

PanVK

From PoC to VK1.4 in less than a year

Lars-Ivar Simonsen, Arm
Erik Faye-Lund, Collabora



7 major milestones in 6 months (and four days)

Not experimental any more

```
commit 976eb6825e487d39f1b6bd21835cee23b6a9ef41
```

```
Author: Erik Faye-Lund <erik.faye-lund@collabora.com>
```

```
Date: Mon Dec 9 16:03:26 2024 +0100
```

```
panvk: do not require opt-in for panvk on v10
```

As of writing, PanVK on v10 HW is in pretty good shape. It's not yet conformant, but we were passing over 99.9% of the CTS last time I checked. That's probably good enough to drop the opt-in here.

```
Reviewed-by: Boris Brezillon <boris.brezillon@collabora.com>
```

```
Part-of: <https://gitlab.freedesktop.org/mesa/mesa/-/merge\_requests/32561>
```



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Enabling Vulkan 1.1

```
commit 1a81bfff6aa431b3fc6a2900bde96ea3e74543433
```

```
Author: Erik Faye-Lund <erik.faye-lund@collabora.com>
```

```
Date: Mon Dec 16 14:20:19 2024 +0100
```

```
panvk: expose vk1.1 on v10 hardware
```

```
Subgroup ops were the last bit missing
```

```
Reviewed-by: Boris Brezillon <boris.brezillon@collabora.com>
```

```
Part-of: <https://gitlab.freedesktop.org/mesa/mesa/-/merge\_requests/32710>
```



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Vulkan 1.1

- 75 commits since removing opt-in
 - Most significantly, subgroup operations now work
 - But a *lot* more fixes than that!
- Shipped in Mesa 24.3

Adding Mali V12 support

```
commit e7308a3902edf1905fe6ca5f847ae9f64cca5e78
```

```
Author: Mary Guillemard <mary.guillemard@collabora.com>
```

```
Date:   Wed Feb 26 16:08:00 2025 +0100
```

```
panfrost: Advertize Mali-G720 support
```

```
We need GPU_FEATURES to determine if this is another variant but this  
will do for now.
```

```
Signed-off-by: Mary Guillemard <mary.guillemard@collabora.com>
```

```
Reviewed-by: Boris Brezillon <boris.brezillon@collabora.com>
```

```
Reviewed-by: Lars-Ivar Hesselberg Simonsen <lars-ivar.simonsen@arm.com>
```

```
Part-of: <https://gitlab.freedesktop.org/mesa/mesa/-/merge\_requests/34032>
```



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Adding Mali V13 support

```
commit fb0a8488db94bfc38a01cc0f0abc7e52ce06dc07
```

```
Author: Mary Guillemard <mary.guillemard@collabora.com>
```

```
Date: Thu Jan 30 11:56:21 2025 +0000
```

```
panfrost: Advertize Mali-G725 support
```

```
We need GPU_FEATURES to determine if this is another variant but this  
will do for now.
```

```
Signed-off-by: Mary Guillemard <mary.guillemard@collabora.com>
```

```
Reviewed-by: Boris Brezillon <boris.brezillon@collabora.com>
```

```
Reviewed-by: Lars-Ivar Hesselberg Simonsen <lars-ivar.simonsen@arm.com>
```

```
Part-of: <https://gitlab.freedesktop.org/mesa/mesa/-/merge\_requests/34032>
```



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Mary is the G.O.A.T

- 26 commits to enable V12 and V13
 - No more IADD.v4s8
 - Index-driven vertex shader: IDVS2
- V12: Radxa Orion 06
- V13: MediaTek MT8196
- Shipped in Mesa 25.0

Enabling Vulkan 1.2

```
commit b3fd8ddf6a421efebb94b40972eeeffa4f6b9f65
```

```
Author: Erik Faye-Lund <erik.faye-lund@collabora.com>
```

```
Date: Thu Apr 10 12:13:41 2025 +0200
```

```
panvk: support vulkan 1.2 on v10+
```

```
While not yet officially conformant, we support all the required  
features, and we pass the CTS. Let's mark off Vulkan 1.2, to make things  
easier for applications.
```

```
Backport-to: 25.1
```

```
Reviewed-by: Boris Brezillon <boris.brezillon@collabora.com>
```

```
Part-of: <https://gitlab.freedesktop.org/mesa/mesa/-/merge\_requests/34512>
```



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Vulkan 1.2

- 161 commits since enabling Vulkan 1.1
 - 29 new extensions
 - 37 new device features
- Shipped in Mesa 25.1

