Mobile Gaming and OpenCL™

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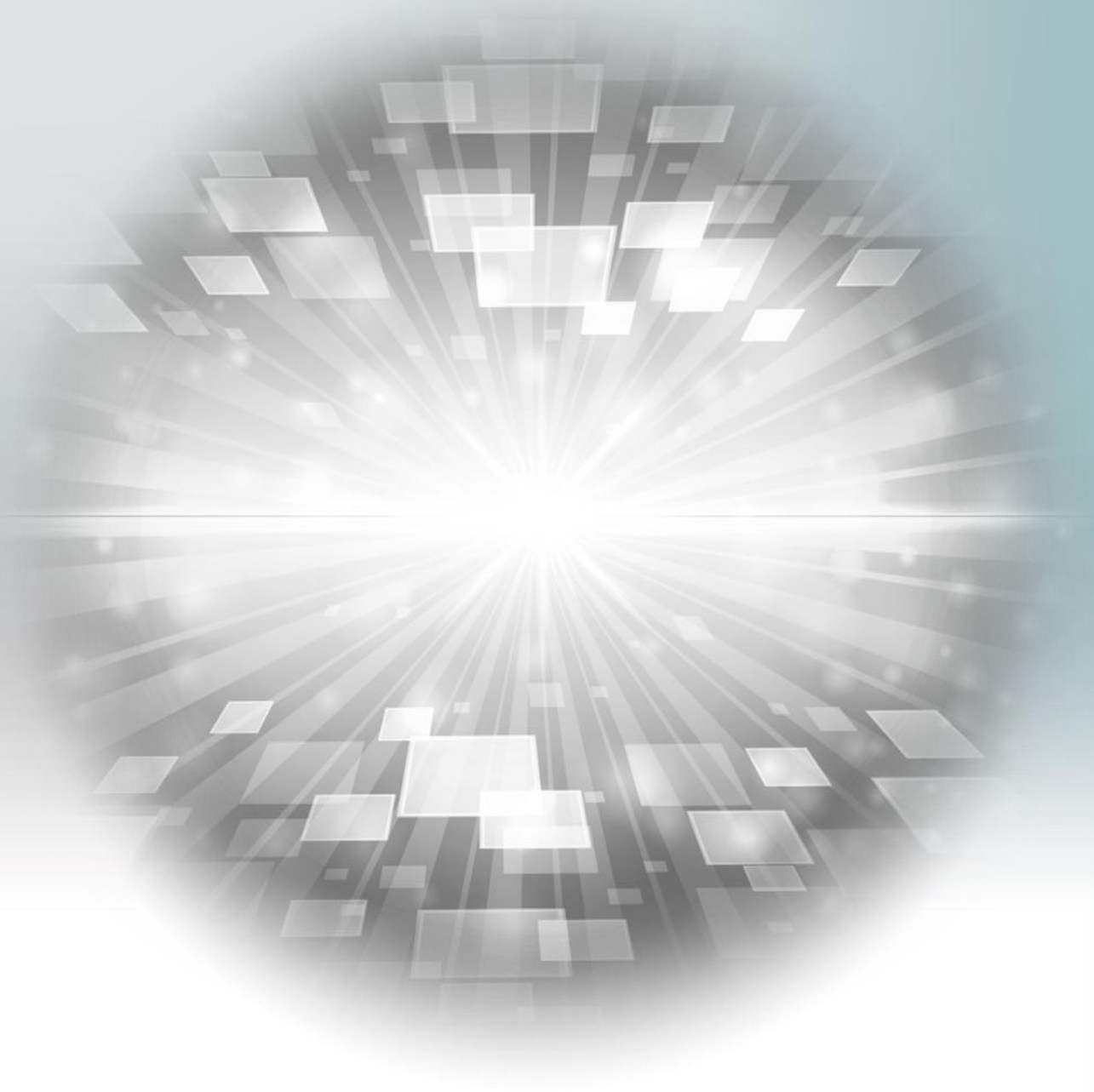
GPU Compute

