

Andrew Pangborn

Principal Software Engineer — Color, HDR & UI Compositing at Apple Inc.

16 years of experience developing and supporting features on 2+ billion active devices — specializing in color, HDR, and display pipeline design from SoC integration through the display compositor and developer UI frameworks. I'm passionate about bringing hardware and software together to build delightful user experiences at scale.

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EXPERTISE

SYSTEMS ENGINEERING

- CPU architecture, SIMD vectorization
- Concurrency and IPC
- Performance profiling and optimization
- SoC hardware acceleration for graphics and media
- Cross-functional experience bringing together Display, GPU, Camera, Video, and Sensor pipelines

GRAPHICS & DISPLAY

- UI compositing, Window Management
- Extended Dynamic Range (EDR) compositing architecture
- HDR image and video rendering
- Tonemapping, ICC color management, wide gamut pipeline design
- Ambient adaptation for mesopic and photopic human vision

PROGRAMMING LANGUAGES & FRAMEWORKS

- C++, C, Objective-C, Python, Swift
- Metal, OpenGL(ES)
- UIKit, AppKit, SwiftUI

EXPERIENCE

Apple Inc.

Cupertino, CA

CoreAnimation · Senior / Principal Software Engineer

2014 – Present

- Brought ICC color management to iOS, enabling wide gamut (P3) displays and laying the foundation for HDR and professional color features. Leveraged specialized hardware to achieve minimal performance impact on existing sRGB content. Deployed to all active iPhone & iPad users.
- End-to-end HDR support across iOS, macOS, and tvOS: designed & implemented the HDR compositing architecture (Extended Dynamic Range). HDR photo rendering, video playback for DolbyVision, HDR10(+), and HLG. GPU and specialized SoC acceleration of display mapping for OLED, LCD, miniLED, and external TVs.
- HDR UI effects in Liquid Glass and Icons.
- Specialized color management via 'Reference Mode' on iPad Pro to enable review-and-approve workflows used by many Hollywood Studios.
- Reference presets on Pro Display XDR, MacBook Pro XDR, and Studio XDR Displays — used by professional video editors, photographers, and graphics creatives. Detailed precision, pipeline analysis, and debugging to ensure presets meet industry standards.
- Led color & HDR issue triage for 6+ years; recently built AI agent tooling to automate GPU and SoC color pipeline analysis, and domain-specific code review — applying LLMs to specialized systems debugging at scale.
- Transitioned the macOS window server and compositing engine to Apple Silicon, supporting all Macs shipped since 2020.

- 2D Graphics APIs (CoreGraphics, Skia, canvas)
- Familiar with: Vulkan, Qt, GLUT, JavaScript

PLATFORMS & TOOLS

- macOS, iOS, Linux
- AI-assisted development: Codex, Claude Code, MCP tools, agent skills
- Xcode, lldb & gdb, clang & GCC, GPU shader debuggers, Unix shell tools, VSCode
- BitBucket, GitHub, JIRA, Confluence
- Personal projects: Arduino, Raspberry Pi, Linux server admin, Docker, Unifi

STANDARDS

- ISO 21496-1, 21496-5, 22028-5
- ITU-R BT.2100, SMPTE ST 2084, ST 2094-40
- ICC (ISO 15076) · H.264, H.265, AV1

EDUCATION

Rochester Institute of Technology

2004 – 2010

M.S. Computer Engineering ·
B.S. Computer Engineering

Thesis: "Scalable Data Clustering Using GPUs" (2010) — early GPU parallel computing research for large-scale data workloads

- Lossless compression throughout compositor and media playback to reduce DRAM traffic by ~50% and provide significant power savings (additional 4 hours of video playback, 1 hour Safari browsing).
- Integrated SoC features from Display, GPU, Camera, Video, and Sensor hardware teams into compositor across 12 years of iPhone, iPad, Apple TV, and Apple Watch products and 6 years of Apple Silicon Macs.
- Content-aware brightness control on iPhone enables seamless transitions for HDR content viewing on OLED and miniLED displays with minimal power impact. Required tight sensor, UI rendering, display hardware, and display calibration integration.
- External display support on iPad and iPhone, including AppleLog output to enable "Shot on iPhone" production for Apple Keynotes and Hollywood movies such as "28 Years Later".

ImageIO & CoreGraphics · Software Engineer 2010 – 2014

- Accelerated JPEG decoding by integrating a dedicated SoC hardware decoder.
- Performance optimization and bug fixes on the GPU-accelerated CoreGraphics rendering stack powering WebKit.
- Text rendering improvements for languages like Hindi with overlapping glyphs.
- Security hardening, new APIs, and full support for XMP, EXIF, and IPTC image metadata.
- Maintenance and integration of open source image codecs: libPNG, libTIFF, libGIF.
- Added JPEG2000 image format support.

PATENTS

Content Dependent Brightness Management System US 12,230,191

Graphics Engine and Environment for Efficient Real Time Rendering of Graphics that are Not Pre-Known US 9,679,346