

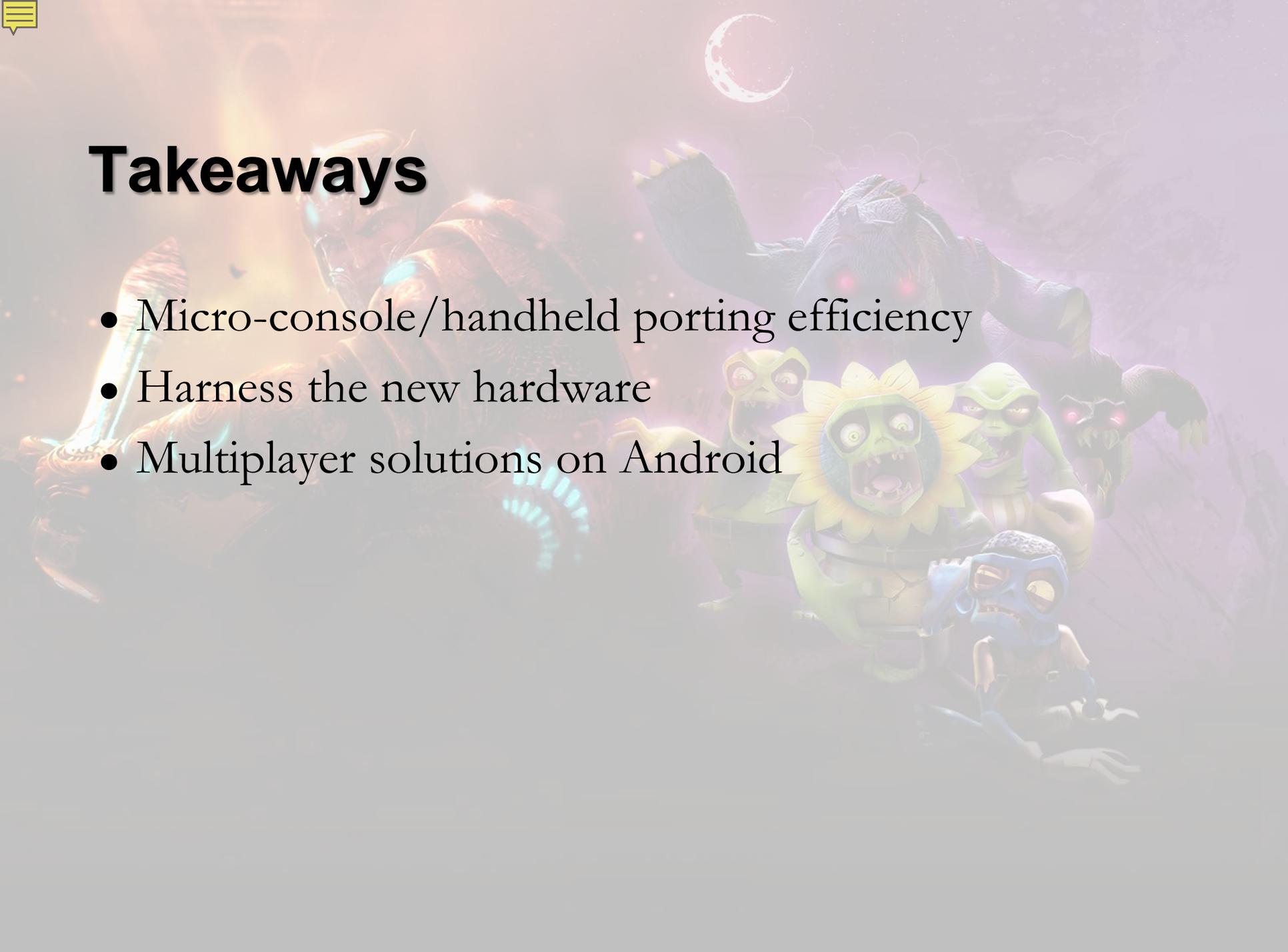


GDC¹³

Porting games from PS3 or Web to SHIELD and OUYA

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Senior Intern, Frima Studio



Takeaways

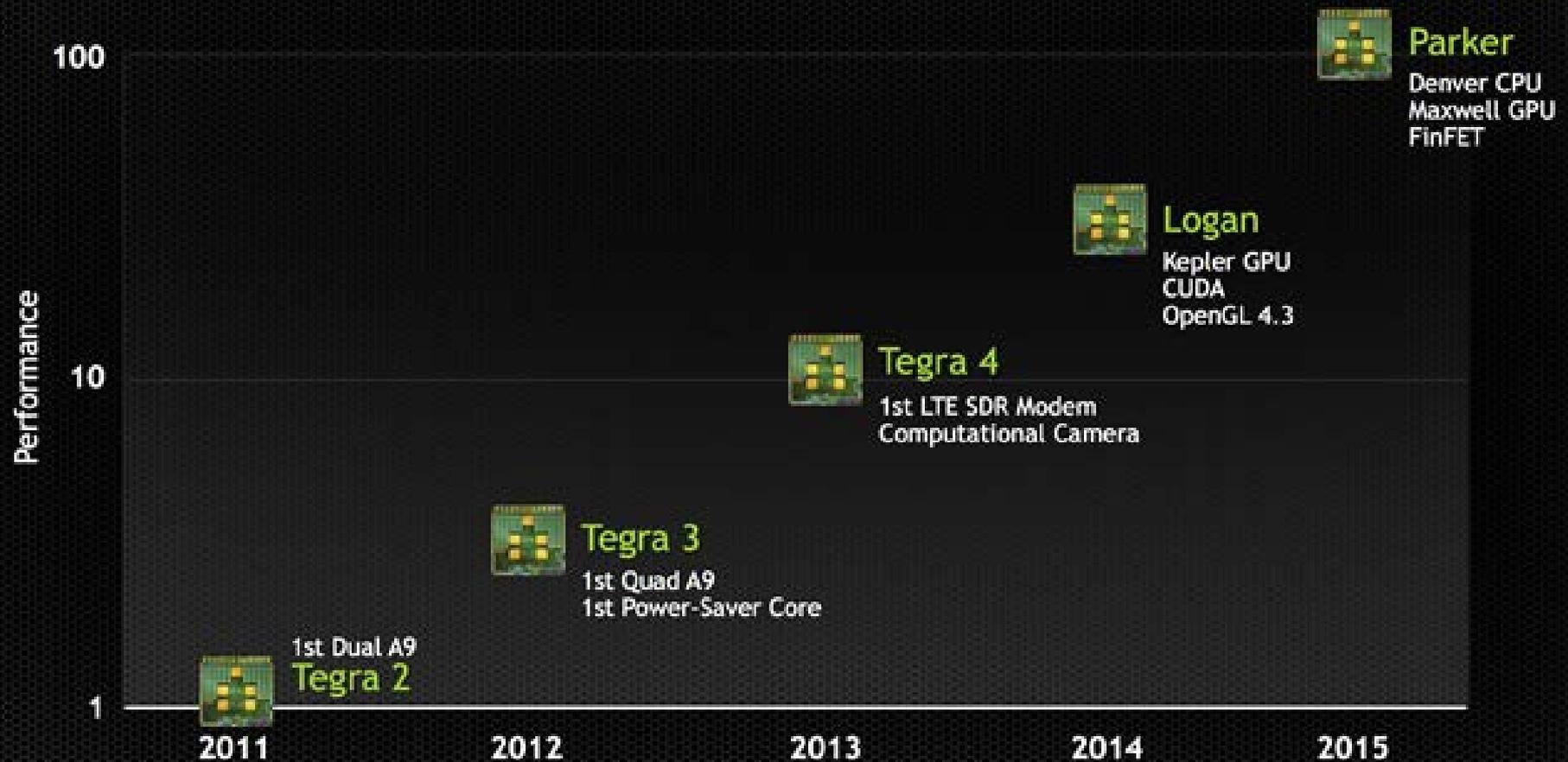
- Micro-console/handheld porting efficiency
- Harness the new hardware
- Multiplayer solutions on Android



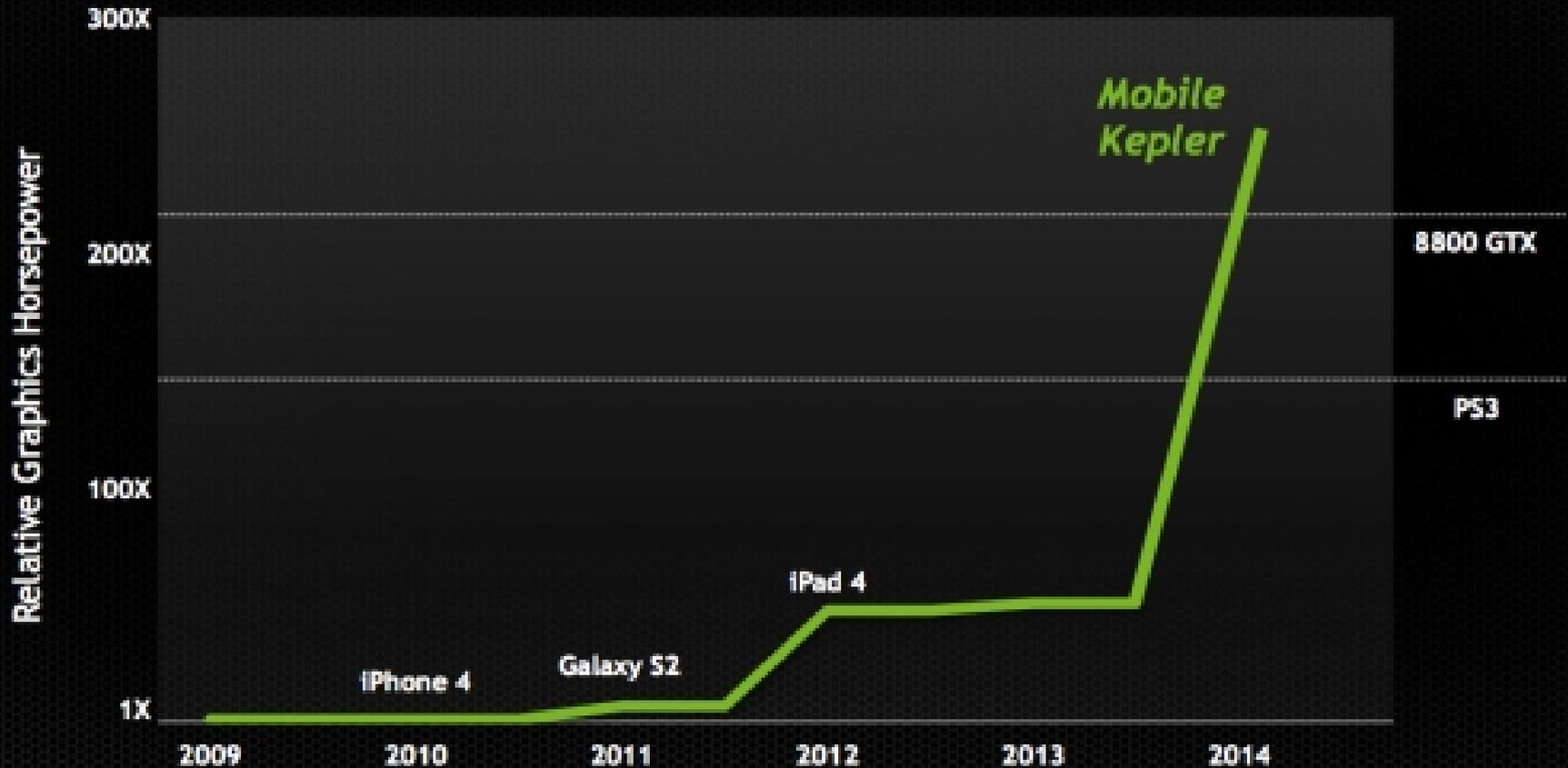
Lexicon

- *Android-based gaming consoles mobile or not, handheld or with a controller*
 - Micro-console
 - Handheld
 - Android based console
 - Mobile device
- Acronym dumping

Tegra Roadmap



A Major Discontinuity in Mobile Graphics



"It is, in fact, 140 times more powerful than the first Cray supercomputer, or 1.6 times more powerful than a PlayStation 3."

The Future of Micro console

- PCmag.com
 - 4/5 “most impressive handheld gaming systems”
- Slash gear
 - “What we’ve got here is a sort of perfect storm for benchmark butt-kicking.”

VERDICT

Built on superb hardware and backed up by tons of games, but compatibility and PC streaming have a ways to go.





