OpenGL Efficiency: AZDO

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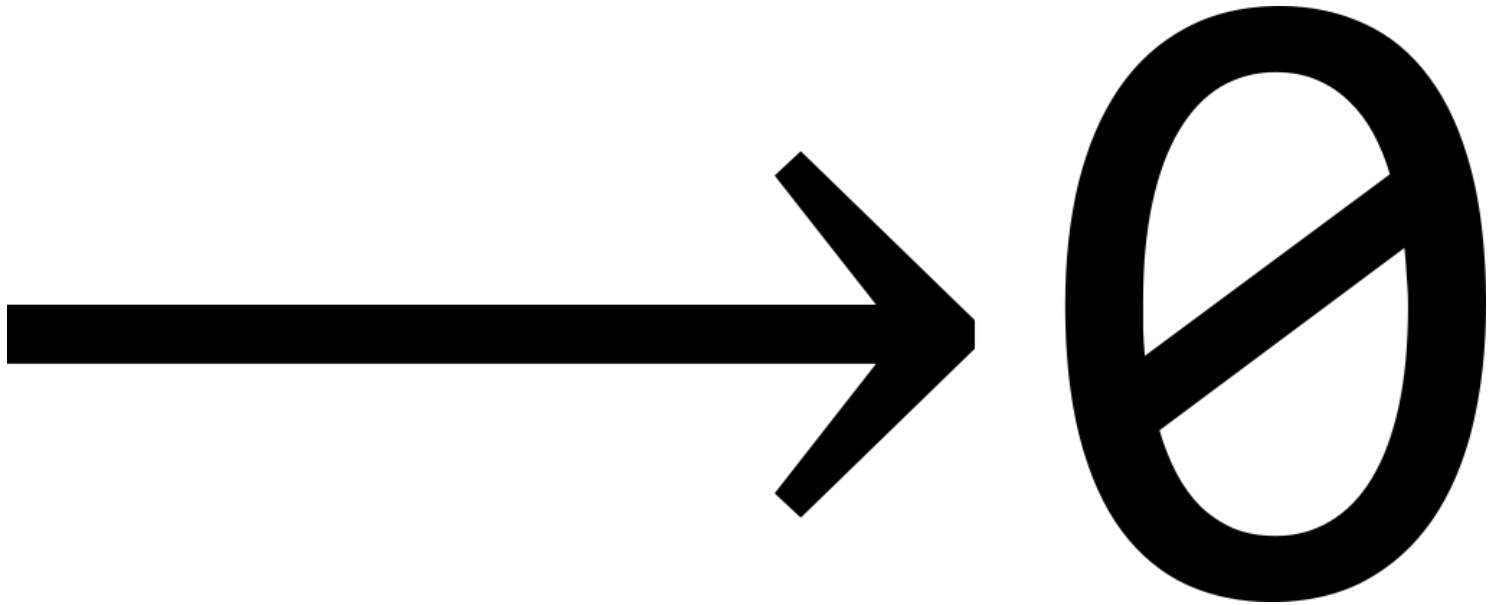
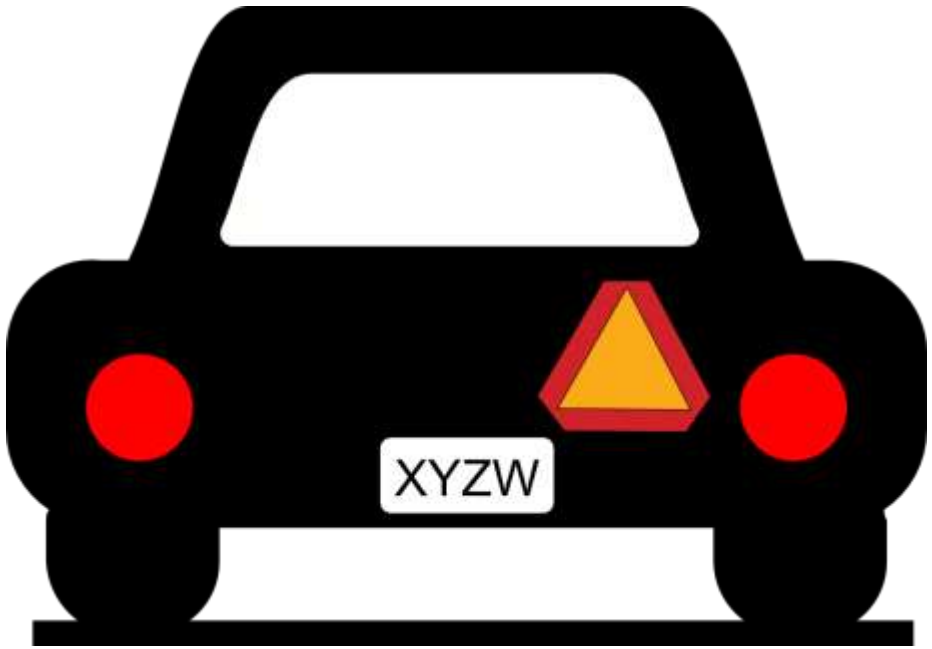
AZDO?

- Approaching Zero Driver Overhead



Why do you care about driver overhead?

