t*)((char*)device + deviceRB);
}

```

Google NEXUS 7

NVIDIA Tegra3 Chip
Processor : NVIDIA Tegra3
ARM Cortex A9 - 4Core
Clock Frequency : 1.2[GHz]



Original Source Code

```
void SkRGB16_Blitter::blitRect(int x, int y, int width, int height) {
  SkASSERT(x + width <= fDevice.width() && y + height <= fDevice.height());
  uint16_t* SK_RESTRICT device = fDevice.getAddr16(x, y);
  unsigned deviceRB = fDevice.rowBytes();
  SkPMColor src32 = fSrcColor32;

  SkRGB16_Blitter_blitRect_oscar(width, height, device, deviceRB, src32);
}

void SkRGB16_Blitter_blitRect_oscar(int width, int height, uint16_t* device,
  unsigned deviceRB, SkPMColor src32) {
  int i;
  uint16_t* deviceTMP;

  for (i = height; i > 0; i--) {
    deviceTMP = (uint16_t*)((char*)device + (deviceRB * (height - i)));
    blend32_16_row(src32, deviceTMP, width);
  }
}

```

Separate C++ File

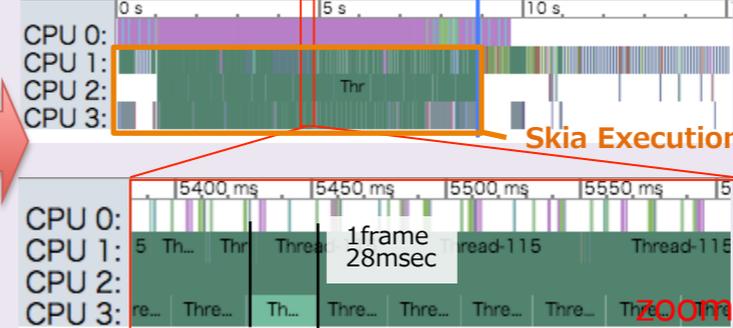
True dependency on variable deviceRB is solved

Evaluations

Sequential Skia - 1PE



Parallelized Skia - 3PE



CPU Load Graph [DrawRect]

Performance

0xbenchmark 2D Canvas Test