Our Experiments

- Lightbringer
 - Web and Mobile
 - Adobe Flash (AIR)
- Zombie Tycoon 2
 - PS3 and VITA
 - Unreal 3

AIR

- What is AIR?
- As of October, 2013,:
 - 120,000 distinct applications
 - >140M downloads since July



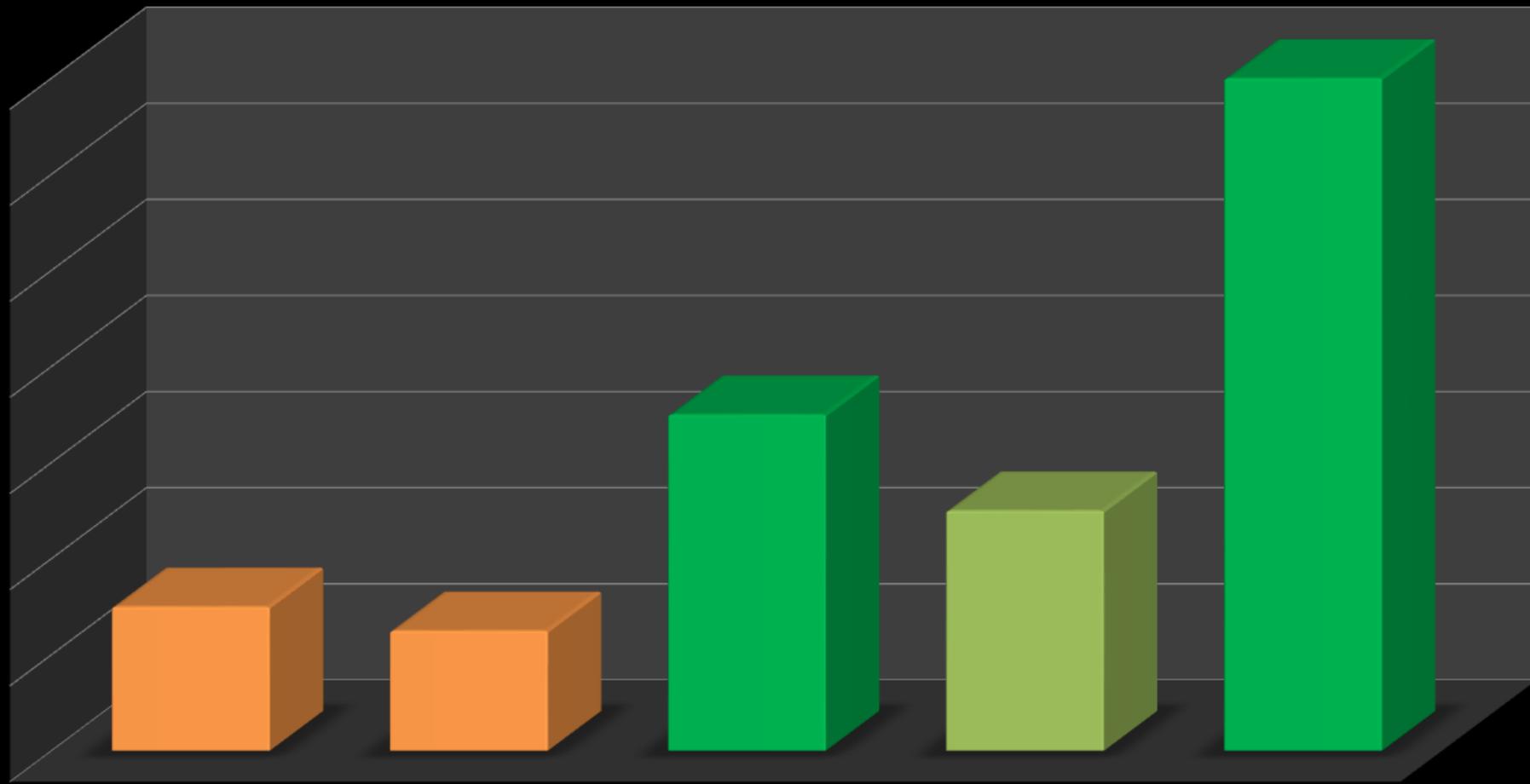
Batman: Arkham Origins · Waves · Blastpoints · Magrunner: Dark Pulse · Asura's Wrath · Tiny Brains · Diabolical Pitch · Brothers: A Tale of Two Sons · Aliens: Colonial Marines · Doctor Who: The Eternity Clock · Extraction · Betrayer · Master Reboot · Silent Hill: Downpour · Daylight · Core Blaze · Q.U.B.E. · The Bureau: XCOM Declassified · The Solar System · Dungeon Defenders · Marvel Heroes · Bless · Eden to Greeen · Shadow Company · Blade & Soul · Nosgoth · Contrast · Lights, Camera, Party! · Zeno Clash II · Cloud Spin · Gunner Z · Crimson Dragon · Dark Void · Deadlight · Revolution 60 · Game of Thrones · Nether · Infinity Blade III · Injustice: Gods Among Us · Jeklynn Heights · Lord of Vermillion 3 · Spec Ops: The Line · SMITE · Limp · Chainsaw · SOL: Exodus · Tera: The Exiled Realm of Aborea · Warp · Zombie Tycoon 2 · Sorcery · ThRED · Renaissance Blood · Warm Gun · Desert Zombie: Last Stand · Chopper HD · Unmechanical · Wreckateer · Sminis · In Fear I Trust · Last Knight · 2013: Infected Wars · Dust 514 · Wraithborne · Blacklight: Retribution · World of Mercenaries · Blue Estate · Deadpool · Gyro13: Steam Copter Arcade · Plasma Orb · Ravaged · Outlast · Painkiller: Hell & Damnation · Red Orchestra 2: Rising Storm · Antichamber · Recoil · Hawken · Tower of Guns · The Nightworld · Mass Effect 3 · Borderlands 2 · XCOM: Enemy Within · WRC the Game · Chivalry: Medieval Warfare · Min: A Space Adventure · Coop Phonics · Lili · Tribes: Universe · Demon's Score · Karateka · Lost Planet 3 · Rise of the Triad · Wild Blood · Dollar Dash · TMNT: Out of the Shadows · iTapPirate · Sanctum 2 · Forge · Warp · Remember Me · Injustice: Gods Among Us · Monster 500 · Fable Anniversary · Plushy Warfare · Bloodmasque · Fable: The Journey · Super Monday Night Combat · Batman: Arkham Asylum · Dark Meadow · Papo & Yo · Yaiba: Ninja Gaiden Z · Recruits · Tony Hawk's Pro Skater HD · Transformers: Fall of Cybertron · Thief · Tron: Evolution · Real Boxing · Horn · DMC: Devil May Cry · Iron Soul · Killer is Dead · D4 · Gears of War: Judgment · Special Forces: Team X · Coop Space · Murdered: Soul Suspect · Primal Carnage · Dishonored · Alien Rage · Arc Squadron · Takedown: Red Sabre · BioShock: Infinite

Differences between platforms

	Xbox 360	PS3	Wii	SHIELD	OUYA	iPhone4s	Nexus 7	iPad mini	VITA
CPU	PowerPC 3.2 Ghz (3 cores)	Cell 3.2 with 7 SPE	PowerPC 729 Mhz	1.9Ghz A15 Quad Tegra4	1.7GHz quad A9	Dual 800Mhz A9	1.2 Tegra 3 Quad	Dual core A5 1Ghz	2Ghz Quad A9
GPU	500 Mhz ATI	550 Mhz nvidia	243 Mhz ATI	72 cores Tegra4	Tegra3	PowerVR SGX543	416 Mhz nvidia	PowerVR SGX543MP2	SGX543
Memory	512MB GDDR3, 10MB EDRAM	256MB XDR, 256MB GDDR3	24MB SRAM, 64MB GDDR3, 3MB GPU	2GB	1GB	512 MB	1GB	512MB	512+128
Disk	20-320GB		512MB	16GB	8GB	8GB+	8GB	16-64GB	None



Digested benchmark based on non-scientific method



■ Nexus 7 ■ Ouya ■ Shield ■ Vita ■ PS3



**This slide was intentionally left here
by mistake**





Porting LB

- Trying new consoles (First builds)
- SHIELD
 - Profiling and Stepping up
 - Bypassing limitations
 - Post process
- OUYA details



Trying new consoles

- Current:
 - Web
 - Nexus 7 (First generation)
 - iPad 2
- Goal:
 - OUYA
 - SHIELD

OUYA

- Same APK (Android Application Package)
- Missing Controller
- Small touchpad
- FPS: 15



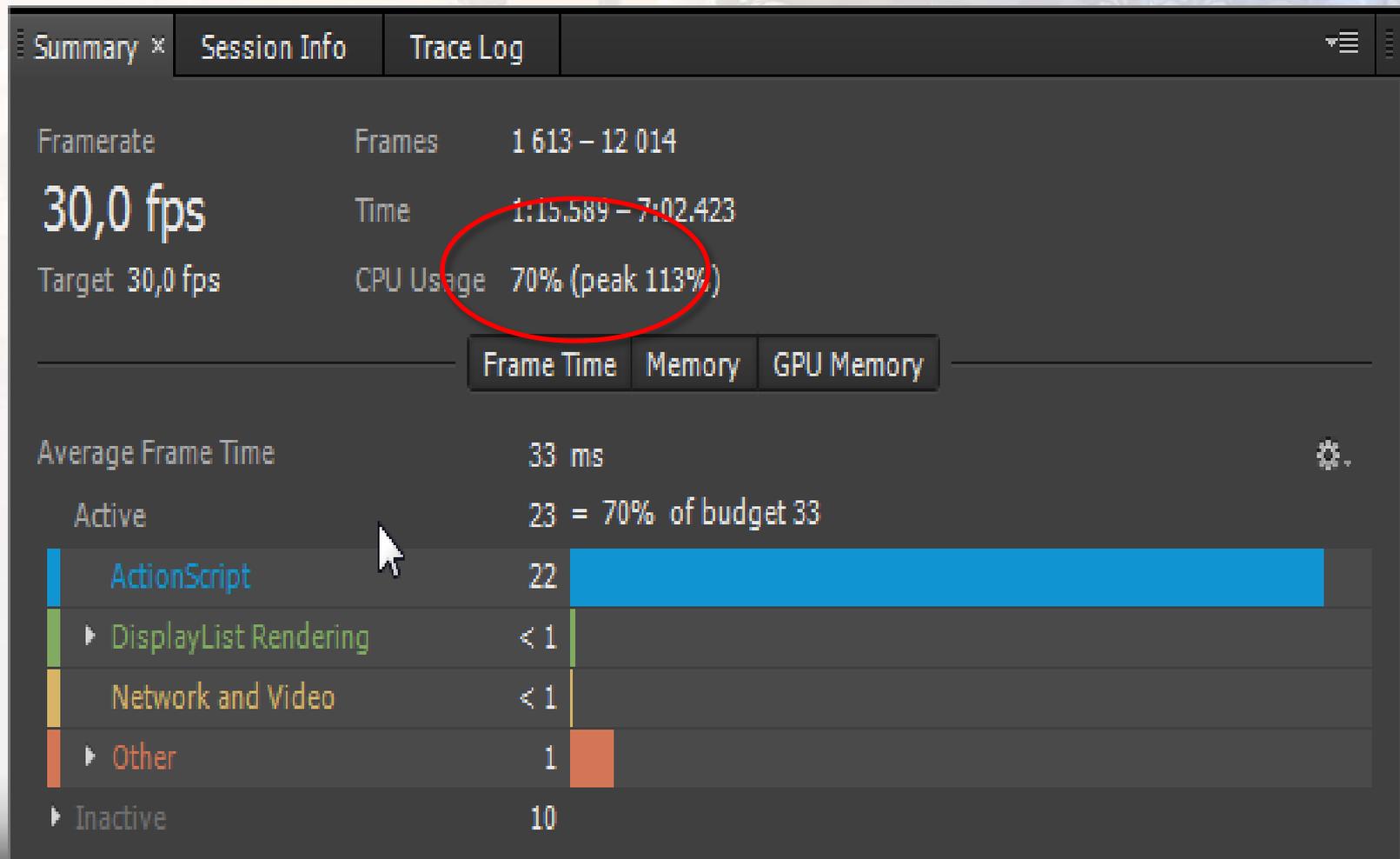
SHIELD

- Same APK
- Controller support
- Touch screen
- FPS: 60

Controller

- Flash.ui.GameInput
- Air 3.7
- Action mapping
- **Bug**
 - Fix : First frame variable
 - Fix : Static variable
- Lag in input
 - 24 FPS on the stage