- Because driver overhead == cost
- Costs
  - CPU cycles from app
  - CPU cache from app
  - power / battery
  - GPU throughput



OpenGL *Fallacy*: Old and Inefficient

Immediate Mode

Fixed Function

Display Lists

Evaluators

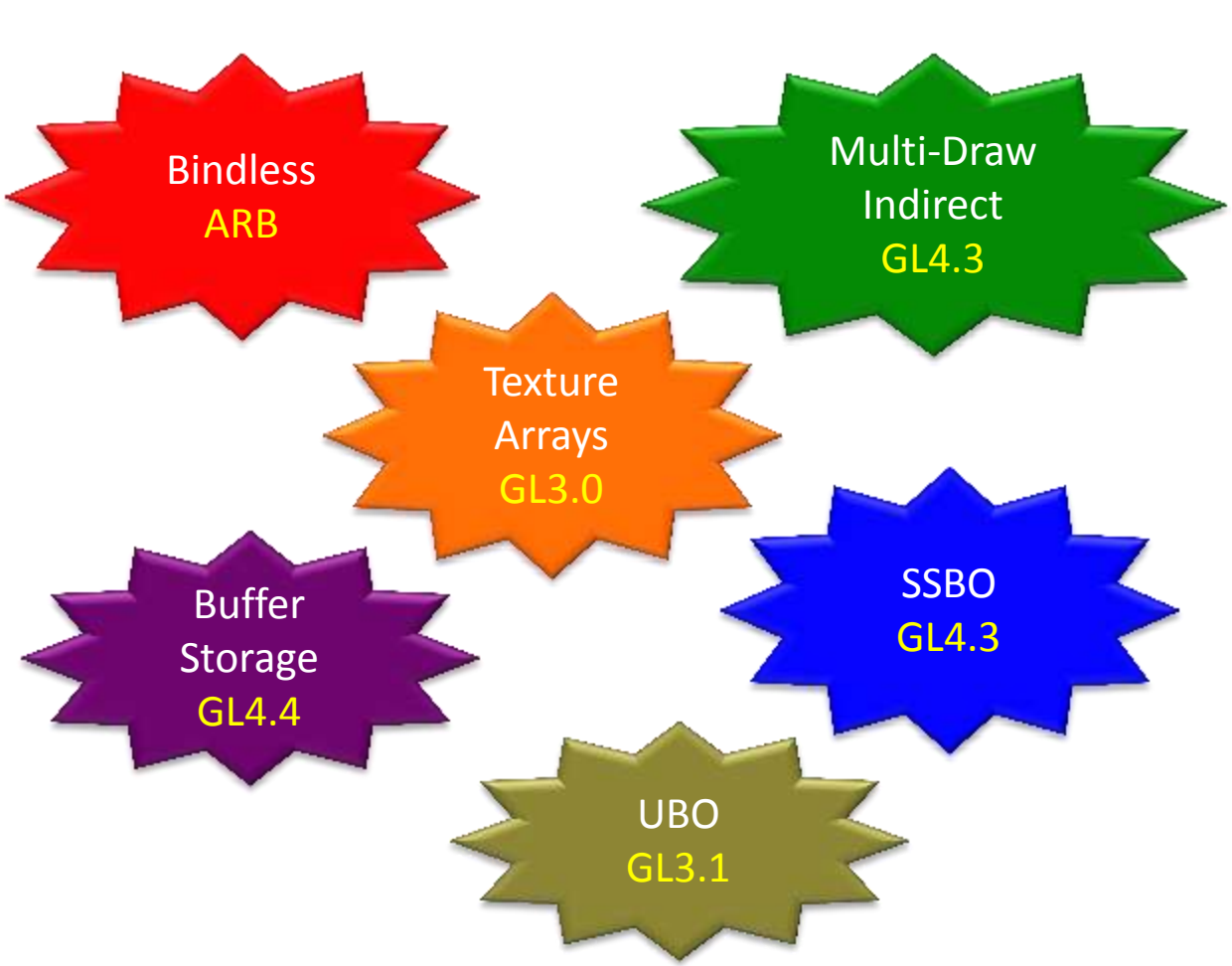
Feedback

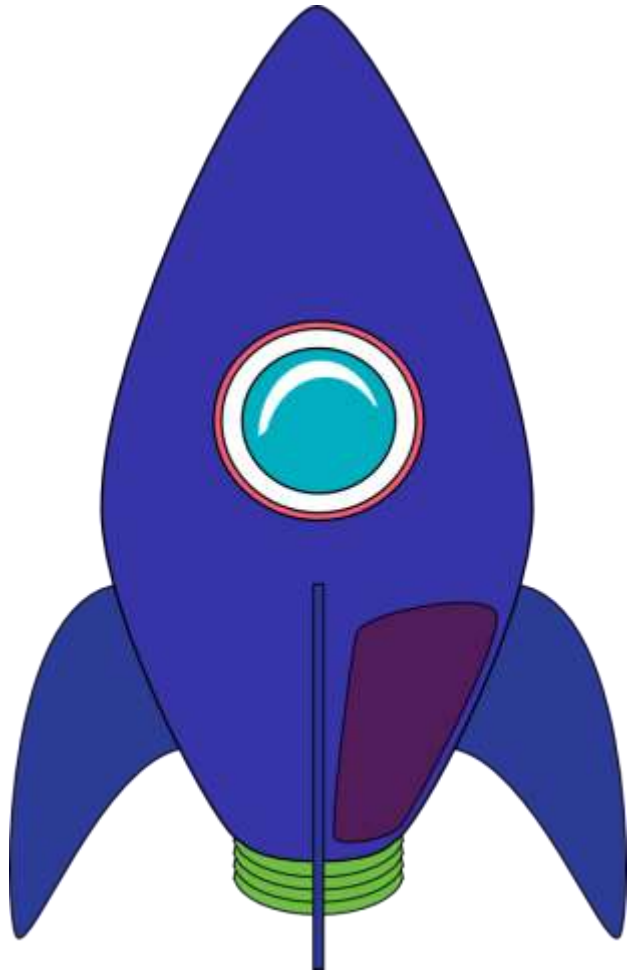
Ancient crufty stuff

Selectors