- CPU is not designed for parallel workloads
- GPU is massively parallel –
  historically used only for graphics
- Enter GPU Compute



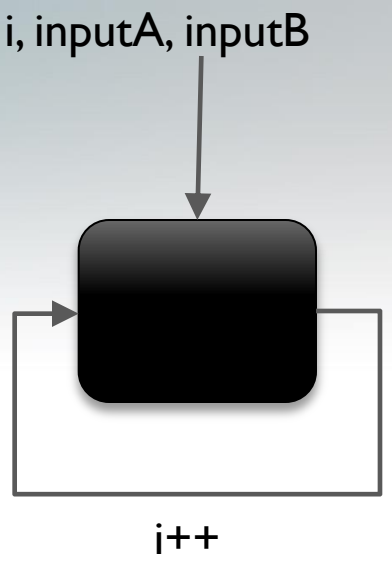
What is OpenCL ?

- Khronos API
- Implemented in desktop GPU and CPUs
- Similar structure to OpenGL® ES
- Allows access to the compute potential of the GPU
- High performance for parallel tasks
- Can share data with OpenGL ES

OpenCL

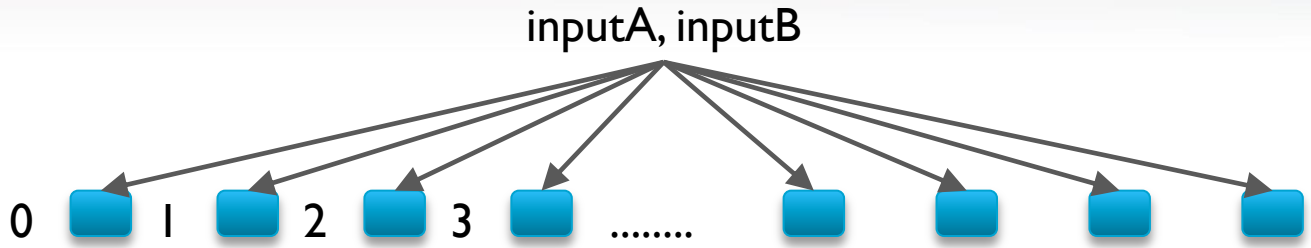
OpenCL

```
for (int i = 0; i < arraySize; i++)
{
    output[i] = inputA[i] + inputB[i];
}
```



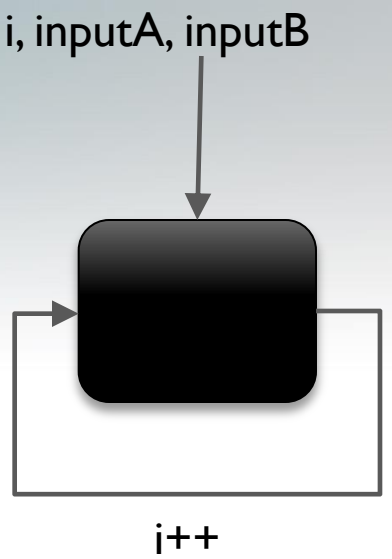

```
__kernel void kernel_name(__global int* inputA,
                          __global int* inputB,
                          __global int* output)
{
    int i = get_global_id(0);
    output[i] = inputA[i] + inputB[i];
}
```

clEnqueueNDRangeKernel(..., kernel, ..., arraySize, ...)