Profiling on SHIELD

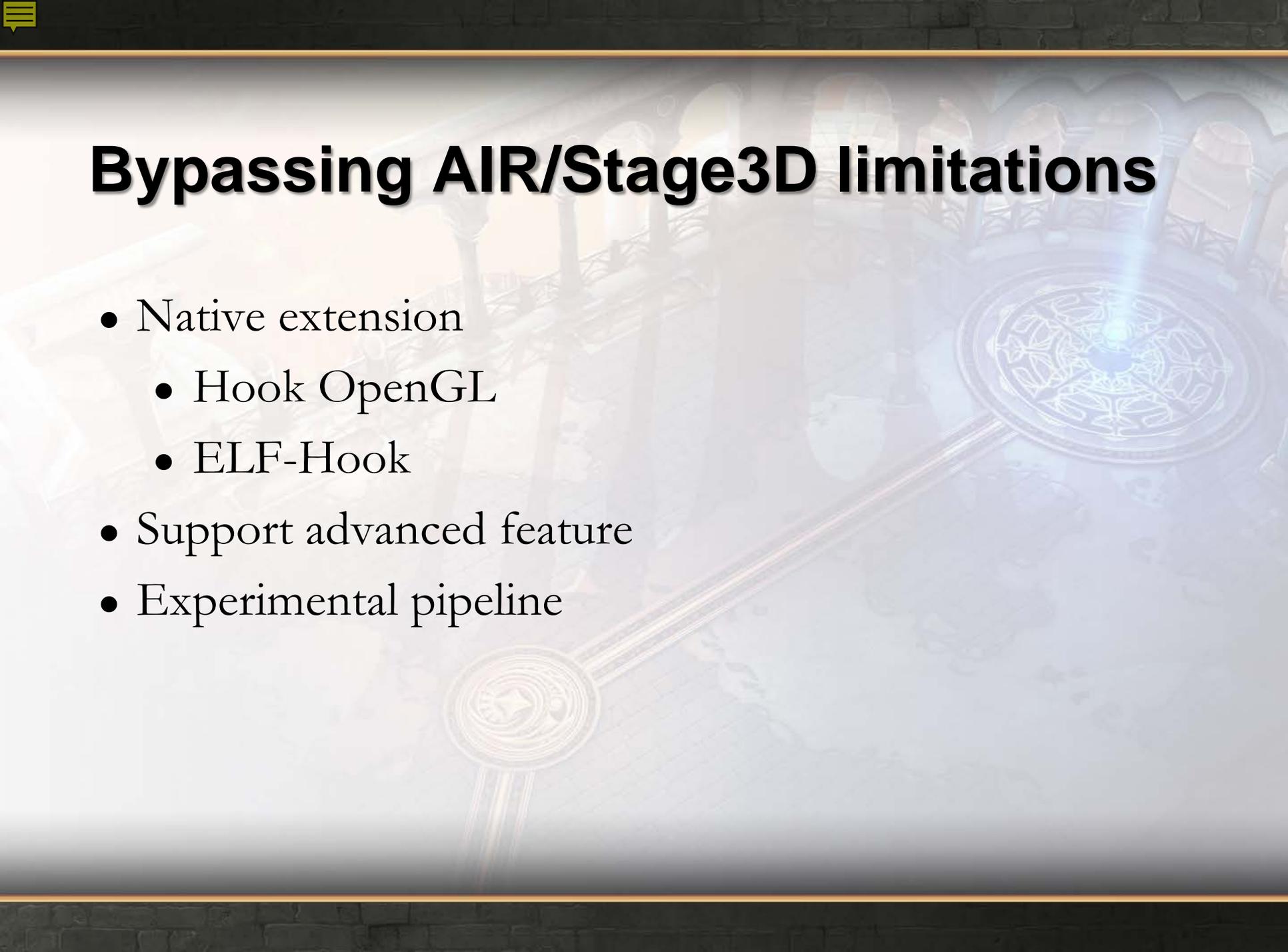


SHIELD(T4) vs T3

- Vertex Shader 8x
- Fragment ALU 8x
- Pixel Rate 2.6x
- Texture Rate 2.6x
- Memory Rate 2.3x
- Z-Kill Rate 1.3x
- Triangle Rate 1.3x
- Nexus : 6 Instructions
- Shield : 48 Instructions
- PCF
- MRT
- HDR
- OMG
- LOL

Step up ideas

- Upgrade meshes and textures (**Triangle Rate**)
- FX, Ambiance (**Pixel Rate**)
- Dynamic shadow, Lighting (**MRT, PCF**)
- Creep¹ (**CPU**)
- Post-process stuff (**ALU/Texture/Pixel rate**)



Bypassing AIR/Stage3D limitations

- Native extension
 - Hook OpenGL
 - ELF-Hook
- Support advanced feature
- Experimental pipeline

Bypassing AIR/Stage3D limitations

```
(/*libCore.so*/  
originalUseProgram = elf_hook(fullpath, base, 'glUseProgram', (void*)MyglUseProgram);  
  
void MyglUseProgram(GLuint program) {  
  
    //Search for our replacement shader  
    GLuint progToUse = programList.find(program); //map<GLuint,GLuint>  
  
    // Call the Original function with our shader instead (glUseProgram)  
    originalUseProgram (progToUse); }  
}
```

What can be done this way?

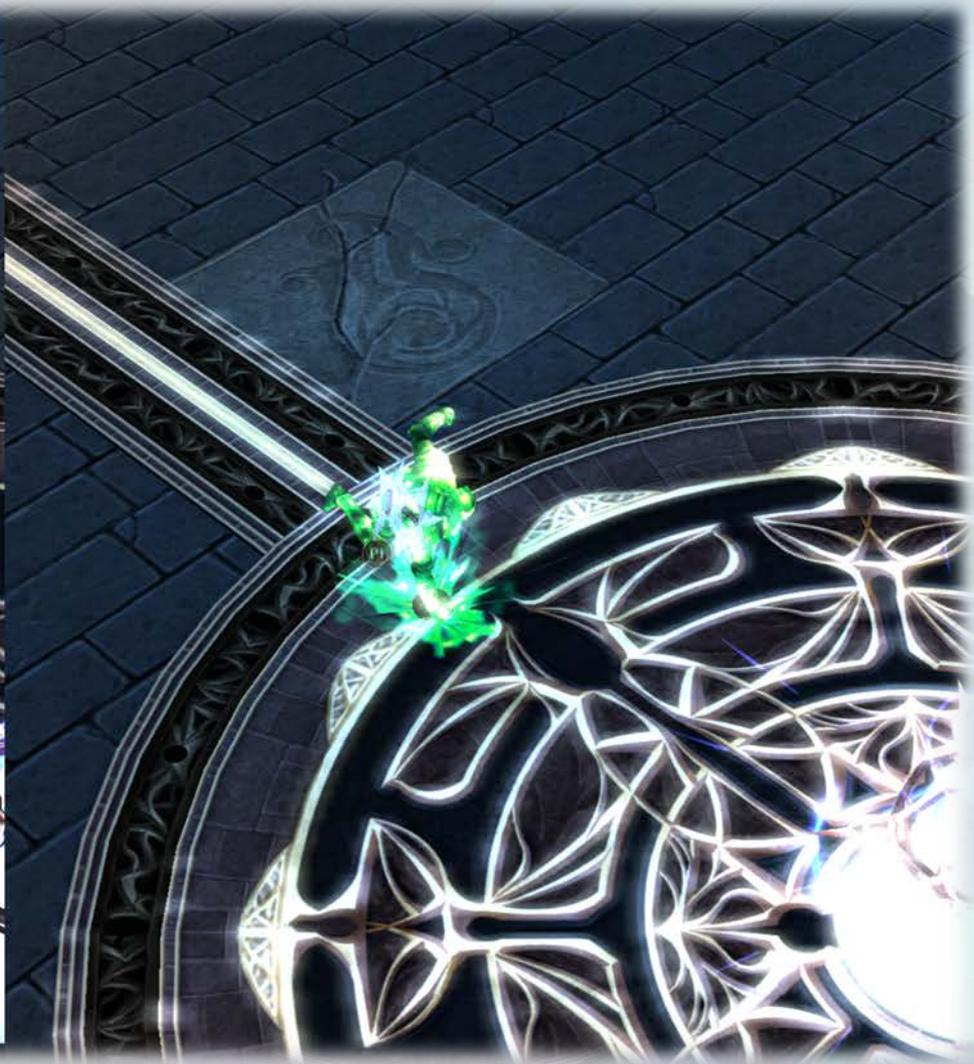
- LowP
- Instruction count
- Branching
- MRT
- Aliasing (AA)

Post-process

- Depth of field
- Bloom
 - Downsizing
 - Convolution blur
- FXAA
- Crytek Sharpening