Enabling Vulkan 1.3

```
commit 8ec846407d446984ab84677826ad1f7f005587b6
```

```
Author: Erik Faye-Lund <erik.faye-lund@collabora.com>
```

```
Date: Thu Jun 12 17:32:26 2025 +0200
```

```
panvk: expose vulkan 1.3 support
```

```
vulkanMemoryModel was the last required feature we needed to expose  
Vulkan 1.3, so let's enable it!
```

```
Reviewed-by: Caterina Shablia <caterina.shablia@collabora.com>
```

```
Reviewed-by: Olivia Lee <olivia.lee@collabora.com>
```

```
Reviewed-by: Boris Brezillon <boris.brezillon@collabora.com>
```

```
Reviewed-by: Lars-Ivar Hesselberg Simonsen <lars-ivar.simonsen@arm.com>
```

```
Reviewed-by: Mary Guillemard <mary.guillemard@collabora.com>
```

```
Part-of: <https://gitlab.freedesktop.org/mesa/mesa/-/merge\_requests/35502>
```



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Vulkan 1.3

- 90 commits since enabling Vulkan 1.2
 - 20 new extensions
 - 23 new device features
- Shipped in Mesa 25.2

Enabling Vulkan 1.4

```
commit 5ee3c10d1edf4663980e8ea759a58dcc054efb71
```

```
Author: Olivia Lee <olivia.lee@collabora.com>
```

```
Date:   Fri Jun 13 19:18:30 2025 -0700
```

```
panvk: advertise vulkan 1.4 on v10+
```

```
VK_EXT_host_image_copy was the last extension needed.
```

```
Signed-off-by: Olivia Lee <olivia.lee@collabora.com>
```

```
Reviewed-by: Erik Faye-Lund <erik.faye-lund@collabora.com>
```

```
Part-of: <https://gitlab.freedesktop.org/mesa/mesa/-/merge\_requests/35910>
```



Vulkan 1.4

- 101 commits since enabling Vulkan 1.3
 - 13 new extensions
 - 11 new device features
- Shipped in Mesa 25.2
 - Two versions in one release! Woohoo!

So we're done, right?

- Vulkan 1.4 was a huge milestone
- But there's more to do!
 - Already good progress since 25.2

What has changed since 25.2?

- Performance improvements
 - Compiler / userspace / AFBC
 - Comparisons are on Rock5B
 - 25.2@4369c24d8df vs main@fce9dbc4938
- Instrumentation improvements
- Preliminary Android support
- A few extra extensions

Compiler optimizations

Totals from 560 (69.74% of 803) affected shaders:
Instrs: 116226 -> 103222 (-11.19%); split: -14.45%, +3.27%
CodeSize: 976384 -> 871296 (-10.76%); split: -13.86%, +3.09%
Estimated normalized FMA cycles: 771.140625 -> 715.921875 (-7.16%); split: -11.03%, +3.87%
Estimated normalized CVT cycles: 673.796875 -> 557.40625 (-17.27%); split: -21.23%, +3.95%
Estimated normalized SFU cycles: 740.875 -> 721.6875 (-2.59%); split: -8.91%, +6.32%
Estimated normalized Texture cycles: 344.5 -> 386.75 (+12.26%)
Estimated normalized Load/Store cycles: 9854.0 -> 7971.0 (-19.11%); split: -20.11%, +1.00%
Maximum number of threads: 912 -> 969 (+6.25%); split: +6.36%, -0.11%
Number of hardware loops: 341 -> 325 (-4.69%); split: -5.87%, +1.17%
Number of spill instructions: 464 -> 154 (-66.81%)
Number of fill instructions: 1598 -> 717 (-55.13%); split: -59.07%, +3.94%



Userspace optimizations

- A few key bottlenecks identified
 - Synchronization, TLS allocations
 - Many already fixed
 - Noticeable impact on ``vkmark --winsys headless``

25.2	main
Score: 1969	Score: 3532

AFBC enabled

```
commit f67d26723734c4a0e5a55b81390a17029c8f6315
```

```
Author: Boris Brezillon <boris.brezillon@collabora.com>
```

```
AuthorDate: Fri Aug 29 17:05:03 2025 +0200
```

```
panvk: Make AFBC an opt-out
```

```
Use AFBC when we can.
```

```
Signed-off-by: Boris Brezillon <boris.brezillon@collabora.com>
```