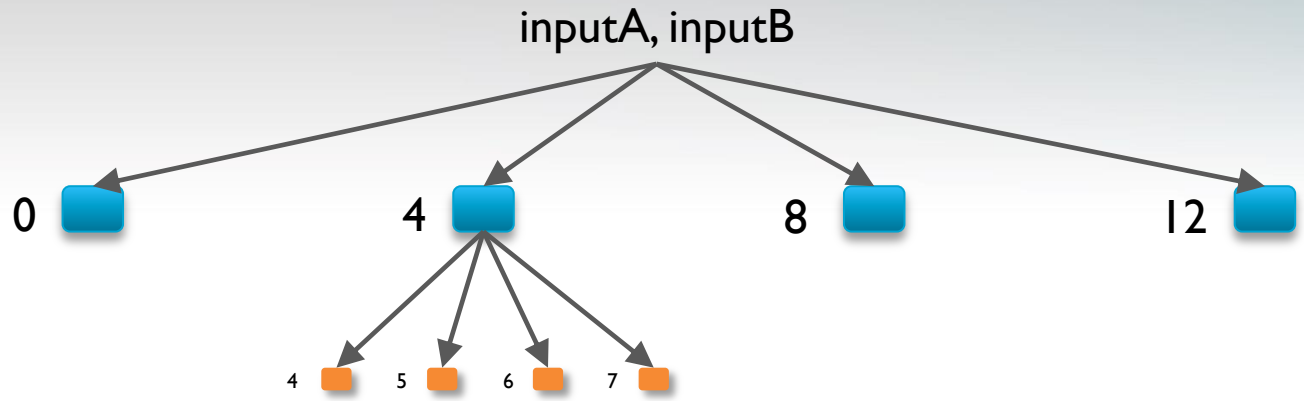
OpenCL Vectors

```
for (int i = 0; i < arraySize; i++)
{
    output[i] = inputA[i] + inputB[i];
}
```




```
__kernel void kernel_name(__global int* inputA,
                          __global int* inputB,
                          __global int* output)
{
    int i = get_global_id(0);
    int4 a = vload4(i, inputA);
    int4 b = vload4(i, inputB);
    vstore4(a + b, i, output);
}
```

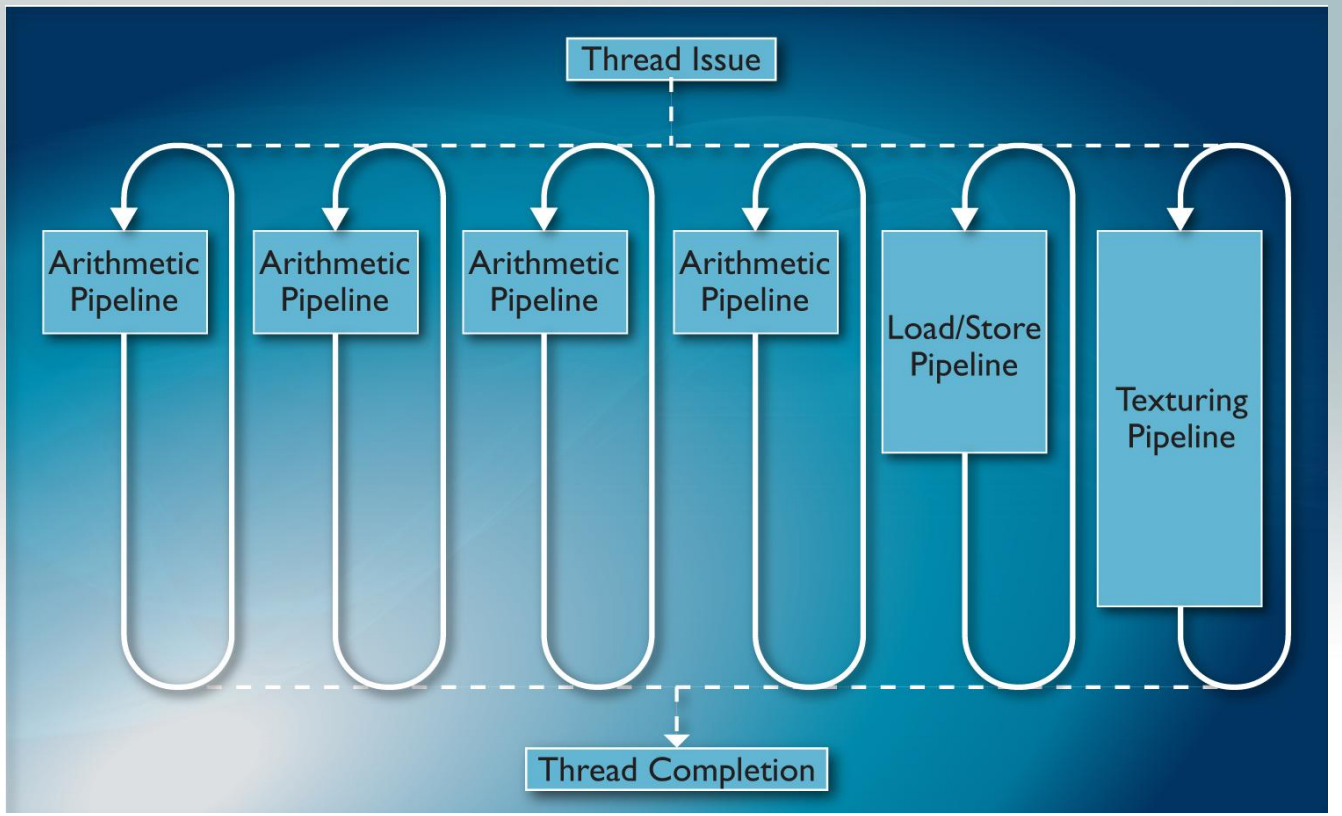
clEnqueueNDRangeKernel(..., kernel, ..., arraySize / 4, ...)



