

Mesa i965

Scenes from a Quiet Revolution

Kaveh Nasri
Director of 3D User Space Graphics
Open Source Technology Center
Intel® Corporation

<https://KavehNasri.com/>

Welcome to the Your Revolution!

My Role:

Manager of Intel's Mesa i965 team since 2011

My Talk today:

Overview of the past

State of the present driver

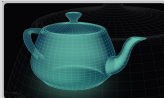
Challenges of the future

INDUSTRY-LEADING OPEN SOURCE GRAPHICS DRIVERS

Intel® open source 3D Graphics Drivers for Linux* are the industry-leading drivers for Linux* distributions for all Intel® graphics platforms shipped over the last decade. Because these drivers are integrated into all popular Linux distributions, you can trust that your Linux system will deliver stunning, high quality graphics without needing additional hardware or extra driver software. Whether you are running the latest Android games on an Intel®-based Chromebook with Google Play Store, or a sophisticated 3D modeling application on a system with the Intel® Xeon® processor, Intel's graphics drivers put beautiful 3D graphics at your fingertips.

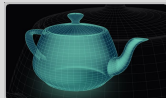


<https://01.org/linuxgraphics>



A Little History

- **1993:** Mesa created by Brian Paul
- **2006:** Intel started contributing to the Kernel i915 and Mesa projects aiming to support for OpenGL® on Intel graphics for all Linux distributions
- **2011:** Chrome OS launched with Mesa
- **2013:** Steam OS launched with Mesa i965 on Intel graphics
- **2013:** Day-1 Khronos certification on OpenGL® ES 3.0
- **2015:** Day-1 Khronos certification on Vulkan® 1.0
- **2017:** Yun OS 6 shipped with Mesa i965
- **2017:** RadeonSI certified for OpenGL® 4.5, picked up by Steam OS
- **Feb 2017:** Khronos certification of Mesa i965 for OpenGL® 4.5, rounding out the *Triple Crown* of 3D computing with OpenGL® ES 3.2 & Vulkan® 1.0

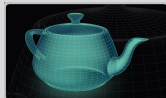
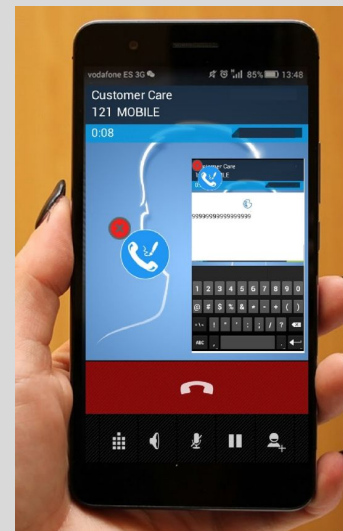


Secret Revealed:

Real Reason To Capture The Triple Crown of 3D computing

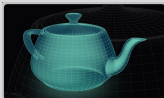
- We really like playing games
- Advanced Games
- The more advanced the better
- Play it on your phone, but it's not an app

New Game Called:
“Just Like Mesa!”



The Rules for playing “Just Like Mesa”

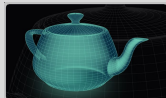
1. Need: Your favorite GPU vendor who only supplies closed source drivers
2. Get them on the phone for a conference call
3. Ask questions, appended with “Just Like Mesa”.



Question #1

Dear GPU Vendor: Could you please provide your *entire source code* in a living project in an open repo

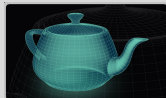
Just like Mesa?



Question #2

Dear GPU Vendor: Could you please license your code in a way that I can modify it in any way I wish, and have the choice of upstreaming or not upstreaming my patches

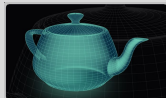
Just like Mesa?



Question #3

Dear GPU Vendor: Could you please provide over 10 years of backward compatibility with any platform I'd like to use, on the latest source code base

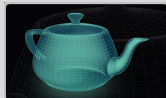
Just like Mesa?



Question #4

Dear GPU Vendor: Could you please provide a regression-free master branch that I can use for releases at my own schedule, instead of waiting for you to make official releases

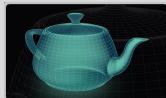
Just like Mesa?



Question #5

Dear GPU Vendor: Could you please give me a complete transcript of discussions among all your developers on new features, improvements, and bug fixes in a fully searchable archive.....

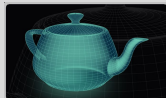
Just like Mesa?



Question #6

Dear GPU Vendor: Could you please provide drivers certified for the latest versions of all three 3D APIs from Khronos, and not just 1 or 2

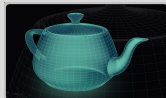
Just like Mesa?