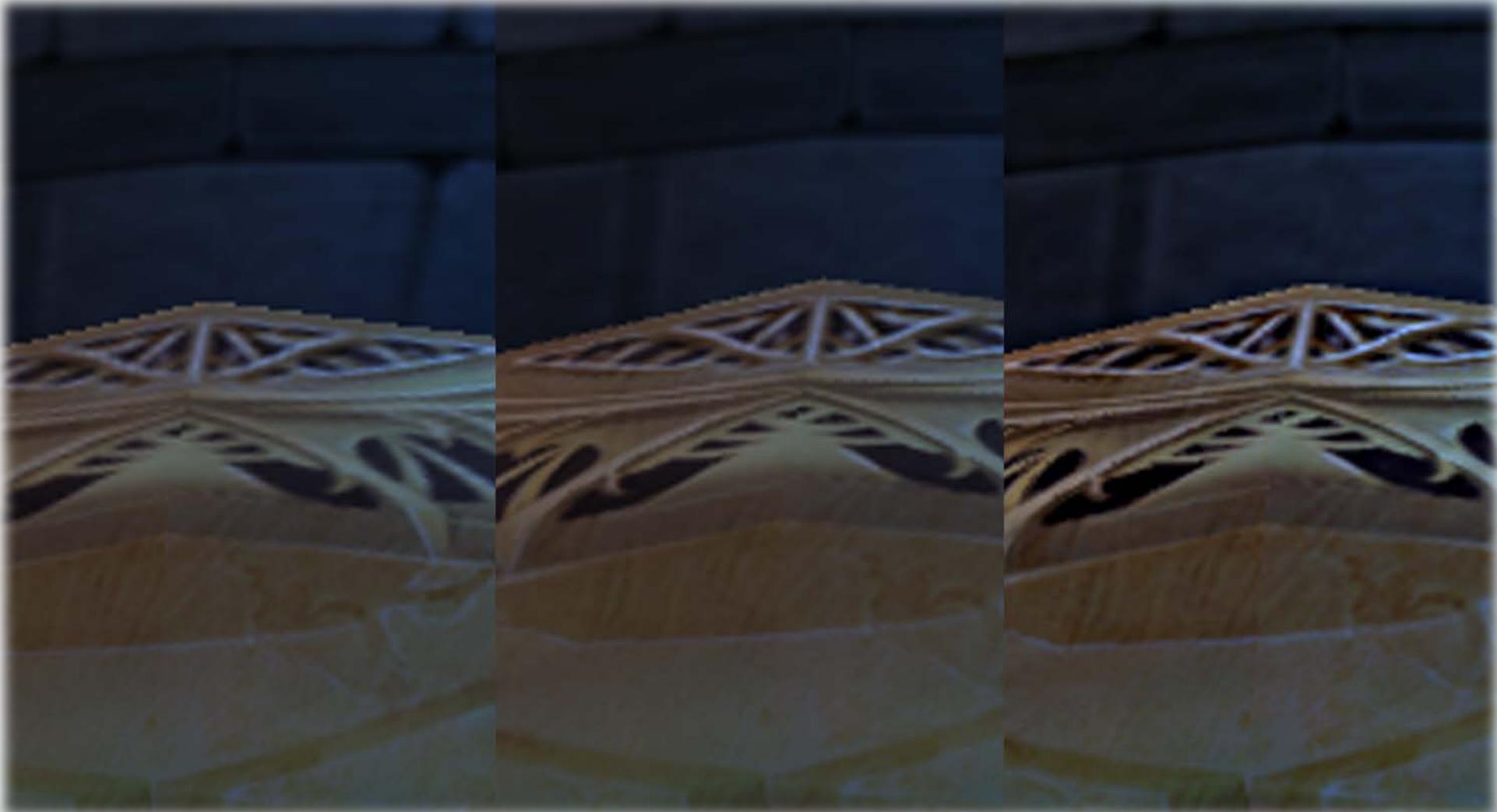


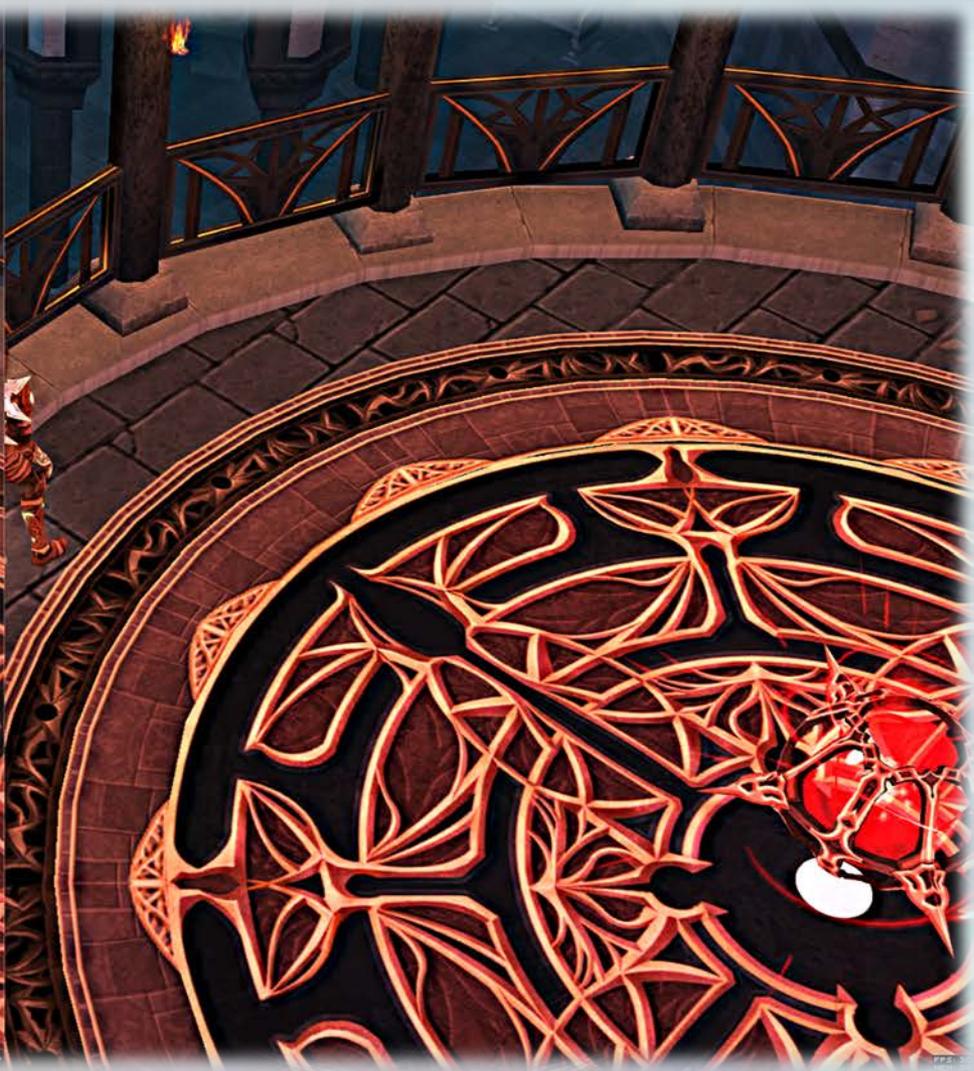


PI jp



PI jp





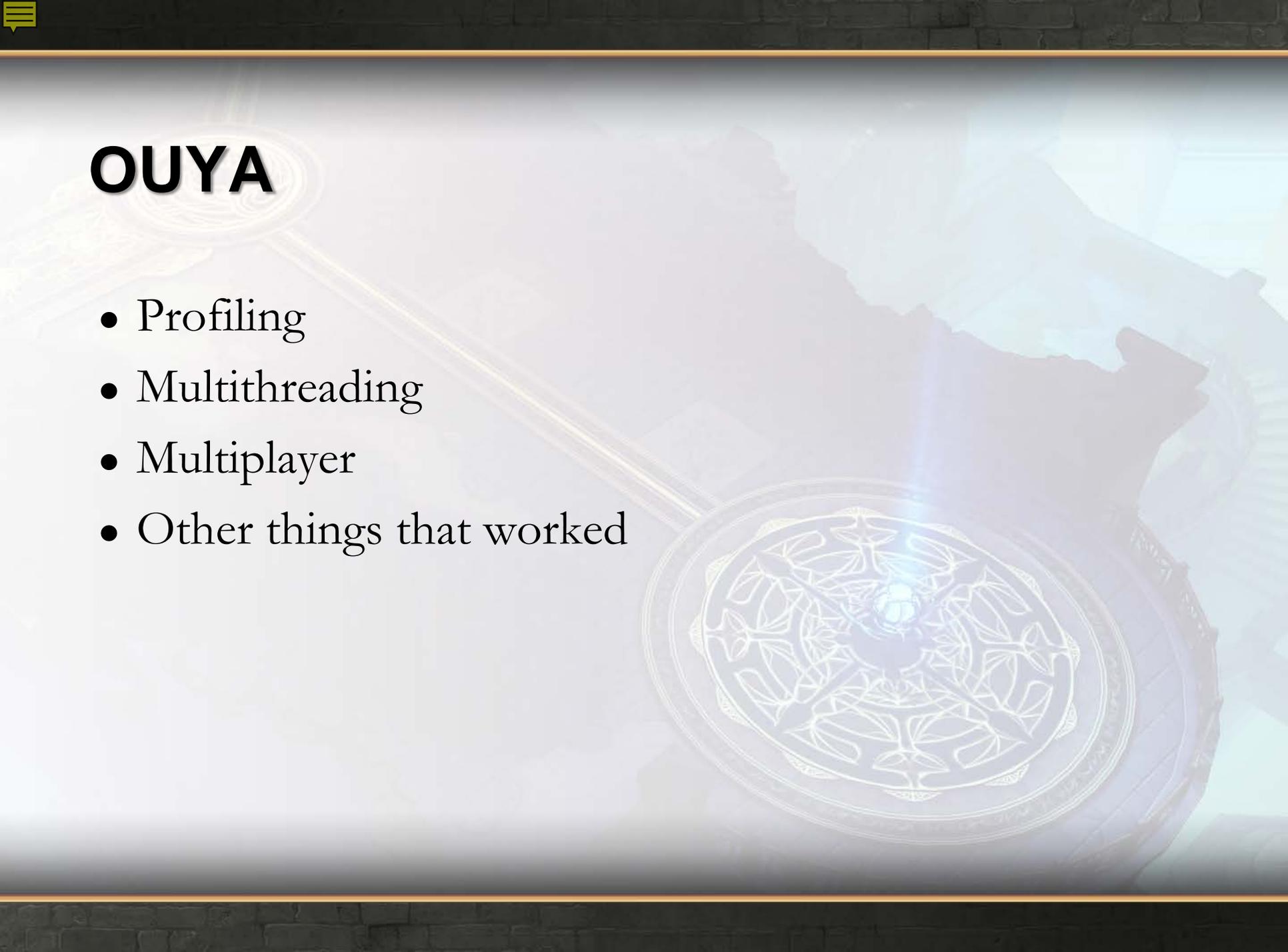
fps: 200

fps: 200



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OUYA

- Profiling
- Multithreading
- Multiplayer
- Other things that worked

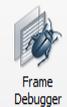
Profiling on OUYA

- 15 fps out of the box
- Slower than the Nexus?
- Heavier OS?
- Not expected

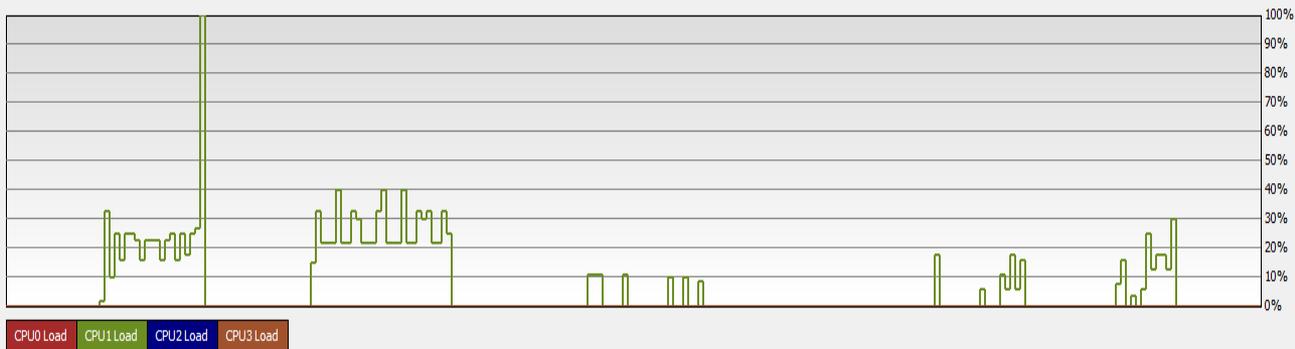


Profiling on OUYA

- NVIDIA PerfHud ES
 - High-Level
 - Timer functions
 - `eglGetSystemTimeFrequencyNV`
 - `eglGetSystemTimeNV`
 - OpenGL hook



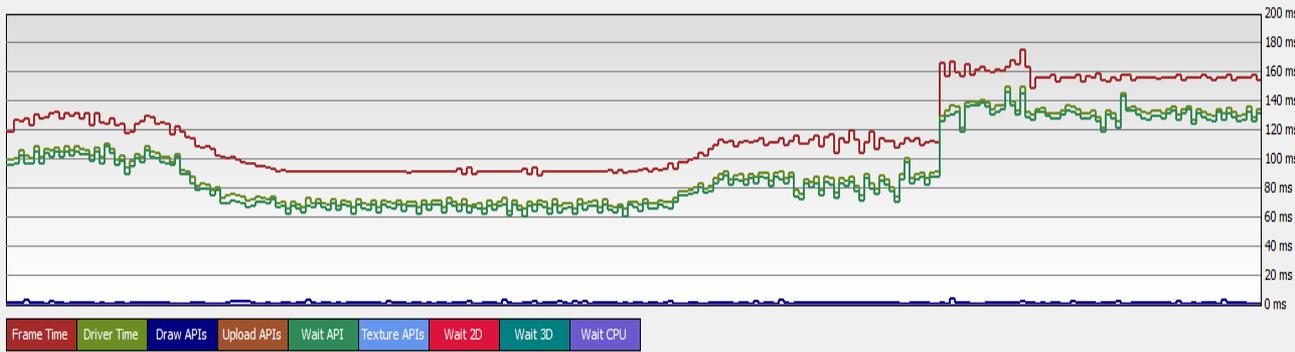
CPU Monitor



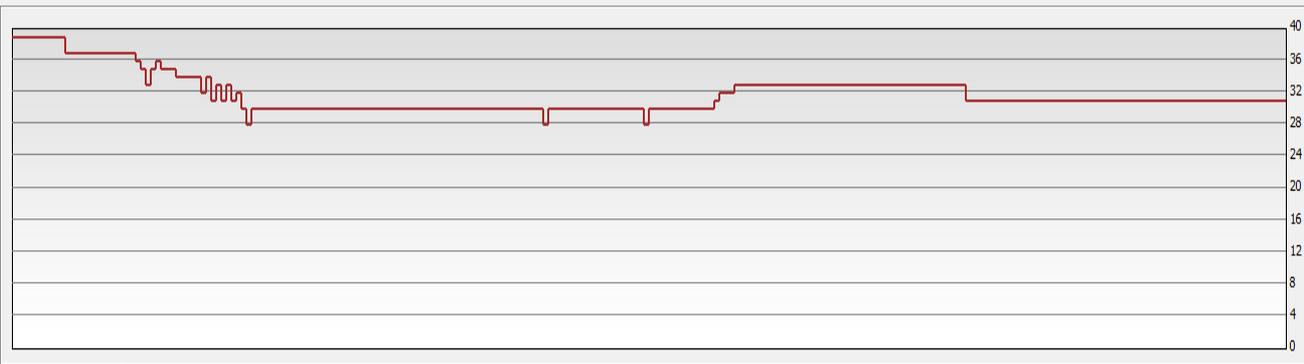
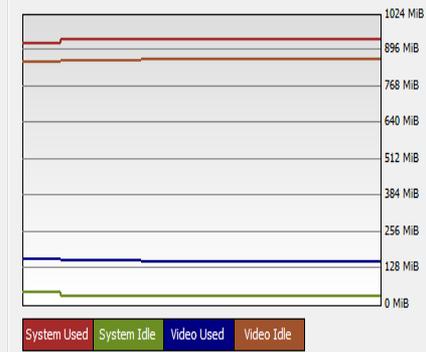
Directed Tests

- 2x2 Textures
- Ignore Draw Calls
- Disable VSync
- Null Fragment Shader
- Null Viewport
- Disable Blending
- Disable Clear
- Disable Filtering
- Disable Texture Upload
- Disable Buffer Data
- Disable Uniform Upload