OpenCL on Mali™ GPUs

- Hardware design for GPU Compute
- Vector capable ALUs
- Unified memory
- Full Profile

Mali-T678 Pipeline

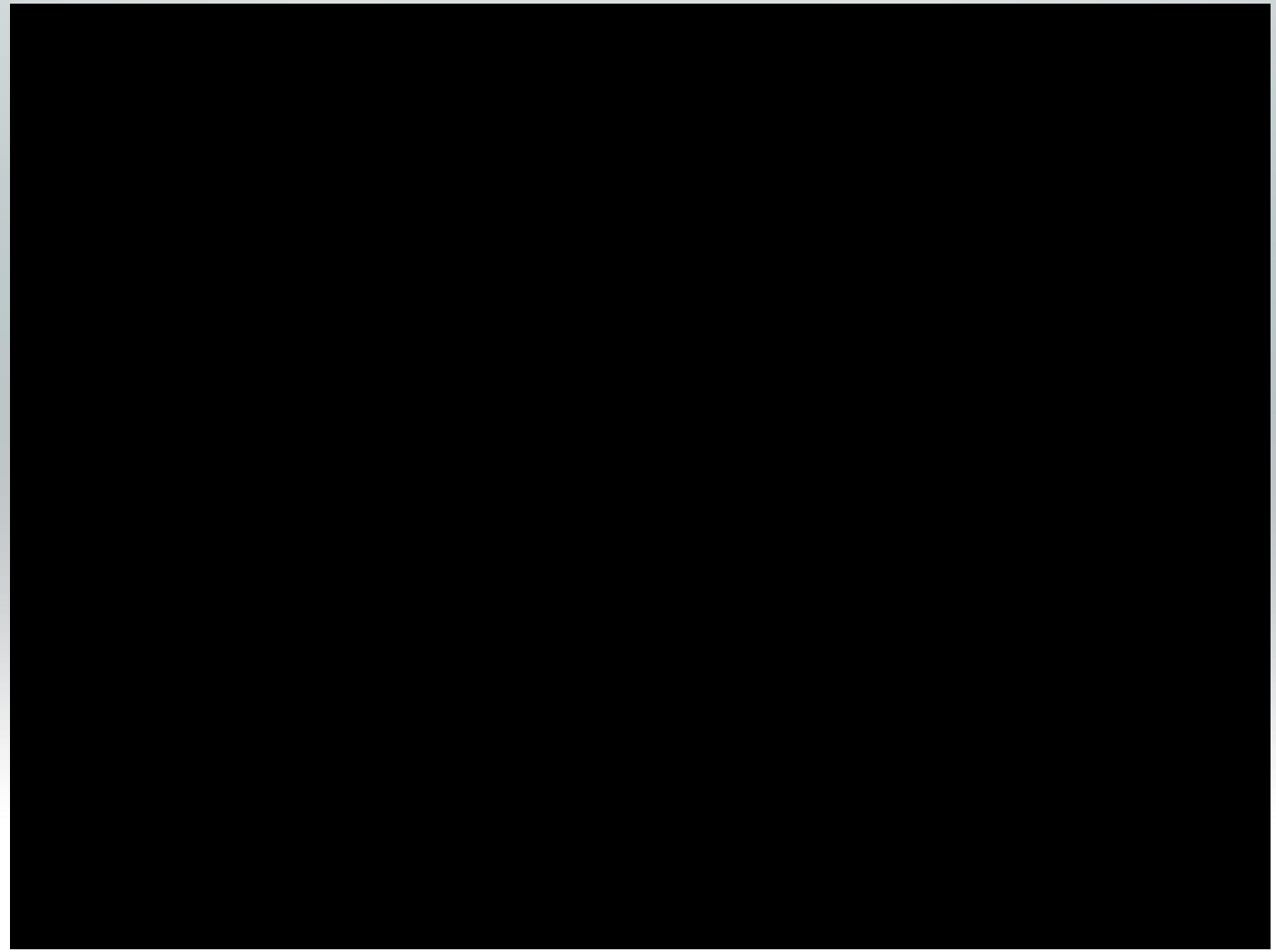


OpenCL Gaming Use Cases

