Stochastic Search-Based Testing for Uniform Block Layouts

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Introduction

Agenda

- Uniform buffer object background / what’s the problem?
- Testing method
- Live demo
UBO std140 packing

Defines an ABI for uniform block layout

- Nine rules for base alignment, structure padding, and array stride
UBO std140 packing

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But implementations are really, really bad...

- In July I fixed a lot of bugs found by new Khronos conformance tests
- 12 Mesa commits: 22f7a46d..b48621c3
“We basically can’t use UBOs.”
  - Christophe Riccio (g-truc.net and Unity3D)

“UBO introspection with GL: don’t do it kids. Every driver has its own way of doing things. std140 layout gives no guarantees either.”
  - Leonard Ritter (@paniq on Twitter)
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  9. If the member is a structure, the base alignment of the structure is \(<N>\), where \(<N>\) is the largest base alignment value of any of its members, and rounded up to the base alignment of a vec4.

```c
struct S { float f; int i; }

uniform U {
    float f;
    S s;
};
```
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  (9) If the member is a structure, the base alignment of the structure is \(<N>\), where \(<N>\) is the largest base alignment value of any of its members, and rounded up to the base alignment of a vec4.

```c
struct S { float f; int i; };

uniform U {
    float f;
    S s;  // should be at offset 16
};
```
Randomized Testing

Generate (semi-)random uniform buffer object
- Each block has a set of required, complex members
- Additional members with basic types fill in around the complex members

Probe all block members
- Every aspect visible to the GL API

Fill UBO with data, probe data in shader
- Not all fields are probed, see bug #84053
- Exposes a bug in AMD’s closed-source driver
Randomized Testing

“Trim” script trims failing test

- Modifications are random, so trimmed test may not be minimal
Results

Found many bugs in open and closed-source drivers

- Bug #83468
- Bug #83506
- Bug #83508
- Bug #83533
- Bug #83639
- Bug #83741
- See white paper for more details
Live Demo
More Information

See the white paper:


Test scripts:

http://cgit.freedesktop.org/~idr/piglit/log/?h=ubo-lolz