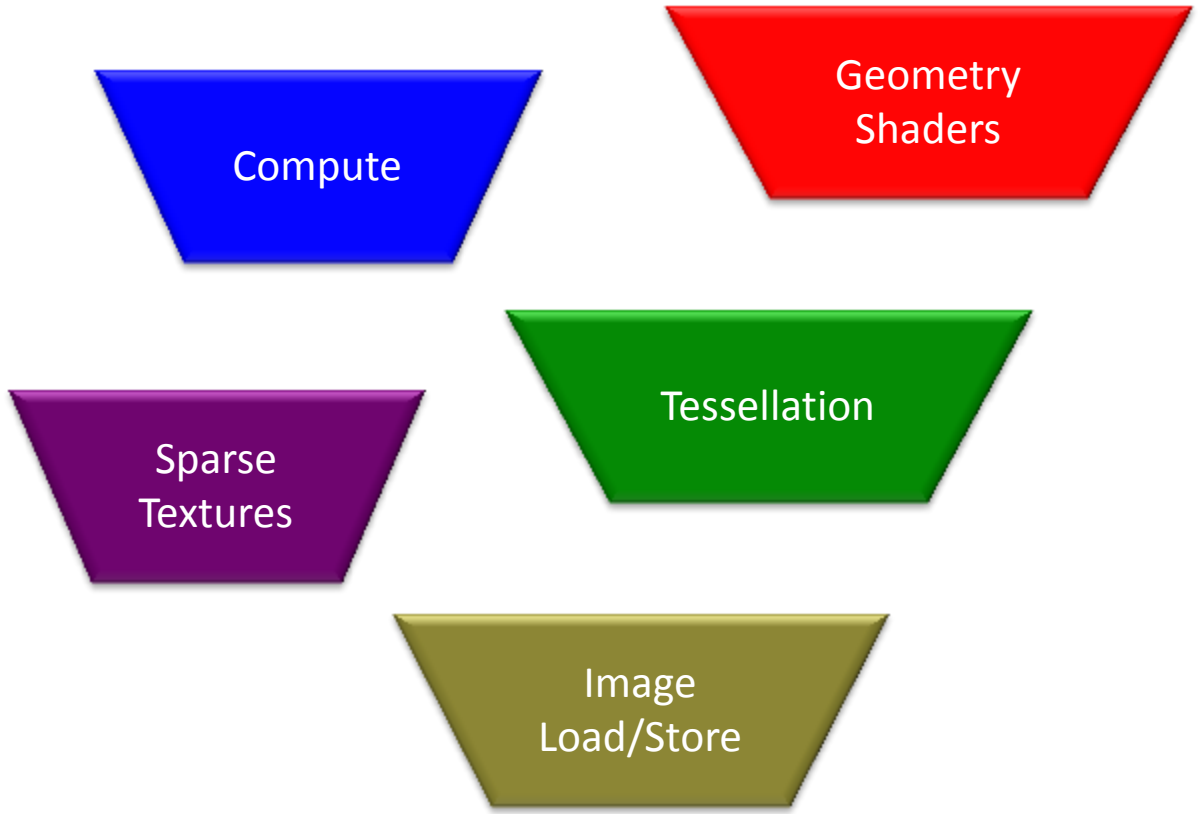
Selection

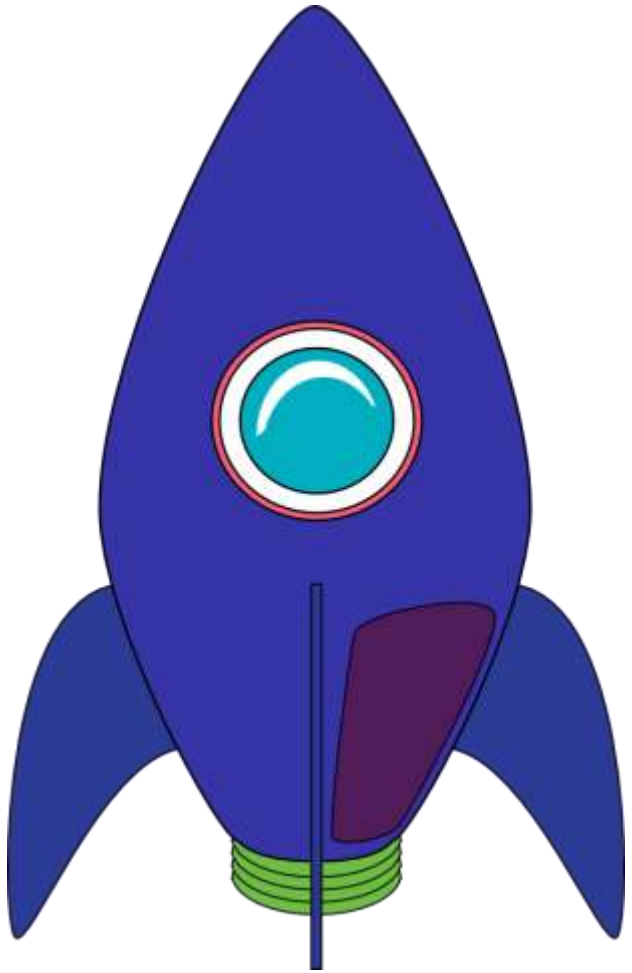
OpenGL *Reality*: Modern & Efficient



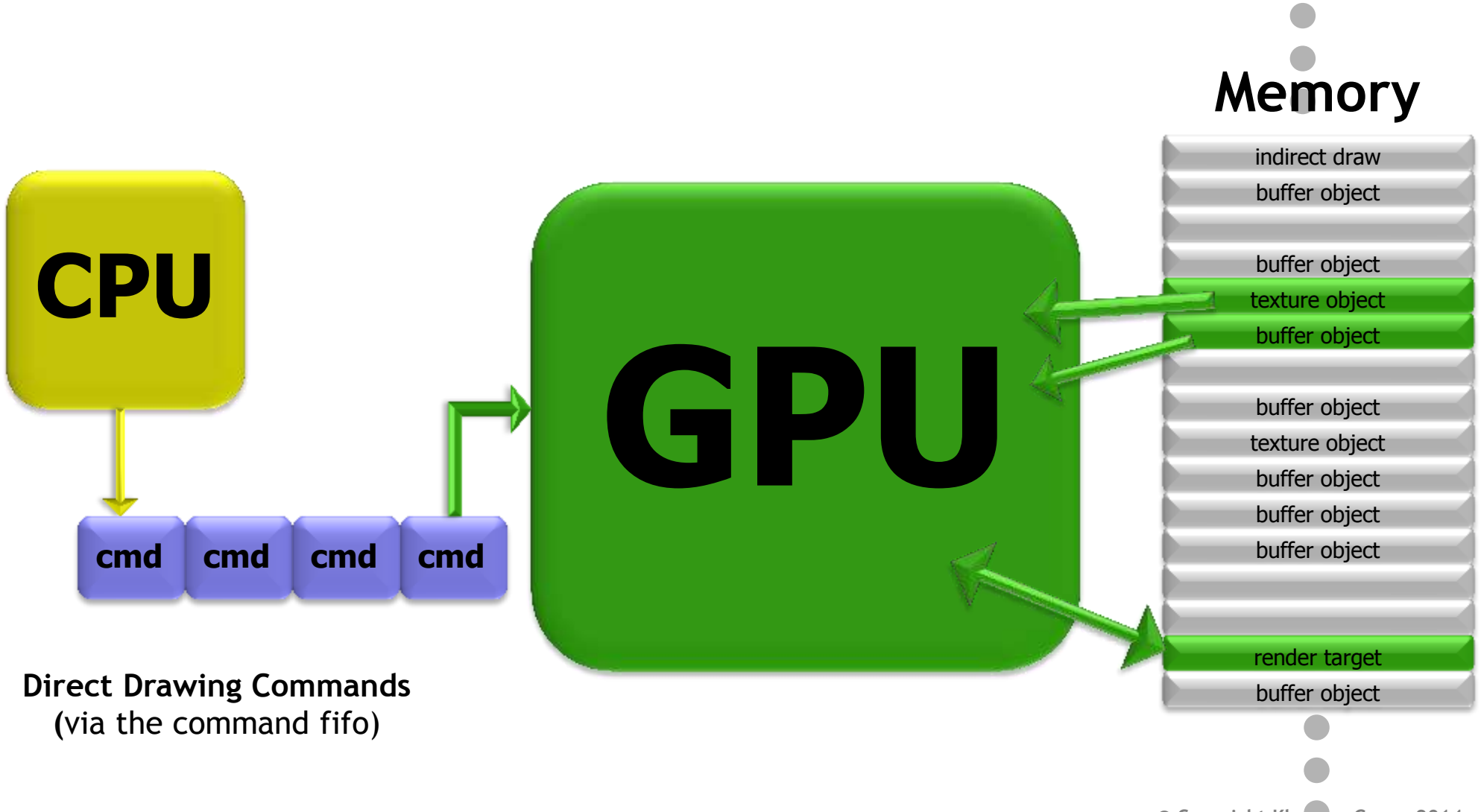


Plus, OpenGL has all the features





Classic OpenGL Model

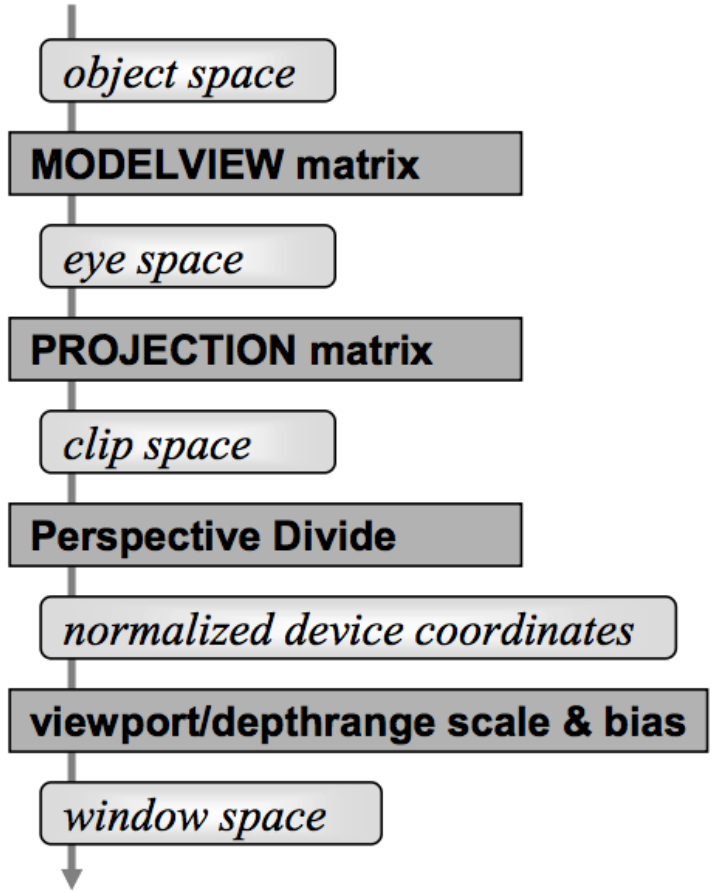


Direct Drawing Commands
(via the command fifo)

Classic Model Pros / Cons

- **Pro**
  - Very stable – 20+ year old code still “just works”
  - Simple
    - driver handles hazards, sync, allocation
  - Empowered the GPU revolution
  - Many classes of applications well served

- **Cons**
  - Demanding apps are not so well served
    - Intense games, VR
  - Doesn’t scale with high scene complexity
  - Threading model
  - Hardware abstraction showing age