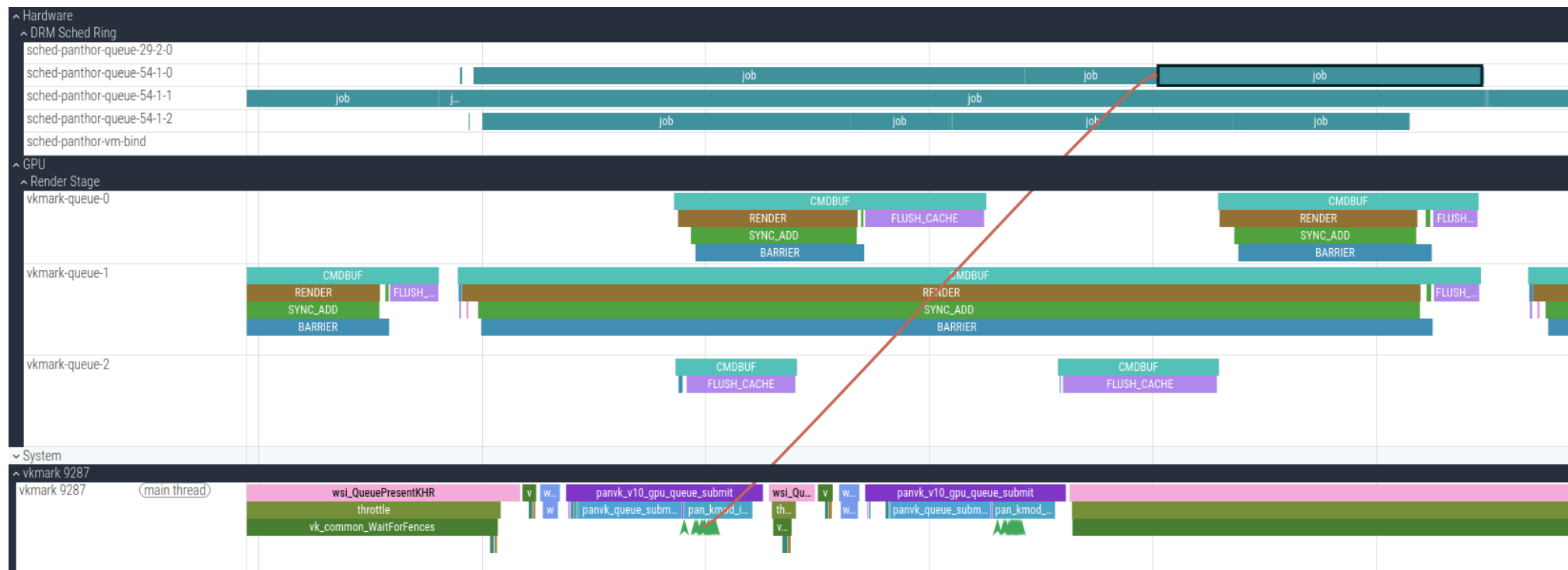
```
Reviewed-by: Eric R. Smith <eric.smith@collabora.com>
```

```
Reviewed-by: Christoph Pillmayer <christoph.pillmayer@arm.com>
```

```
Part-of: <https://gitlab.freedesktop.org/mesa/mesa/-/merge\_requests/37158>
```



Instrumentation



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Preliminary Android support

```
commit b76c556c5935883fce303a68bf21843005342519
```

```
Author: Yiwei Zhang <zzyiwei@chromium.org>
```

```
AuthorDate: Wed Aug 6 09:37:17 2025 +0000
```

```
panvk: support VK_ANDROID_external_memory_android_hardware_buffer
```

```
---
```

```
commit 33ab9d8320f10ced355ba3a2f78ab7fae307552d
```

```
Author: Yiwei Zhang <zzyiwei@chromium.org>
```

```
AuthorDate: Wed Aug 6 07:17:14 2025 +0000
```

```
panvk: add shared image support and advertise VK_ANDROID_native_buffer
```

Features/extensions

- VK_KHR_maintenance[7|8|9]
- VK_EXT_mutable_descriptor_type
- VK_ARM_shader_core_builtins
- sparseBinding / sparseResidencyBuffer
- robustBufferAccess (v11+)