- Physics
- AI

- Voice recognition
- Gesture recognition
- AR
- Multimedia post-processing

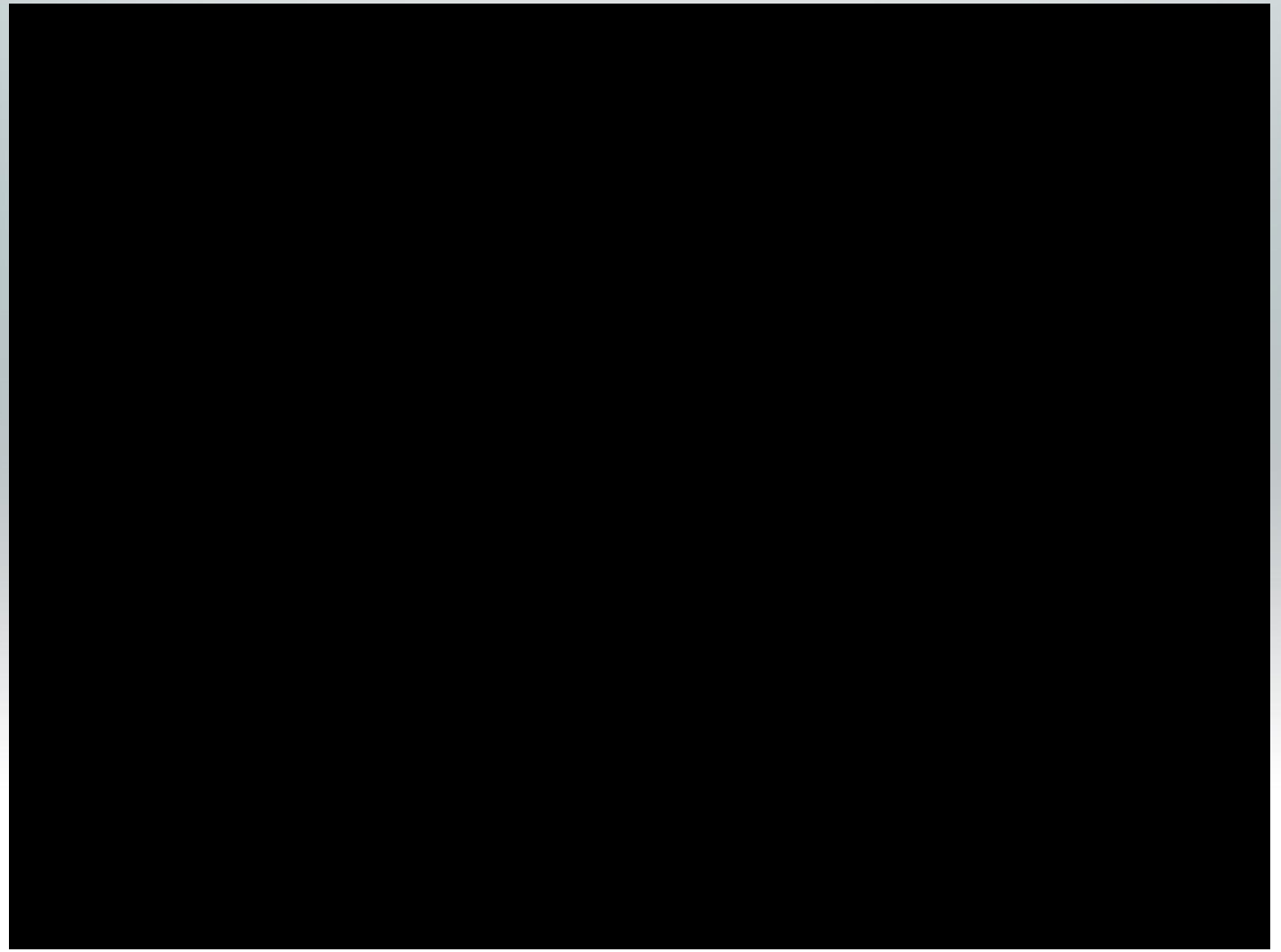
Physics Demo



Physics Demo

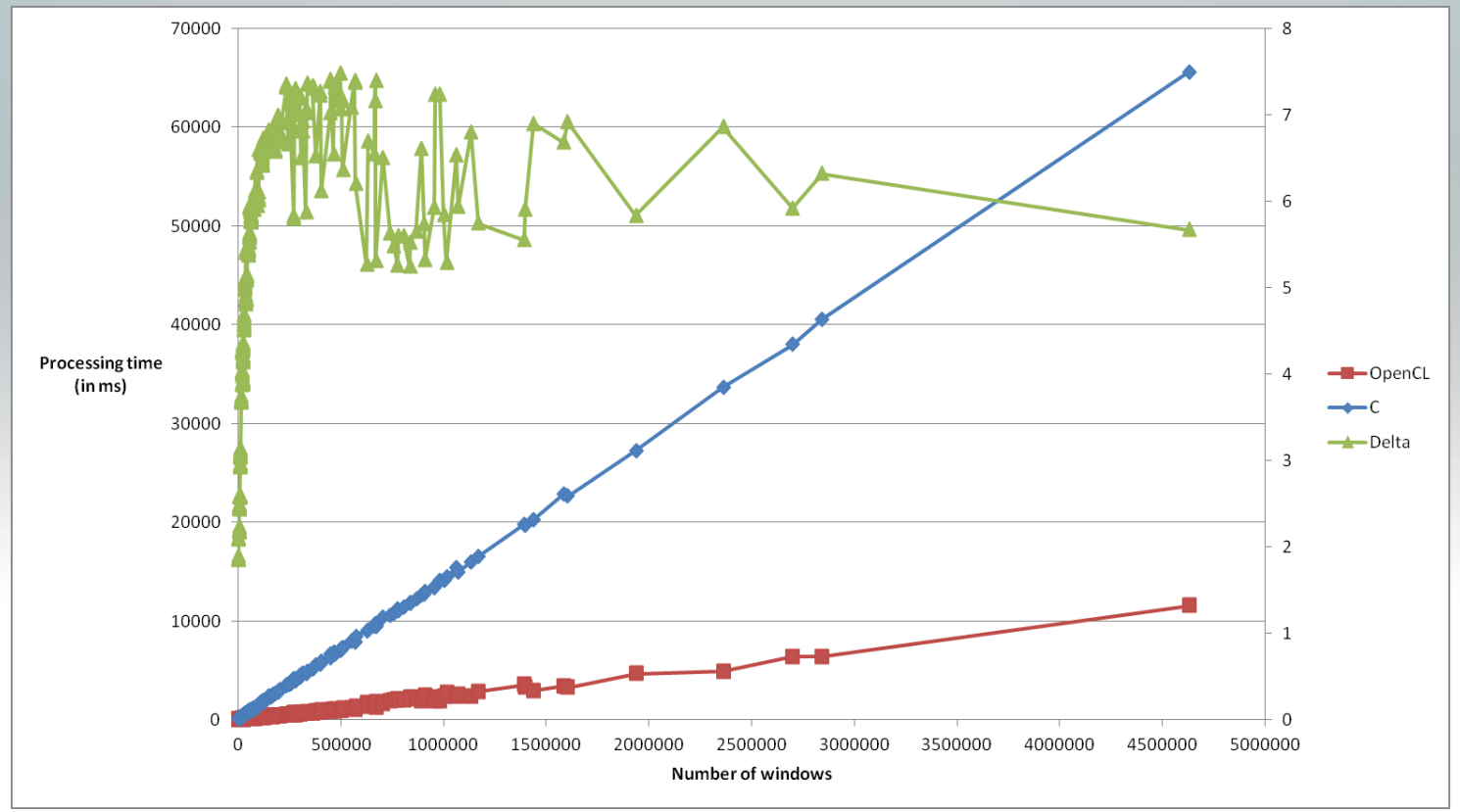
- Spring model with 6,000 vertices
- OpenCL version:
  - 8x times faster and twice the number of vertices
  - Single digit CPU load
- Multithreaded C version:
  - 100% CPU load