Aspirational Goal

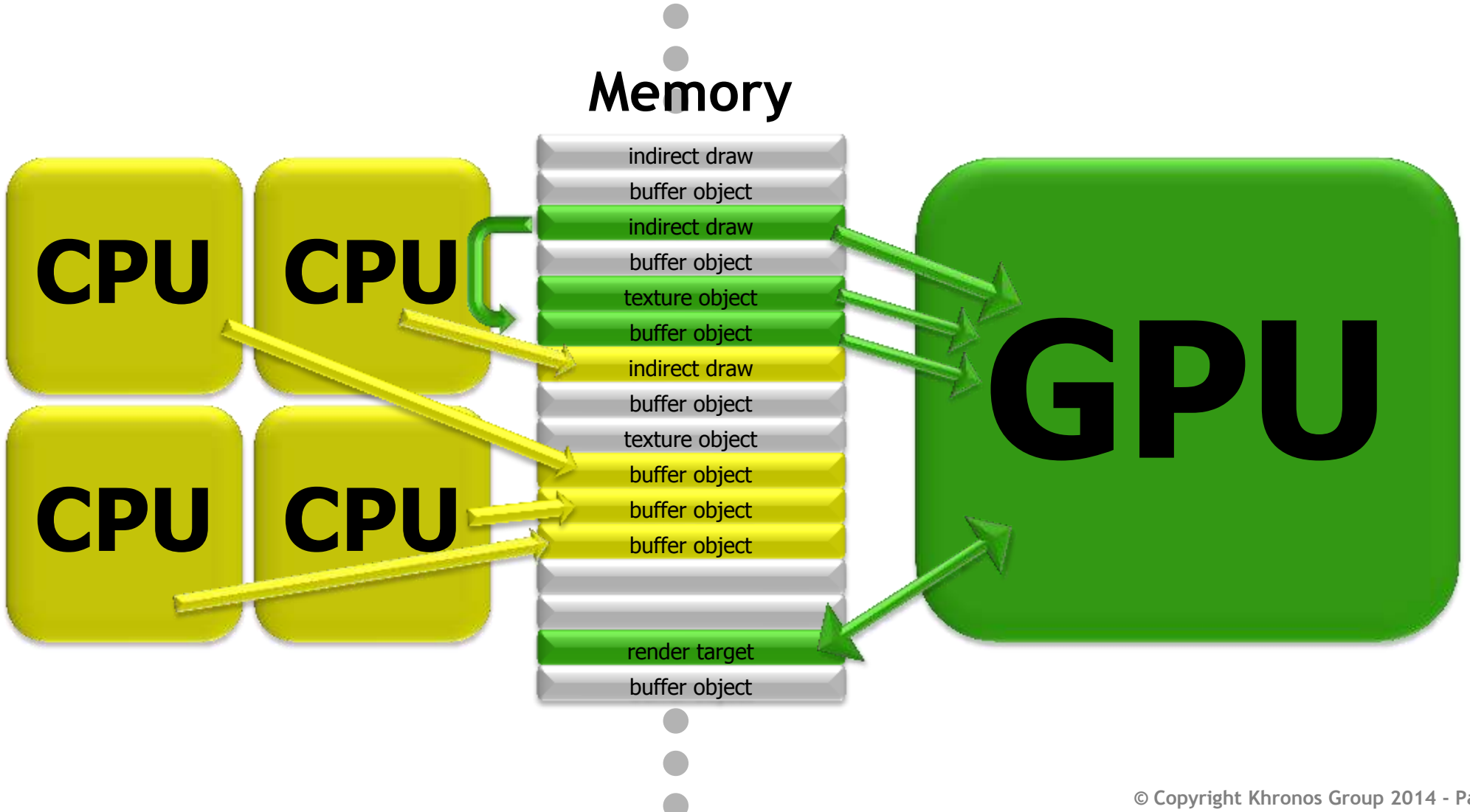
- **Can we address the cons within the framework of the existing API?**
  - That is, can we fix the cons without tossing the pros?