Games



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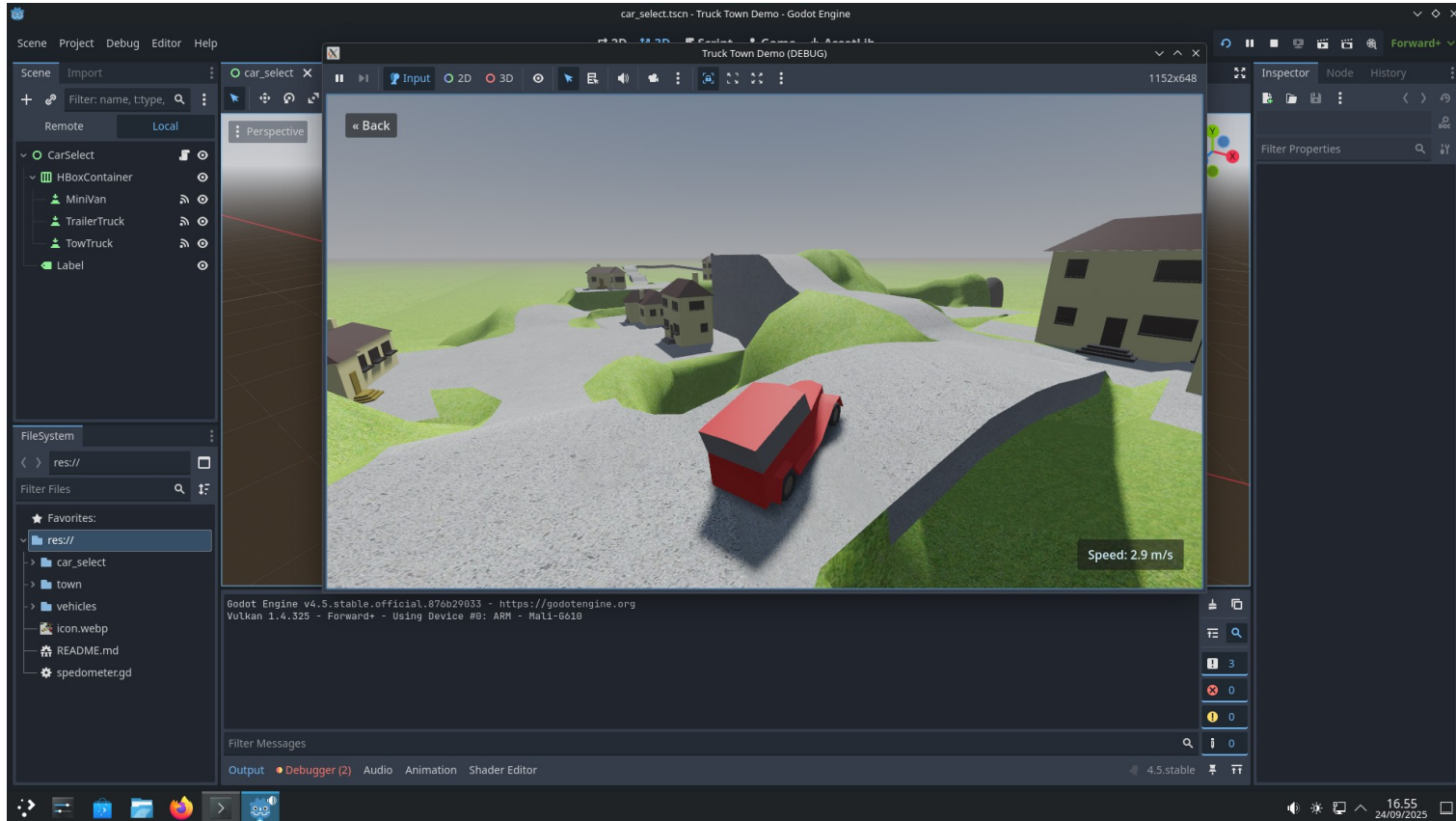
Games



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The Future

Close the feature gap

- Other mesa drivers / the proprietary driver
- A lot of features and extensions to add
 - Transform feedback
 - Tessellation/geometry
 - Protected memory
 - Other features/extensions used by games/applications
- Up to date with new Khronos roadmap profiles

Expanded GPU support

- v10, v12 and v13 already supported
- Goal to add support for future GPUs
- Missing support
 - v11 – lacks open hardware to test on
 - v9 – would like to, but not a priority
- Bifrost will not regress, but also not a priority

Performance

- A lot more work required!
 - Compiler
 - Command stream optimizations
 - Investigation of bottlenecks
 - AFBC
 - HW features on v12+ GPUs

Instrumentation

- More work on utrace in PanVK
 - Current implementation is quite rough
- Performance counters
 - In progress, not yet landed



Conclusion

- The last year has been eventful for PanVK
 - We're up to date to the latest specification
- More work to be done
 - Current focus is application support, future hardware and performance



Thank you!



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