Question #7 - My Favorite

Dear GPU Vendor: Could you please provide a user mode source code base that can work on *any* version of the kernel and can be integrated into *any* Linux-based OS without modification

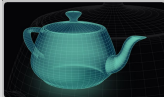
Just like Mesa?



Thank you for Playing and Remember

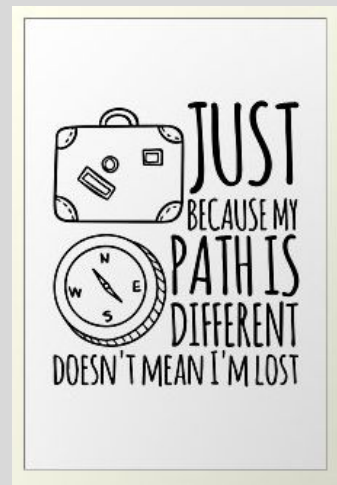
Everybody's a winner when you play ...

Just like Mesa!

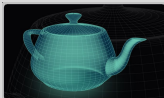


Success Factors

- Years of community support from contributors to early users to OS vendors
- Perseverance and maniacal focus to make Mesa the best driver it could be
- Major productivity boost through Continuous Integration
- The Positive Feedback Loop:
 - Better master branch quality speeded up delivery of features to users
 - Latest improvements allowed advanced apps to run on more platforms
 - More people gained confidence in using a fully open stack
 - Stacks using Mesa advanced rapidly
 - Demand for the use of Mesa kept mushrooming, letting us increase our investment in more features and better quality

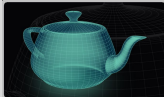
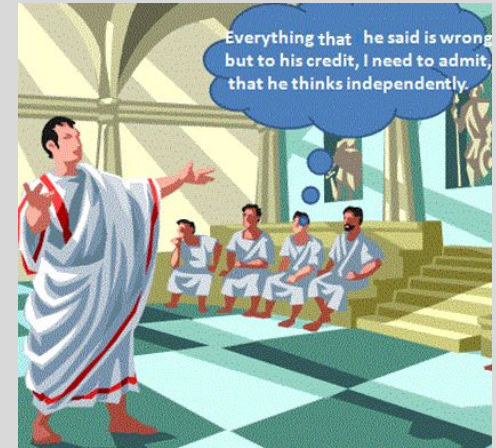


Quote: Gerard Abrams



Inside the Revolution: Lessons Learned

1. Clarity of goals: Baseline of productivity
2. Alignment of upstream and business objective: Essential to investment
3. Open source methodology: Eliminating collaboration barriers
4. Backward compatibility: Big net positive
5. Continuous integration: Secret efficiency weapon
6. Cohesive team: Overcomes all obstacles



Clarity of Goals: Standard APIs

- Great for app developers
- Also very helpful to driver writers
- Avoids spec confusion presenting extra challenges for similarly large software projects without an industry spec

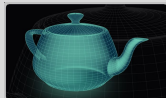
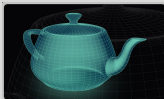


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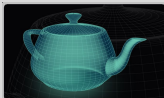
Alignment of Upstream and Internal Business Goals

- Open source processes allow multiple companies to share the cost of development and productization, delivering great ROI for each
- Critical mass of commercial investment is required to be successful
 - Efficiency is not enough, business goals needs to be met to justify corporate investment
 - Without substantial corporate investment, Mesa would lack critical mass and would be back to the low development speeds of the past.
- Our pragmatic and business-savvy developers understand this, and have helped ensure continual alignment



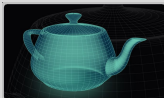
Open Collaboration w/ partners and customers

- GPU-agnostic code is shared among all drivers
 - The wheel is invented once, used by everyone
- Everyone knows exactly what driver developers know
 - Progress on features
 - Bugs
- Anyone can contribute features
 - Or make their own private branch if they wish
- Option of zero-turnaround-time for bugs
 - Customers can fix the bugs they care about themselves
 - Without bug tickets, phone calls, NDAs, etc.



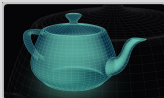
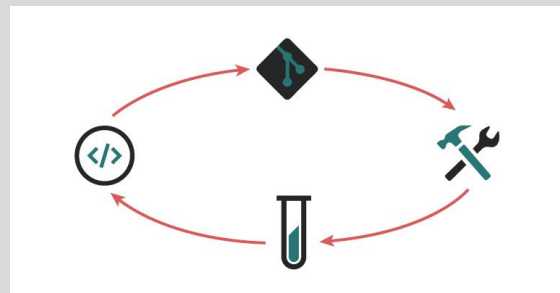
Backward Compatibility: Big Net Positive