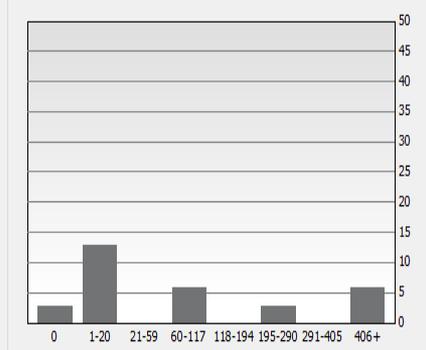
Timing Graph



Memory

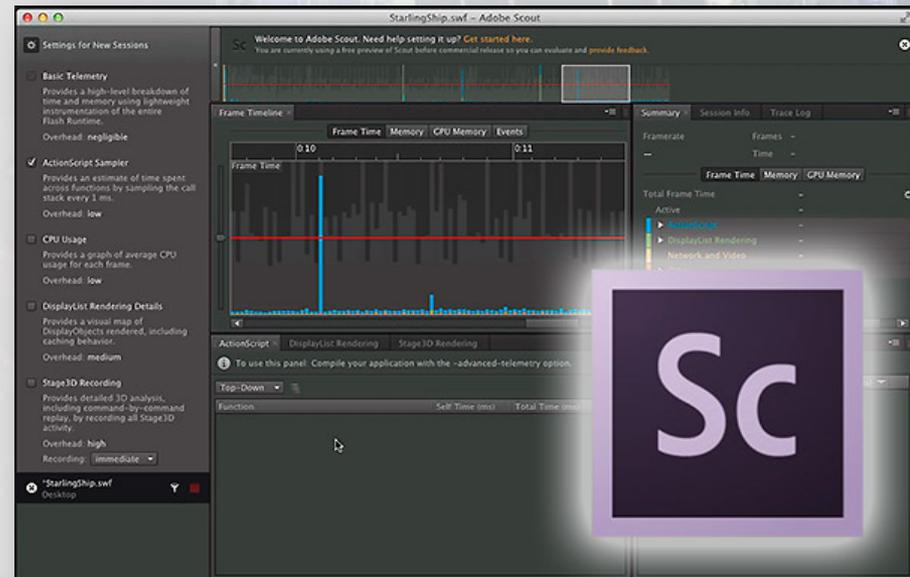


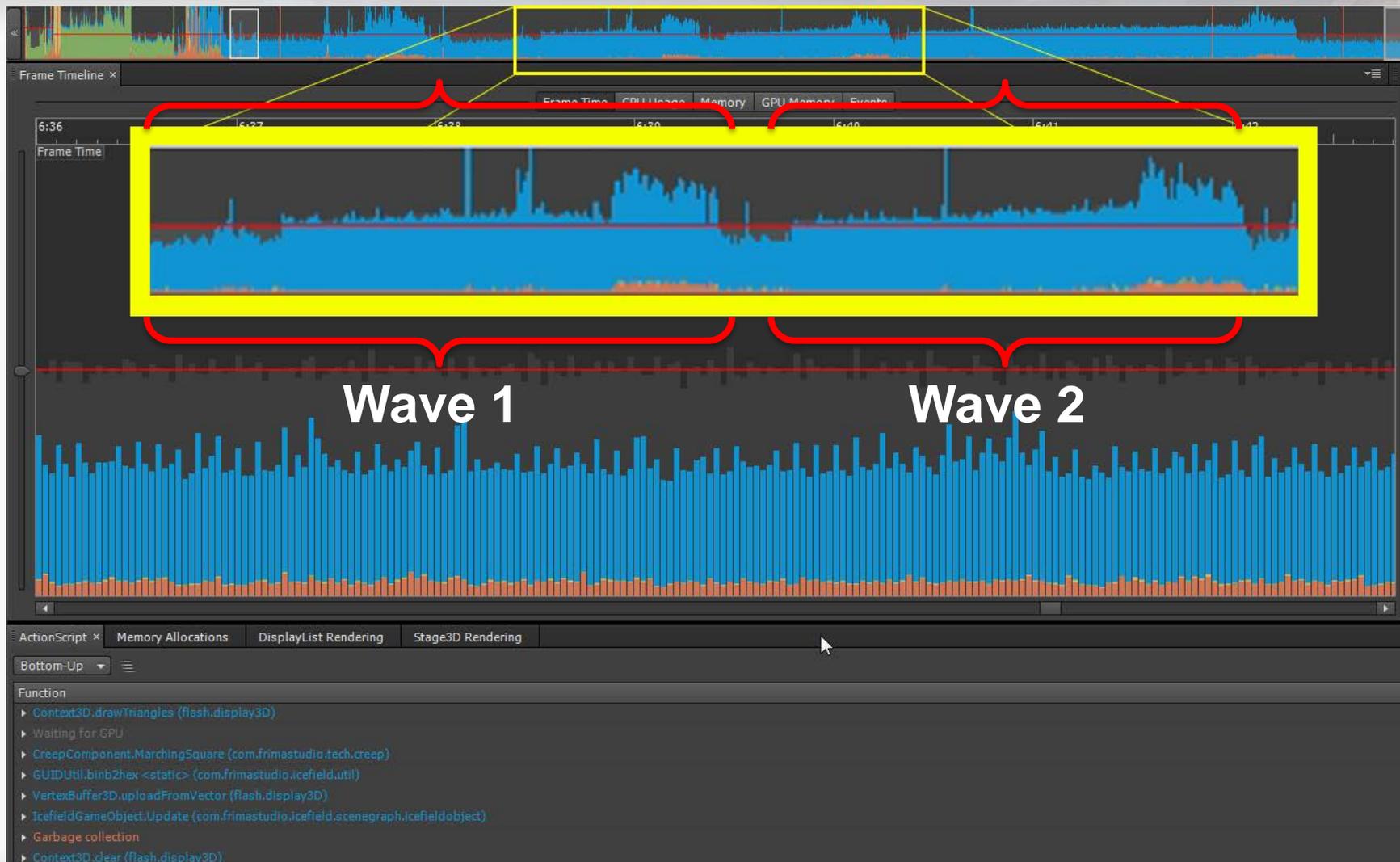
Batching Histogram



Profiling on OUYA

- Adobe Scout
 - Companion app
 - No Google store
 - Install on Nexus
 - Backup apk
 - Install on OUYA







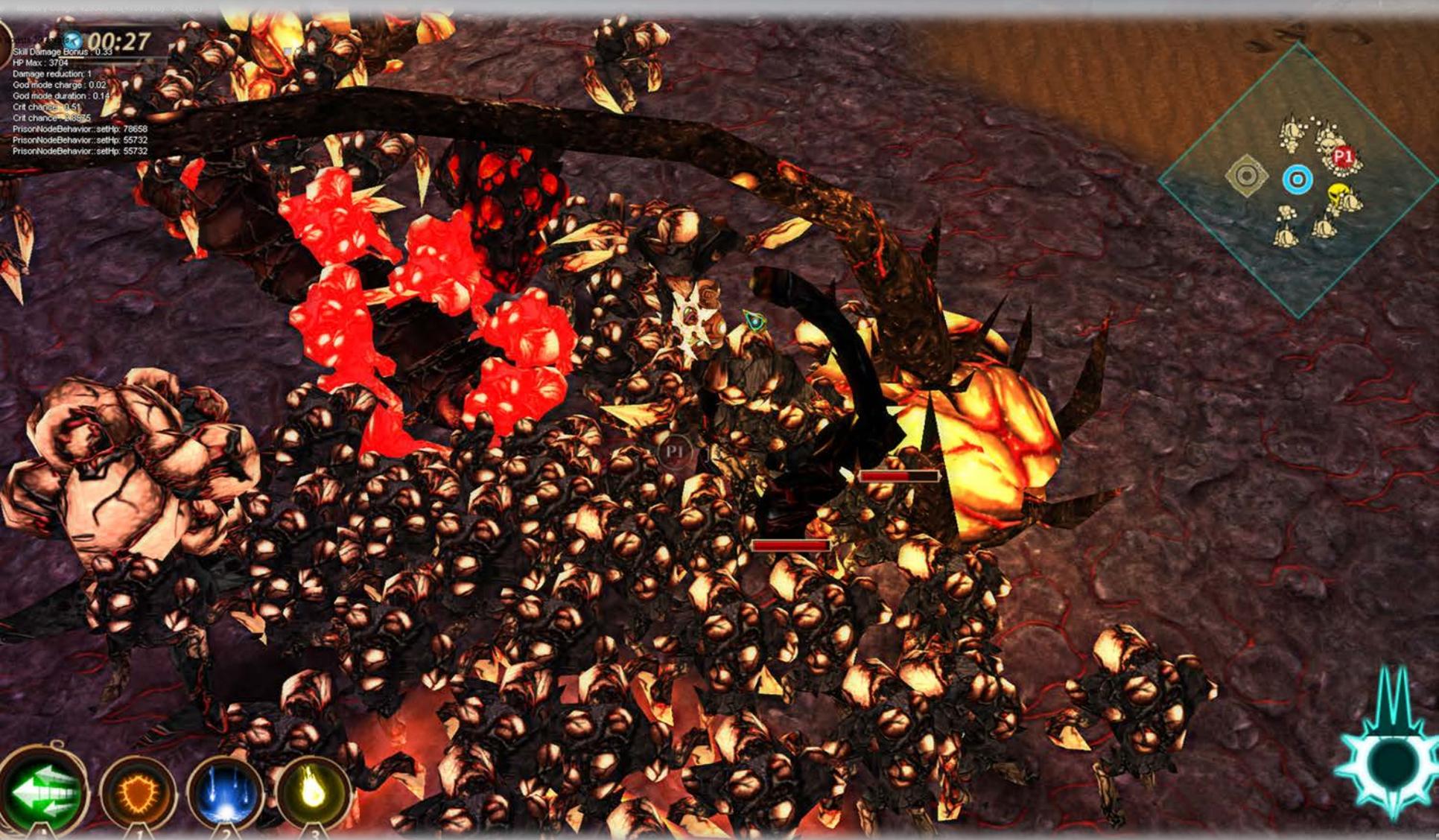
00:32

Damage reduction: 1
 God mode charge: 0.02
 God mode duration: 0.14
 Crit chance: 0.51
 Crit chance: 2.8575
 SurvivalScript: StartScript: Setting Seed value
 SurvivalScript: set Seed: Got a seed value!
 WaveIndex=0
 WaveIndex=1





00:27
Skill Damage Bonus: 0.33
HP Max: 3704
Damage reduction: 1
God mode charge: 0.02
God mode duration: 0.14
Crit chance: 0.51
Crit chance: 38395
PrisonNodeBehavior::setHp: 78658
PrisonNodeBehavior::setHp: 55732
PrisonNodeBehavior::setHp: 55732



Profiling results

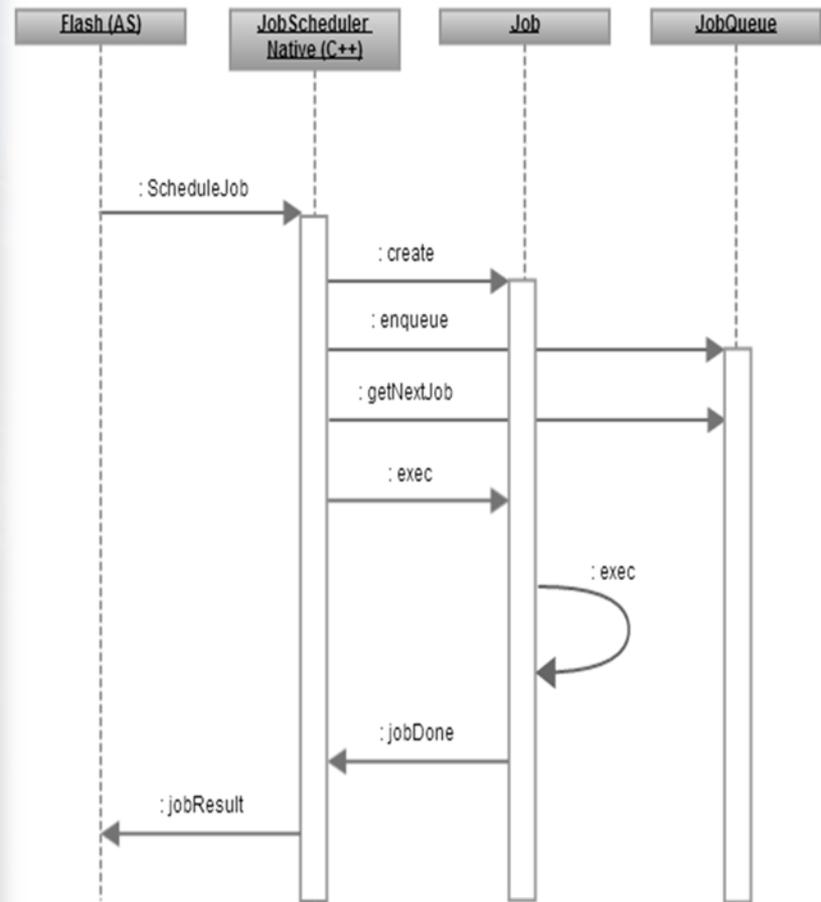
- 15 fps out of the box?
- Firmware and stuff
- Yeah! Like Nexus 7
 - 25-30 fps
- Extra cores?