OpenCL Face Detection



Face Detection Case Study

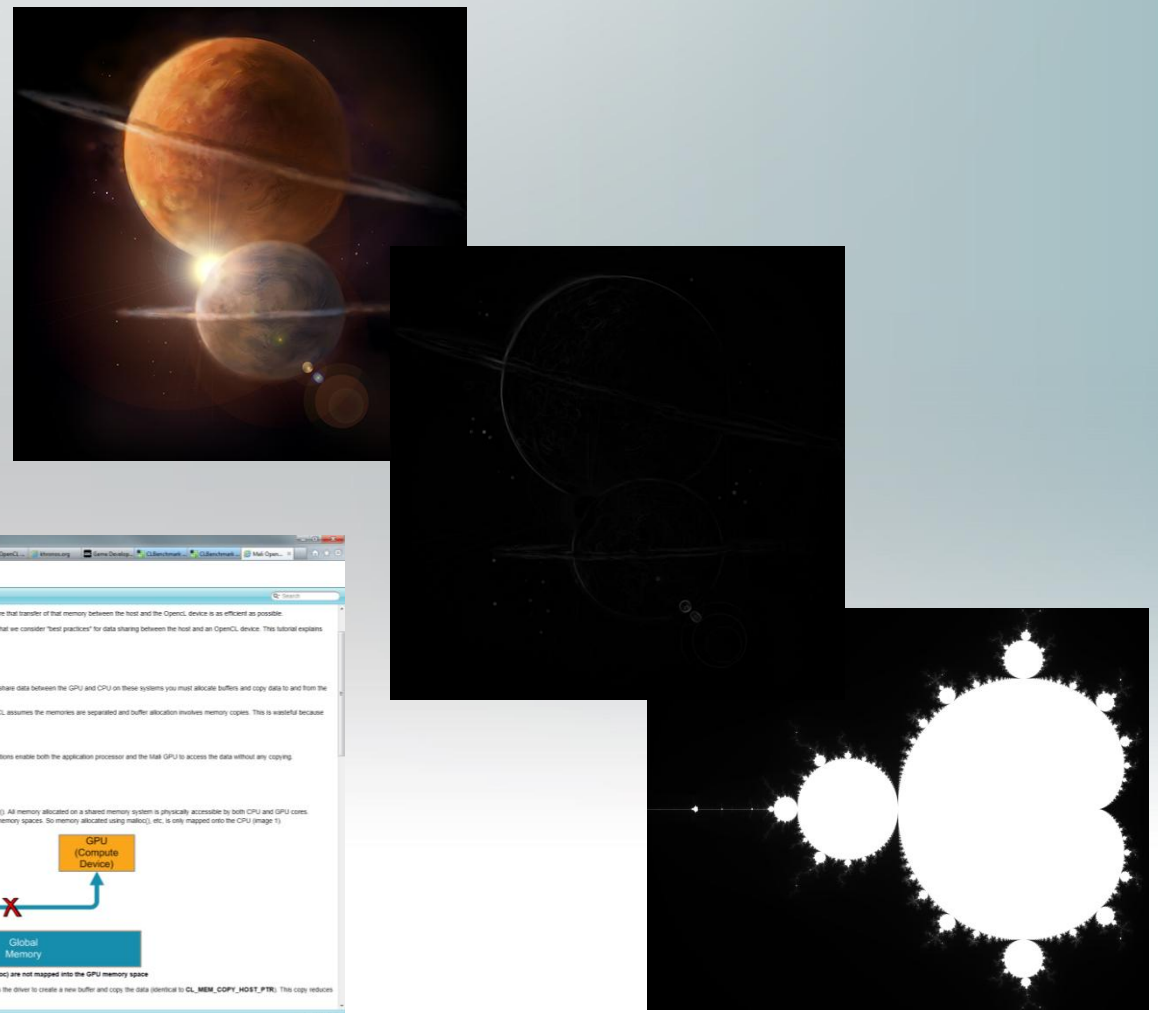
- Initial investigation focused on face detection application accelerated using OpenCL