- Carries some extra cost
 - Subcomponents need to consider multiple GPU generations
 - Regressions on old platforms might delay patches that work on new platforms
- Benefits far outweigh the costs
 - Some features and bug fixes automatically ripple back to the old generations,
 - Makes existing platforms more robust and performant at no extra cost
 - Eliminates need for separate sustaining teams for old releases
 - Developers focused mostly on new features and optimizations
 - Driver for new platform is 90%+ done before the platform is available



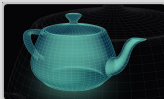
Continuous Integration: Productivity Turbocharger

- Confluence of Benefits, resulting in a big win
- Regression-free master branch
 - Unlimited “releases” for optimal time-to-market for OS vendors and stack integrators
- Regression bug fixing time dramatically reduced (usually to negative!)
- Lifting a major context-switch psychological burden off developers
- Ensuring that “Mesa just works”



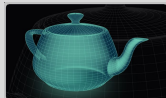
Cohesive Team: Best Antidote for Obstacles

- Individuals care *personally* about Mesa's features and quality
- Closely collaborate with each other and the community
 - Optimal mix of email/IRC and in-person collaboration
- Understand the entire graphics stack, not just Mesa
- Lightweight and pragmatic management practices
 - Developers drive the project's technical direction
 - Management team provides priorities to align with business goals
 - Oversight and reporting is light, and at high level
 - Clear distinction between upstream and downstream activities
 - Never hired people just to hire people (and yes, we're hiring!)



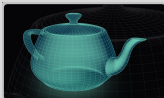
Now What?

- Tens of Millions of installed base devices with Mesa
- Going forward, where can we make the most impact?
- Here's an idea:
 - What OS out-ships every other OS in the industry?
 - What Linux-based OS has almost no device shipping with an open source graphics stack?



You Are Correct: Android Is the Next Frontier

- 1.2 Billion devices in 2016*
 - Primarily Phones and tablets
- Just getting started
 - Android Things
 - Android Automotive
- Huge opportunity to prove value of open source graphics
 - Faster time to market
 - Flexibility to innovate
 - Lower cost to develop and maintain a full stack
 - Mesa i965 already enabling Google Play Store and Android apps on Chromebooks



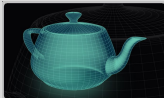
*Source: Image credit: <https://plus.google.com/u/0/+LouisGray/posts/AQ5mmaMcJXe>

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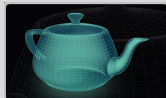
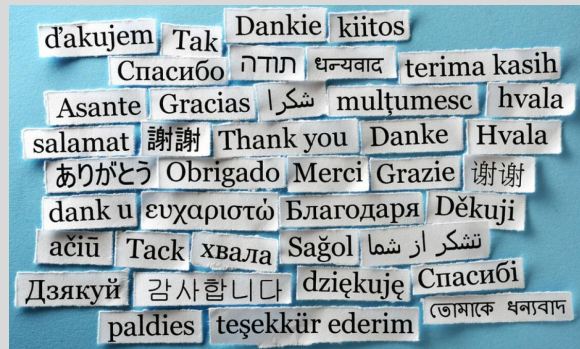
Areas of Focus For Success in Android

- Developers, Lots of Developers!
 - Encourage new developers; Be the project that emerging developers want to join:
 - Blog overviews of the stack for newbies
 - List simple projects to help them get started
 - Take time to answer basic questions on the mailing list and IRC
 - Did I mention we are hiring?
- Tools
 - Make sure your tools work on Android
 - Develop new tools to speed up stack debugging
 - Especially for performance
 - Android OEMs really care about synthetic benchmark performance
- Experiment with platforms with open source graphics drivers
 - Experimental stack for all recent Intel platforms: <https://01.org/android-IA>



Thank You For Getting Us Here!

- **Volunteers** who contribute time and talent because they believe in Mesa
- **OS Vendors** who have invested and supported open source graphics
 - Even when it wasn't as good as is it today
- **Consulting companies** who invest in open source graphics
 - Even when they don't have a paying client
- **Developers** who have chosen to devote their careers to Mesa
 - Even when it seemed hopelessly behind
- **Kernel and kernel graphics** community
 - Without which no user mode driver could run
- **Intel & other GPU vendors** for investments
 - And publishing HW specs openly
- **Personal Thanks to the Mesa i965 team**
 - My team at Intel
 - Teams at Igalia and Collabora

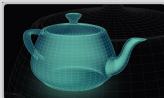


Call To Action

- Get started page for new Mesa developers:
 - <https://01.org/3Dcollab>
 - If I didn't mention before, we are hiring!
- My blog on my experiences:
 - <https://KavehNasri.com>



Mesa's Best is Yet to Come!



Thank You!