Multithreading

- WorkerThread
 - Web
 - Android
 - iOS
- Thread task manager
 - C++ Implementation
 - Native Extension

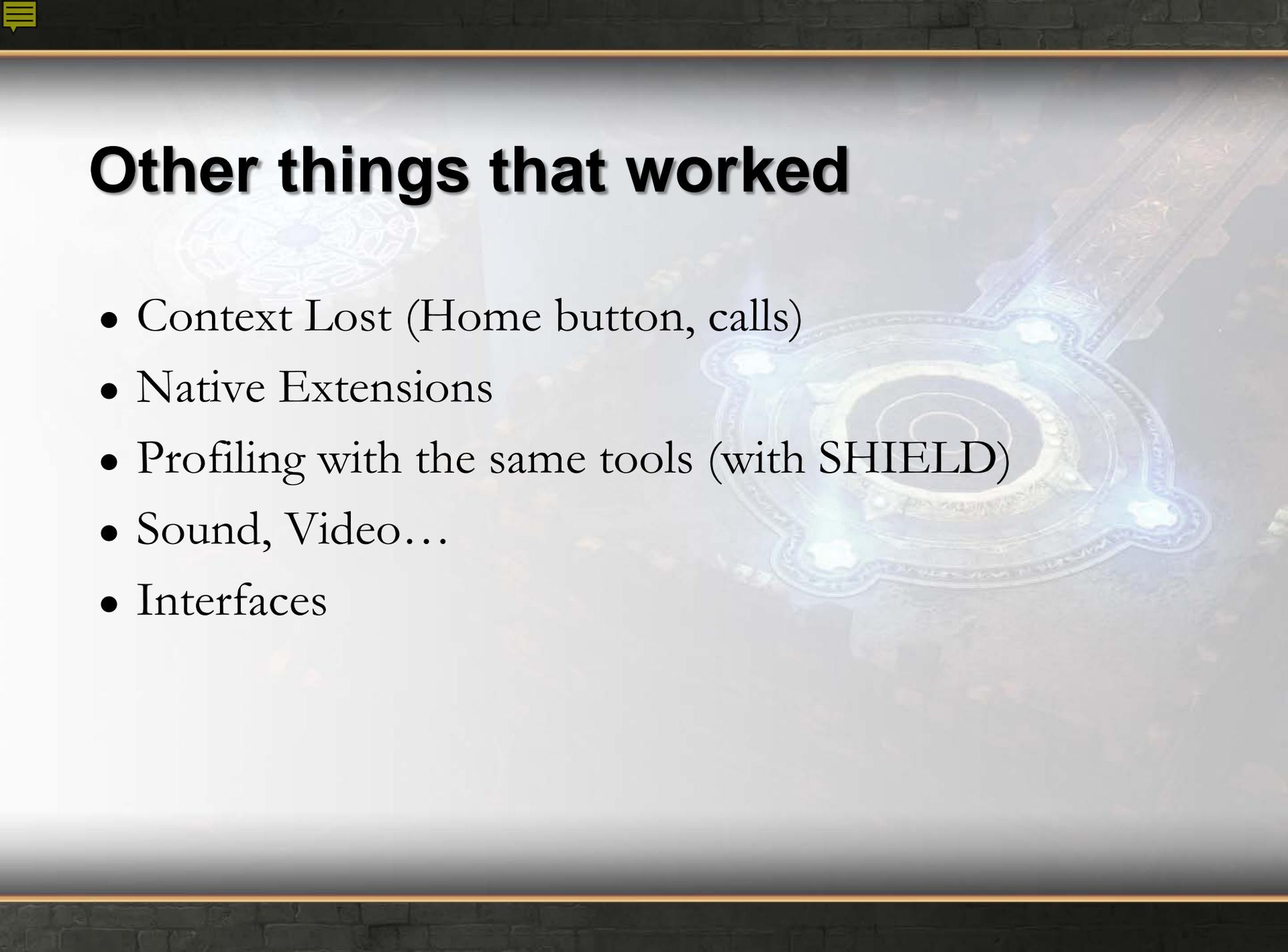
Sequence Diagram



Multiplayer

- Sync lot of object
- The Bro¹
- Cumulus (Cirrus, Stratus)
- RTMFP (data,voice,video)
- Worked on OUYA and SHIELD





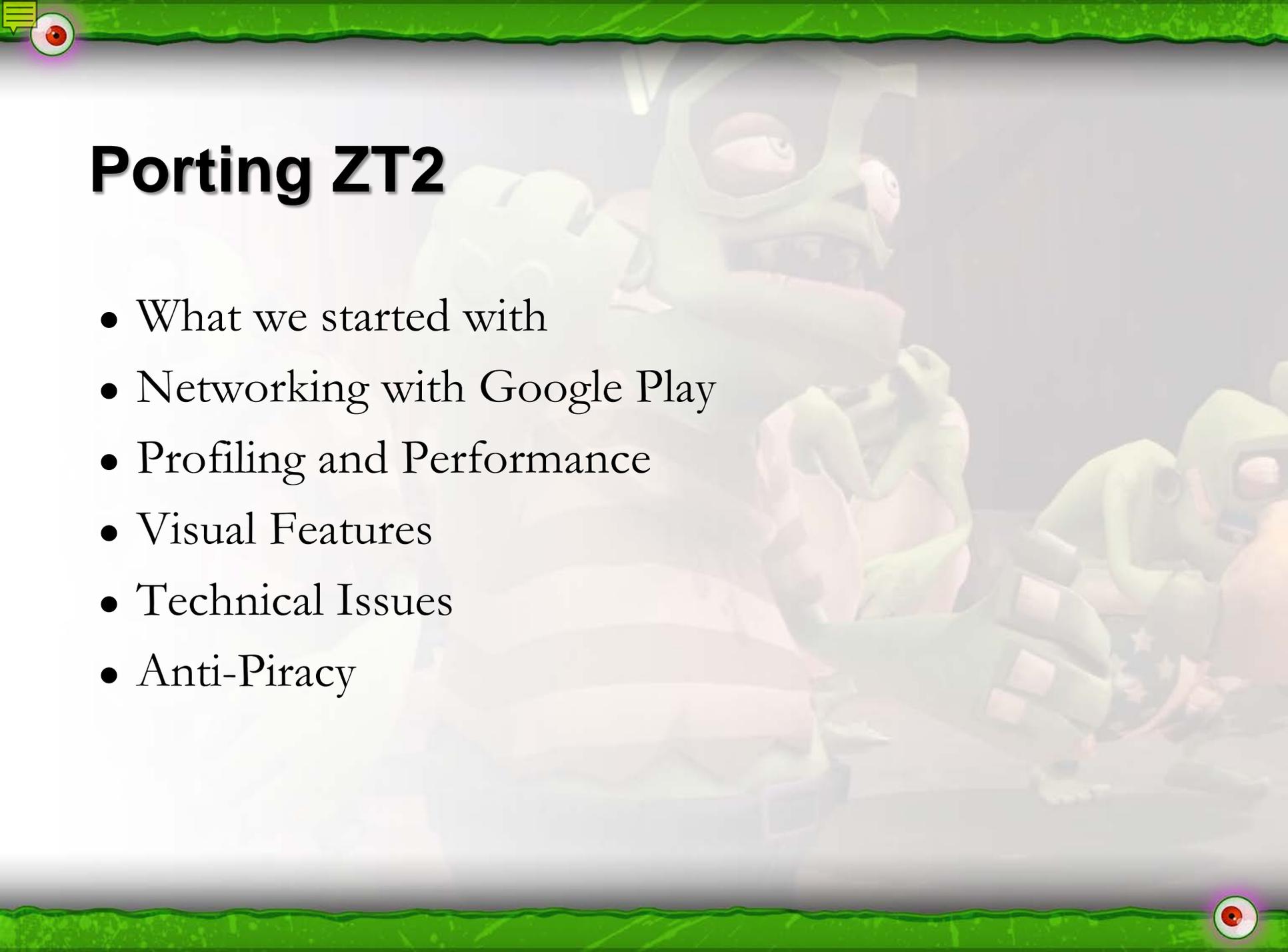
Other things that worked

- Context Lost (Home button, calls)
- Native Extensions
- Profiling with the same tools (with SHIELD)
- Sound, Video...
- Interfaces

ZT2 from PS3 to Shield







Porting ZT2

- What we started with
- Networking with Google Play
- Profiling and Performance
- Visual Features
- Technical Issues
- Anti-Piracy

What was done for VITA

- Unreal ► Mobile Branch ► VITA branch (Alpha)
- Unreal simplified rendering system
- Reduced textures and meshes
- Simplified Fog of War
- Reduced particle count
- Normal Lightmaps (not directional)
- No post process



First SHIELD build

- VITA build on the Shield
 - PS3 textures and meshes
- 40 FPS

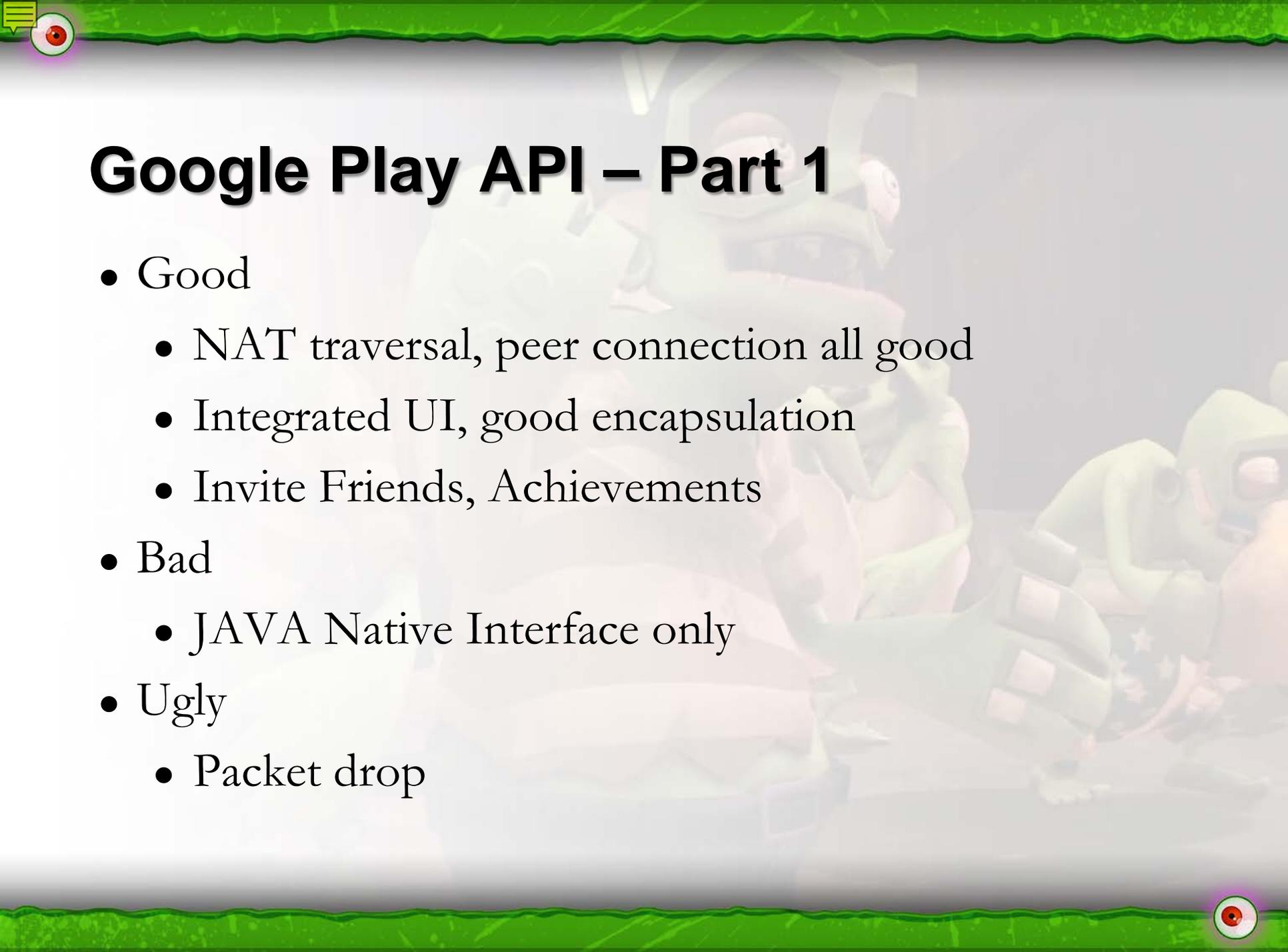




Multiplayer - No PSN!