- **Good question!**

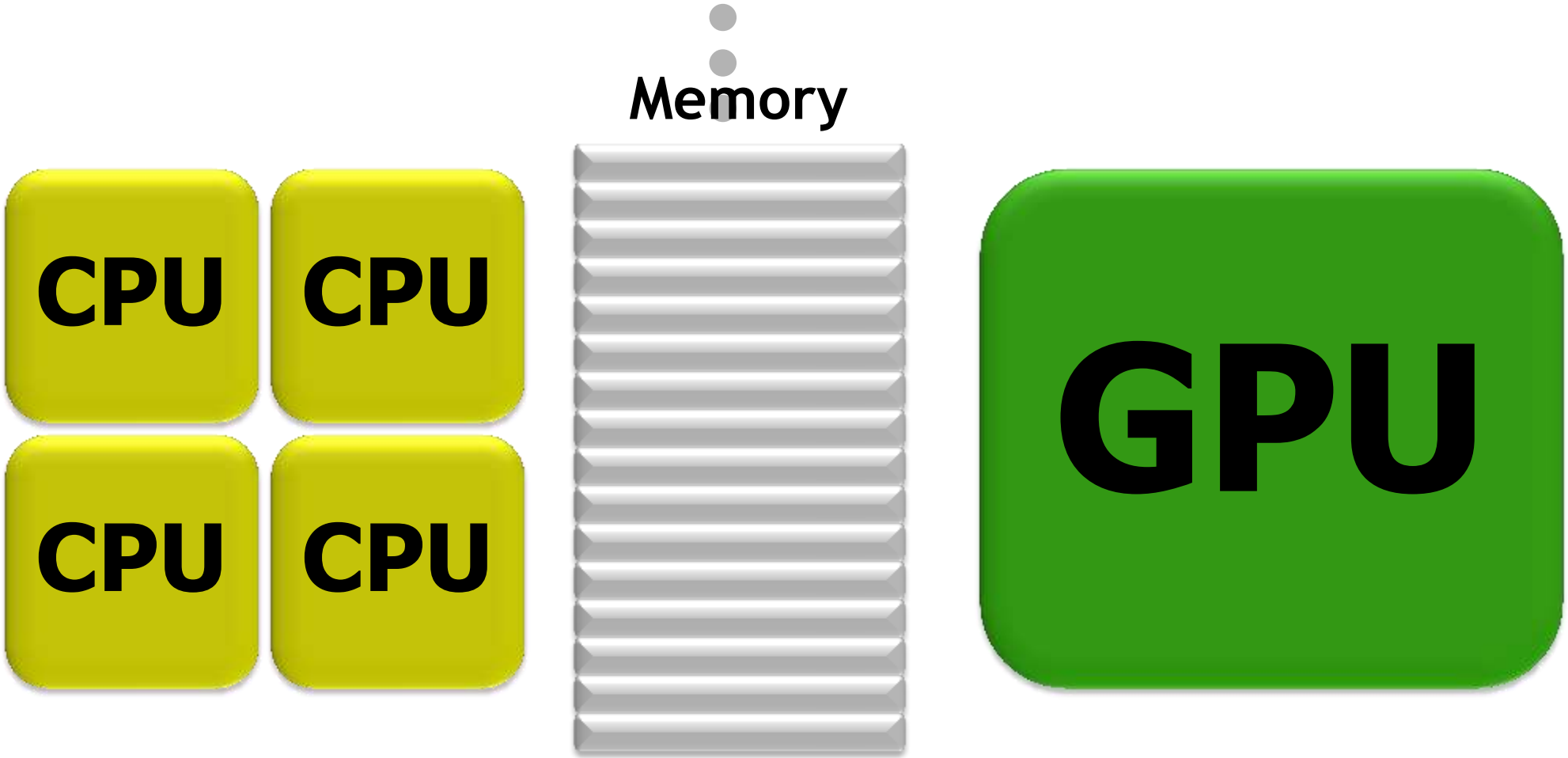
  - As it turns out, Smart People in Khronos have actually been working on this question for a while now
  - And they've developed an efficient, modern OpenGL that
    - Gives amazing perf improvements, and lives within the existing framework