Mali OpenCL SDK

- Simplify writing, porting and optimizing OpenCL 1.1 code for Mali GPU based platforms

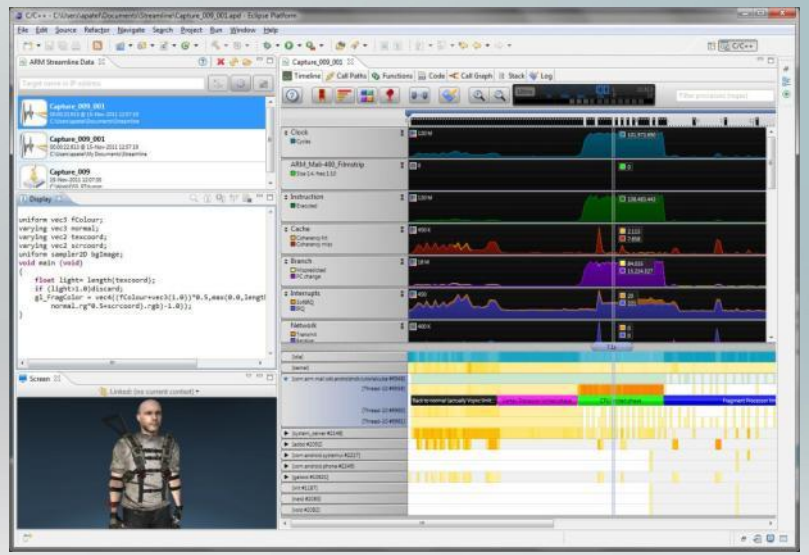
- Demonstrate key differentiating features to developers and programmers



OpenCL Performance Analysis

ARM DS-5™ and Streamline™ Performance Analyzer

- Support for graphics and GPU compute performance analysis on Mali-T604/T658
- Timeline profiling of hardware counters for detailed analysis
- Software counter support for OpenCL 1.1
- Custom counters
- Per-core/thread/process granularity



Summary

- GPU Compute in a familiar style
- Available on Mali GPU platforms
- OpenCL Resources and tools available from ARM
  - http://malideveloper.arm.com
- Potential for OpenCL in mobile gaming

Thank you!
Any questions?

malideveloper.arm.com