- PS3 and Vita
 - PSN: yeah !
 - SHIELD
 - Google Play Game SDK
 - Modify Unreal socket layer
 - JNI communication
- 



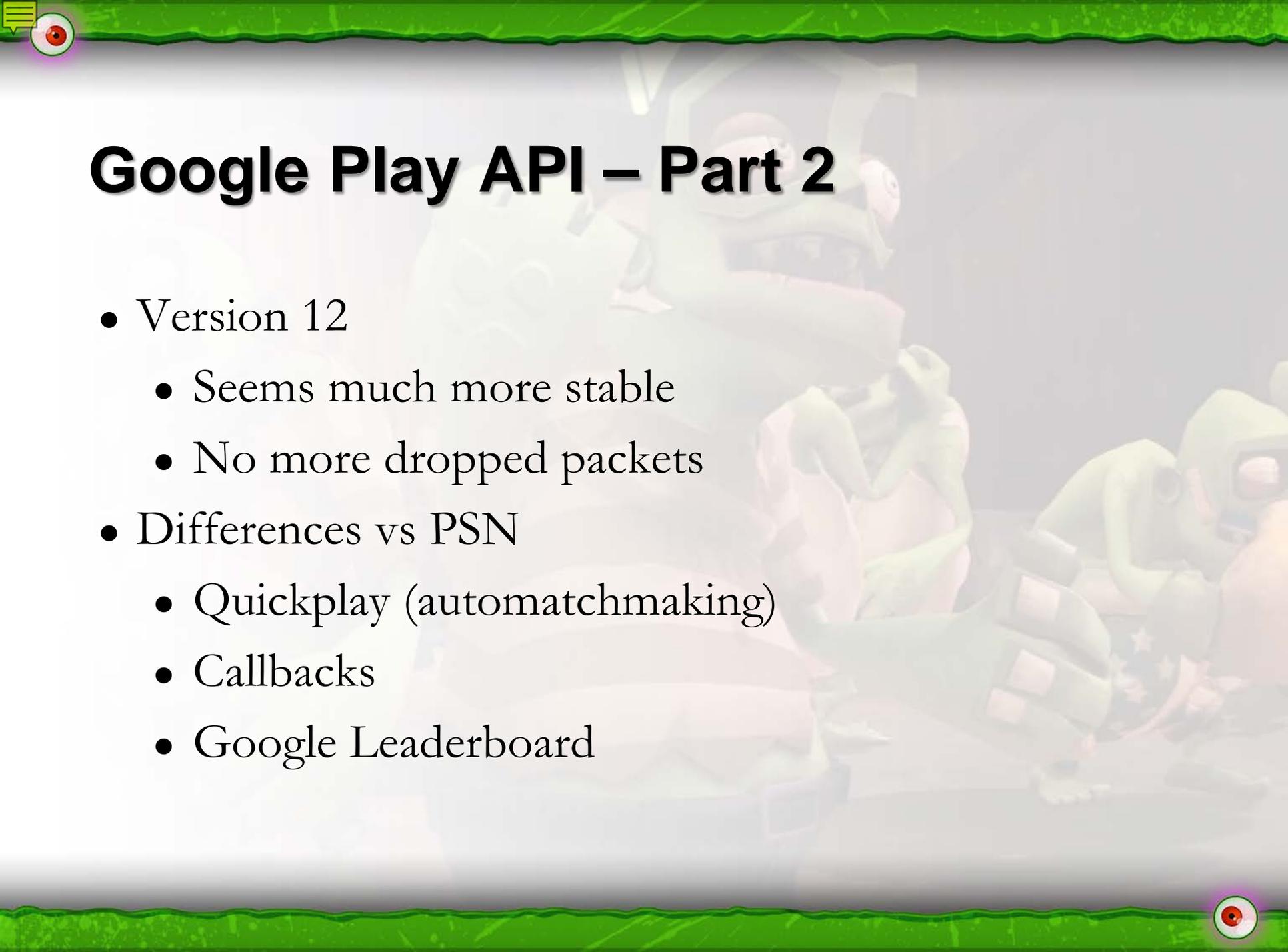


Google Play API – Part 1

- Good
 - NAT traversal, peer connection all good
 - Integrated UI, good encapsulation
 - Invite Friends, Achievements
- Bad
 - JAVA Native Interface only
- Ugly
 - Packet drop

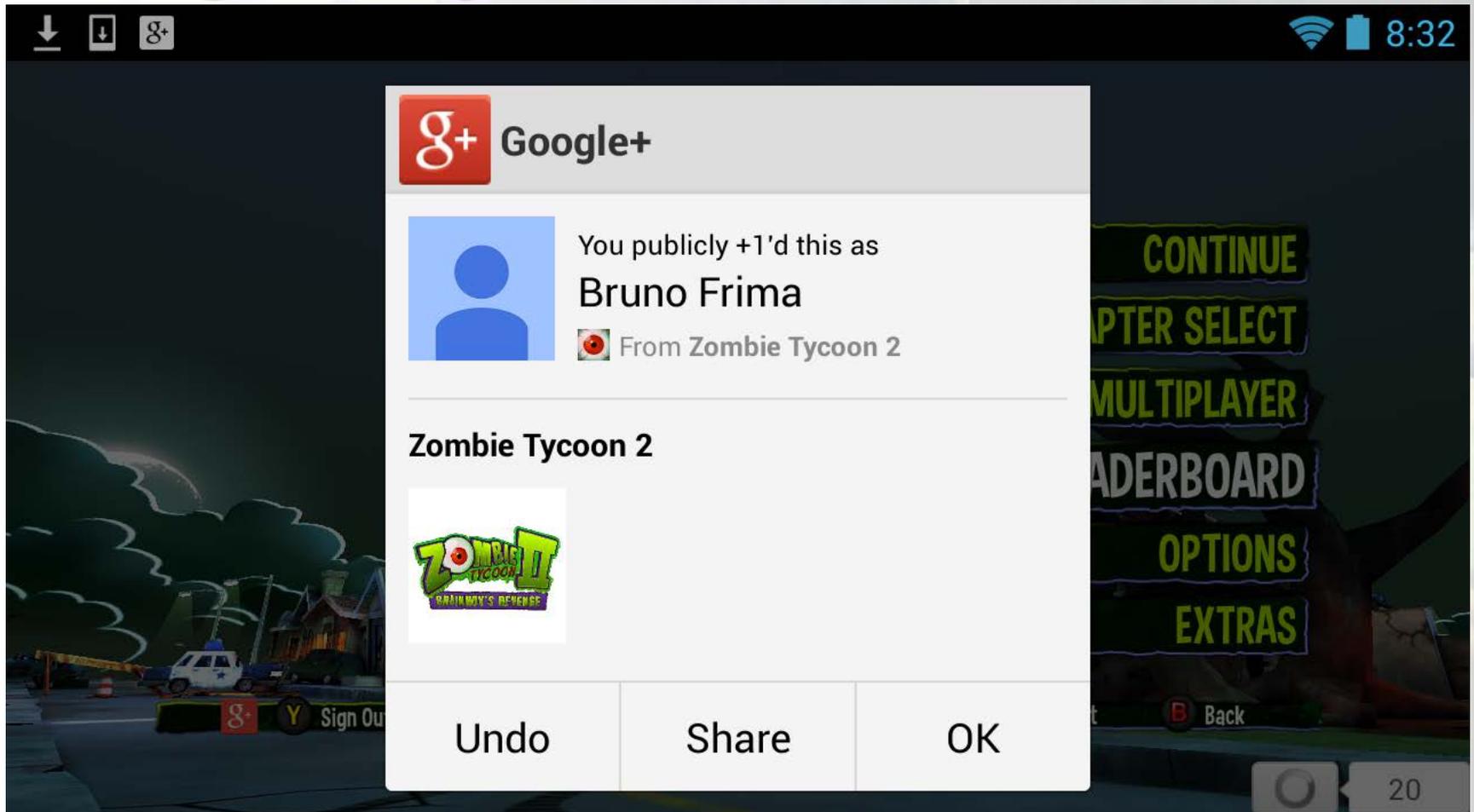


Google Play API – Part 2

- Version 12
 - Seems much more stable
 - No more dropped packets
 - Differences vs PSN
 - Quickplay (automatchmaking)
 - Callbacks
 - Google Leaderboard
- 



Google Play API – Screens



Google Play API – Screens

The screenshot shows the 'Achievements' screen for the game 'Plants vs. Zombies: Garden Warfare'. The interface features a dark grey header with a back arrow, the game's icon, the title 'Achievements', and a three-dot menu icon. The status bar at the top right shows signal strength, Wi-Fi, battery, and the time 10:18. The achievements are displayed in a grid of cards, each with a unique icon and a gold medal icon. The 'Think like a zombie' achievement is highlighted with a blue border.

Icon	Achievement Name	Description	Progress
	Back on track!	Find all trophy parts in chapter 2	Unlocked
	Think like a zombie	Obtain a 5 brain rating in any chapter of the campaign	Unlocked
	Murderer	Slaughter 100 humans	Unlocked
	Know your basics	Complete chapter 1	Unlocked
	Fortune favors the bold	Find the trophy in chapter 1	Unlocked
	Tycoon's superiority	Kill 1000 feral zombies	93%
	Zombie overlord		
	Slow zombies are still th...		

Mobile Features

- Analytics
- Rate us
- Like us (+1)





YUP!

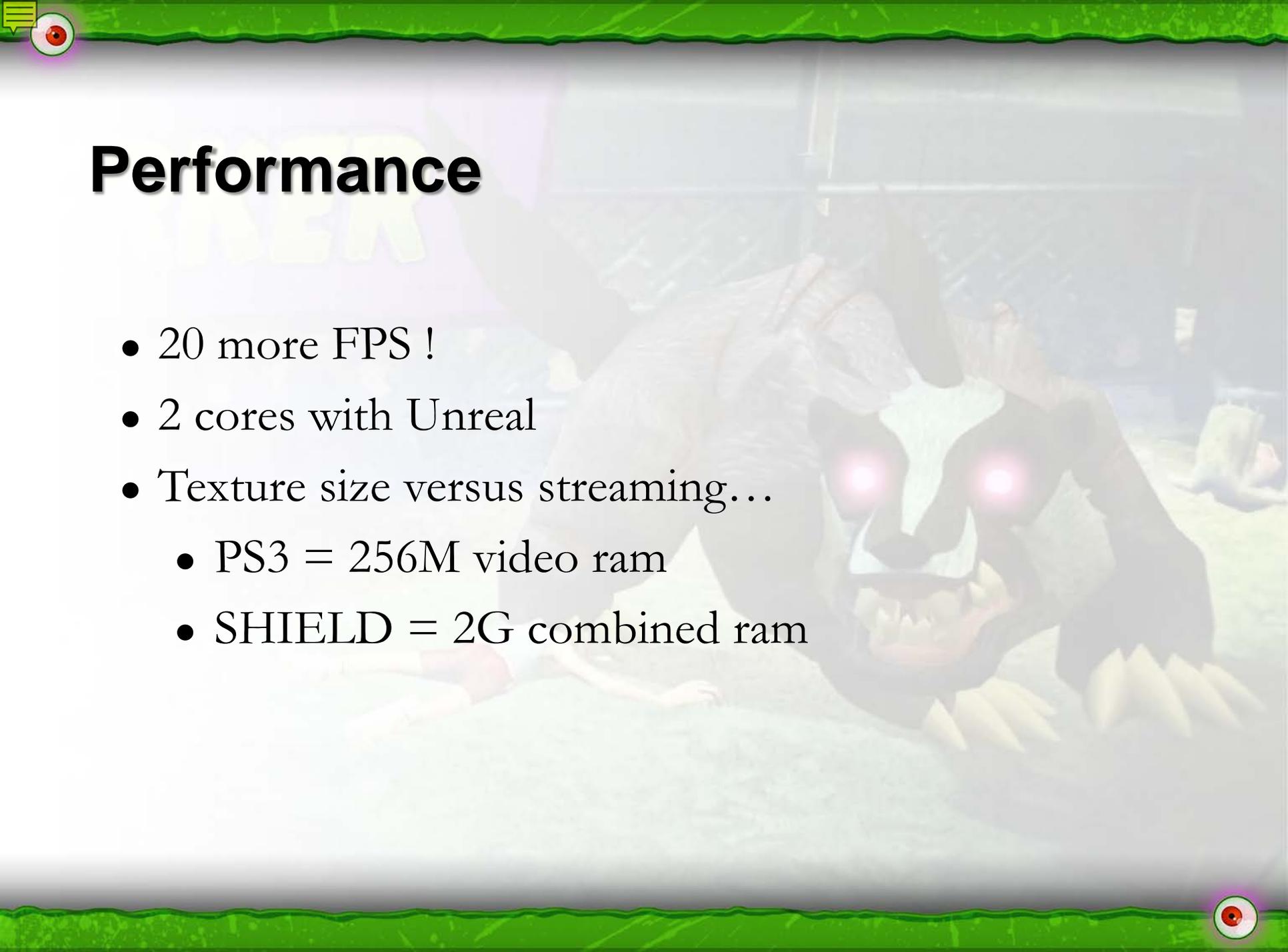
AKER



Profiling and Debugging

- NVIDIA PerfHud ES (T4)
- Shield prototype vs retail
- Same profiler tricks
- Native debugging