- **And here's what it looks like…**

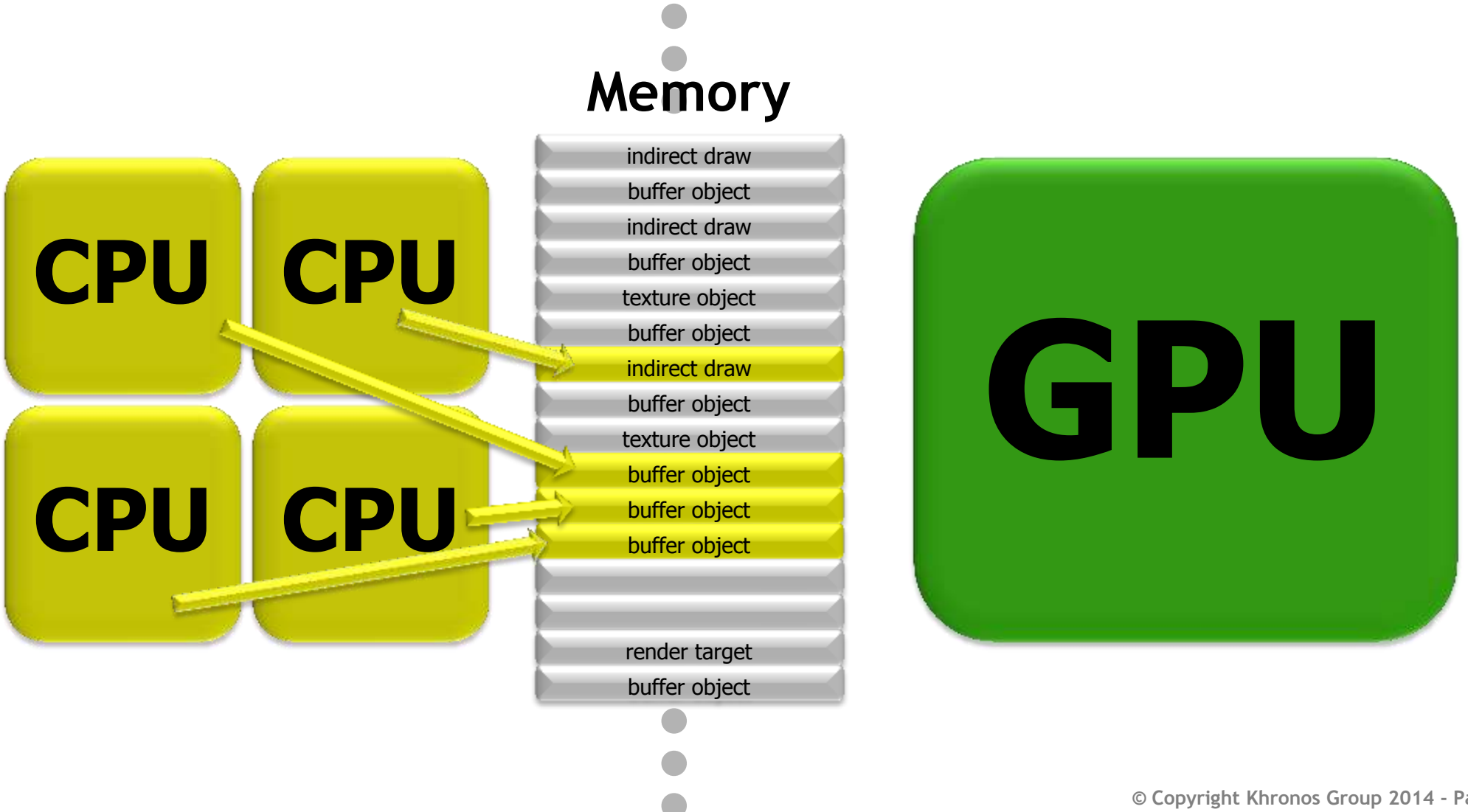
Efficient OpenGL Model



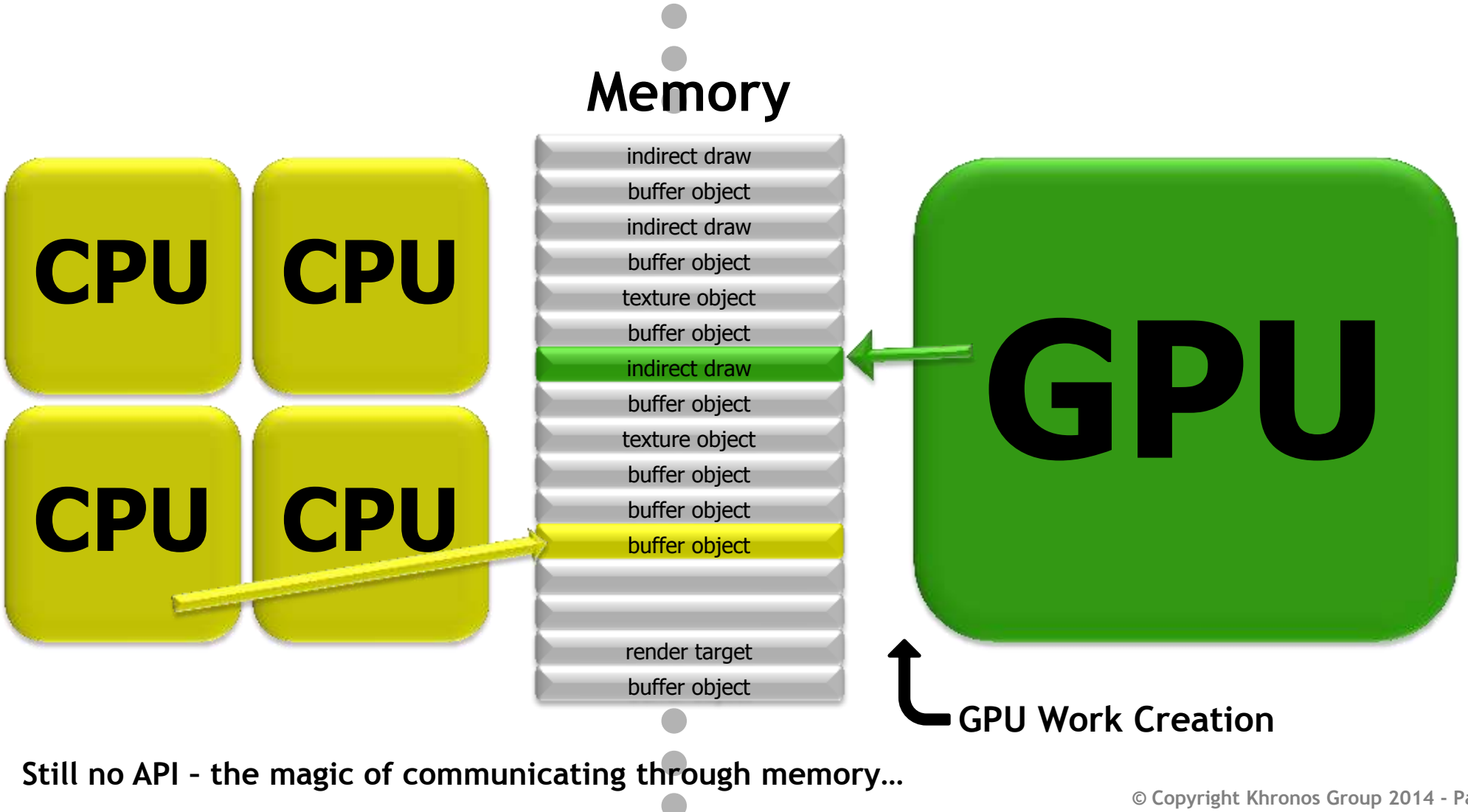
CPU and GPU decoupled



CPU Writes Memory - multi-threaded (no API)!