Performance

- 20 more FPS !
- 2 cores with Unreal
- Texture size versus streaming...
 - PS3 = 256M video ram
 - SHIELD = 2G combined ram



Strategic View



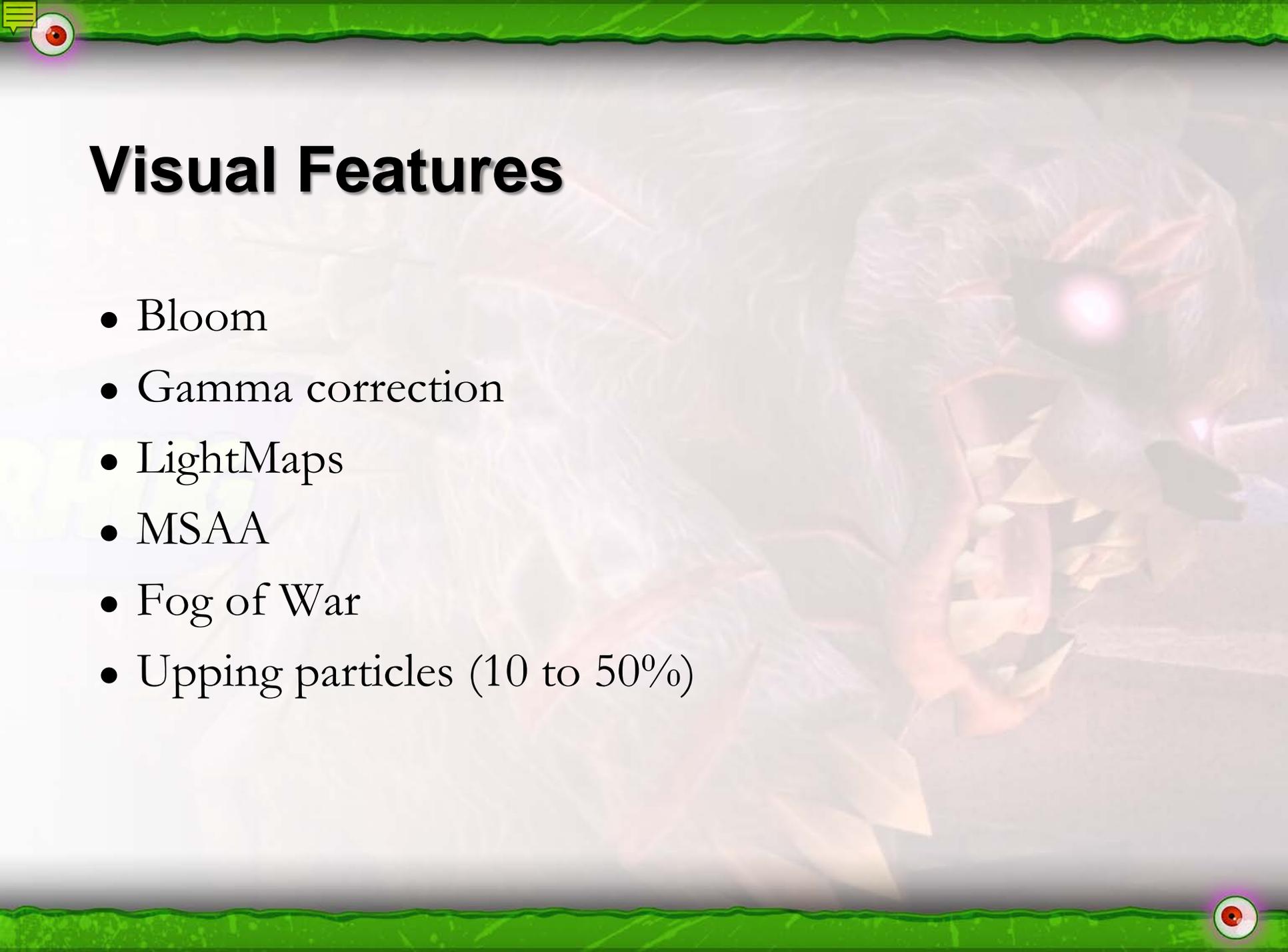


Strategic View



Build weight

- Build weight 1.3G (VITA: 400, PS3:900)
- WAVs only
 - 48KH Stereo to 22KH mono
- Seek free package
 - Package per level
 - Rearrange package reducing redundancy



Visual Features

- Bloom
- Gamma correction
- LightMaps
- MSAA
- Fog of War
- Upping particles (10 to 50%)



XTRAS



XTRAS



Gamma correction



Gamma correction



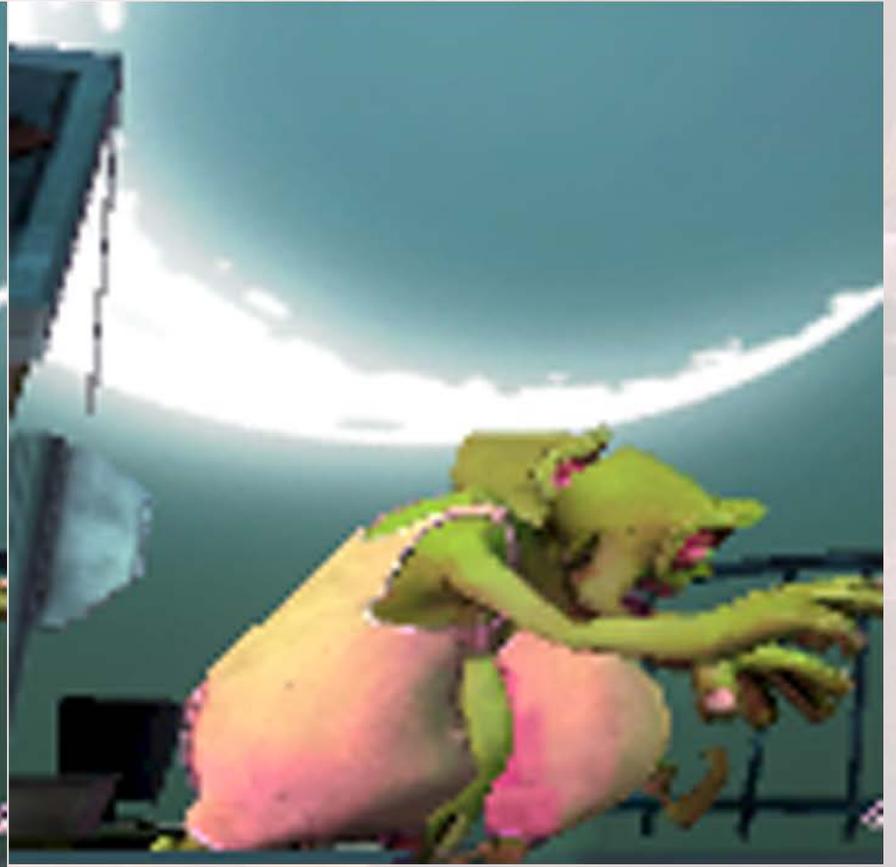
Lightmaps - VITA



Lightmaps - SHIELD



MSAA



New squad!





 Breach the last human stronghold!

 **ADJUST ZOOM**
Tilt the right stick up and down to adjust zoom level.



UI tweaks

- Maybe obvious?
- PS3 rescaled for VITA
- Different controller = different UI
- Don't underestimate





Technical Issues

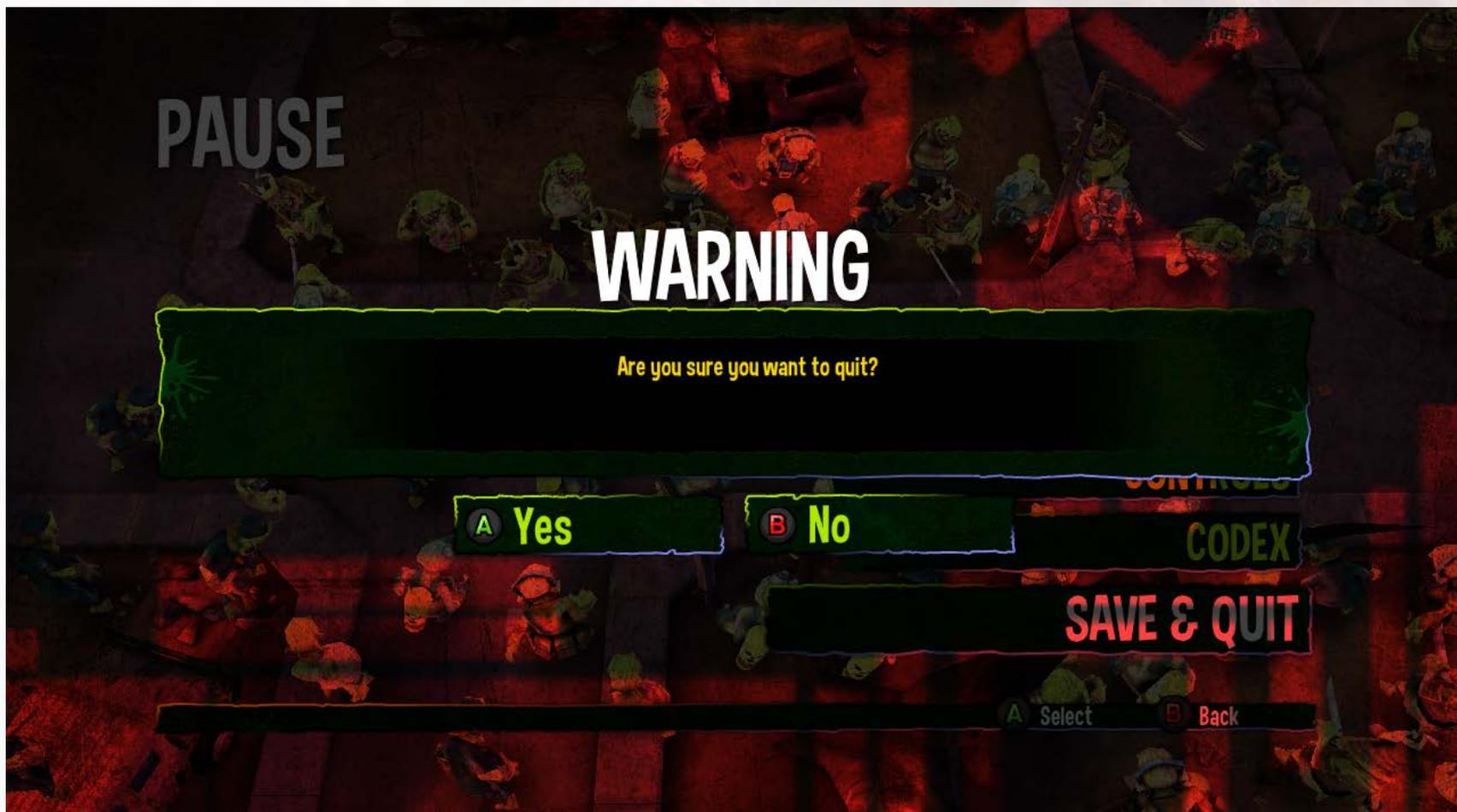
- Context reset
 - Fog of war
 - glReadPixels in batches
 - ScaleForm maturity on Android



Save/Home



Save/Home



Anti-Piracy

- Licence server
 - Use Developer console FIRST
 - **Wait**
 - APK , OBB version number
 - **Wait**
 - Rage quit.
 - **Save | commit | go home**



Compare the final game





Last transition!!!

PHUG





Conclusion

- Android works well to port to
 - Micro-console
- They are powerful today
 - Rapid iterations are planned
- Multiplayer





Thank You

- <http://www.light-bringers.com/>
- ZT2 on SHIELD out Thursday
- Please Fill Survey
- Questions?