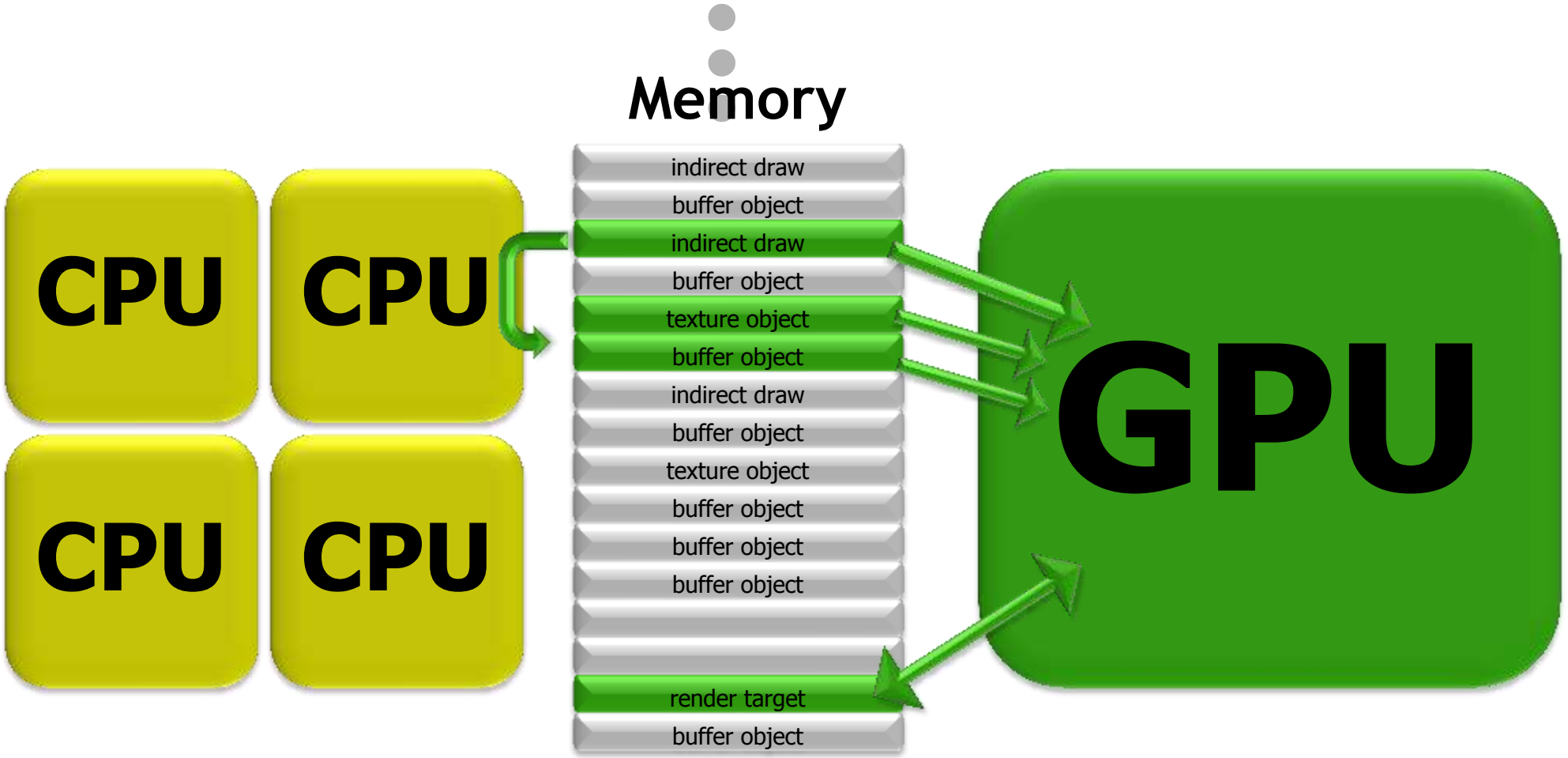


And/Or GPU Writes Memory



Still no API – the magic of communicating through memory…

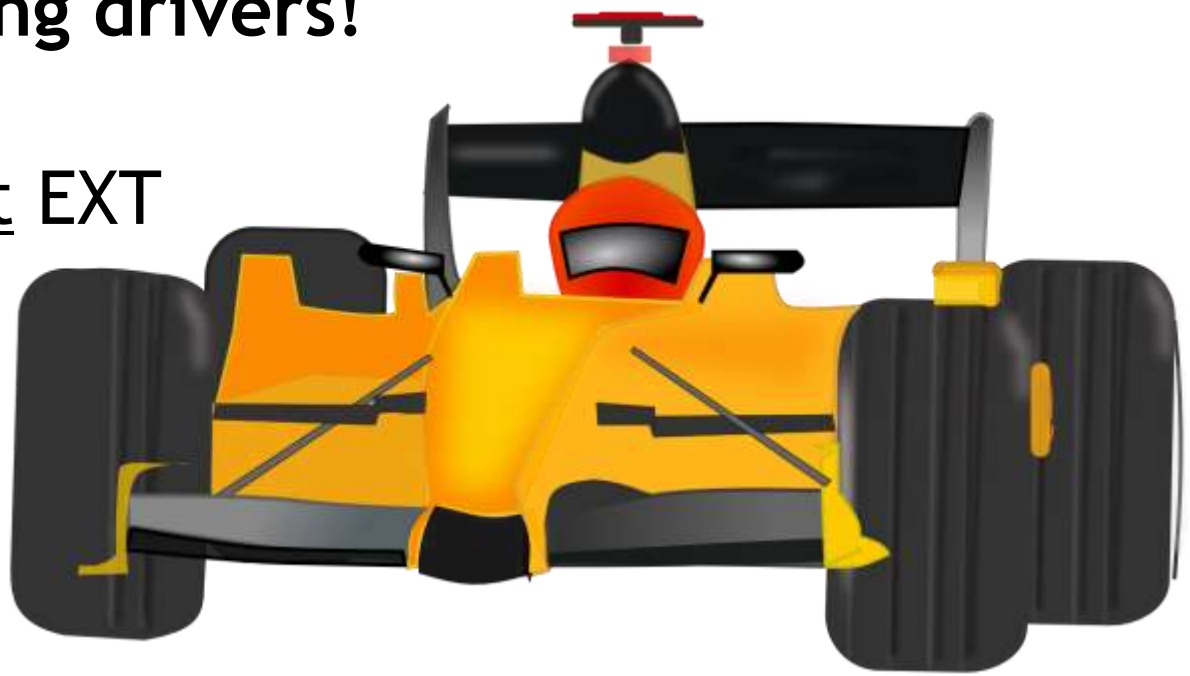
GPU Reads Commands from Memory



Minimal CPU / driver involvement…

Results

- **Integer multiple speedups ~5x - ~15x**
  - This is not a typo
  - On driver limited cases, obviously
- **Works TODAY on existing drivers!**
  - Mostly GL4.2+
  - Extensions are at least EXT



Bonuses

- **Enables scalable multi-threading with no new API**
  - Cores just write to memory
- **Enables GPU Work Creation**
  - Compute job or similar
    - Builds buffers, constructs MDI commands
- **Does not require a new object model**
- **Does not require breaking existing applications**

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