FILE SYSTEMS

Chrome OS utilizes a sophisticated Linux-based file system architecture optimized for security, atomic updates, and SSD performance, primarily relying on ext4 with specialized partitions and overlays.

Internal File System Structure

- ext4 as Primary FS: All core partitions format with ext4 for journaling, extents, and delayed allocation, ensuring data integrity during power loss and high IOPS on eMMC/NVMe drives.
- GPT Partition Table: Drive divides into 12-20 labeled partitions (cgpt tool), including kernel images, rootfs slots, and stateful areas for scalability.
- Rootfs A/B Slots: Read-only squashfs-compressed ext4 images (e.g., 4GB each) verified via dm-verity Merkle trees; active slot mounts during boot.
- Stateful Partition: Writable ext4 (/mnt/stateful) for /home/chronos/user, logs (/var/log), and apps; expands dynamically to fill disk.
- OverlayFS Union: Merges immutable rootfs (lowerdir) with writable upperdir (/overlay-upper) and workdir for non-destructive modifications; enables instant rollbacks.

Encryption Mechanisms

- Per-User Vaults: Encrypted subdirs in stateful partition use kernel fscrypt (AES-XTS-256 since Chrome OS 69); keys derive from TPM-stored VK unlocked by user PIN.
- Fallback eCryptfs: Older devices (<2018) stack encryption atop ext4 with stacked mounts.
- Full-Disk LUKS2: Device-wide dmcrypt layer (optional) with Argon2 key derivation; reseals on logout/reboot.
- TPM Integration: Platform keys (EK, SRK) bind encryption to hardware, preventing offline attacks.

Update and Recovery Handling

- Delta Updates: Downloads apply as OverlayFS deltas to inactive A/B slot; verified boot switches slots atomically on reboot.
- MINIOS Partition: Ext4 recovery image for factory resets or USB Powerwash without data wipe.
- Developer Mode FS: Makes rootfs writable (crossystem dev_boot=1) but disables verification; chroot access for debugging.

External Storage Support

- Native Formats: FAT12/16/32, exFAT (write since 2020), NTFS (ntfs-3g), HFS+ (read-only); auto-mounts in Files app.

- No ext2/3/4 Native: Dropped post-2015 (M40) for security/rename bugs; requires Crostini VM (sudo mount -t ext4).
- Cloud FUSE Mounts: Google Drive/OneDrive as /media/drive via fuse-google-drive; selective offline caching.
- Mount Commands (Crostini): `sudo mkdir /mnt/ext4; sudo mount /dev/sdb1 /mnt/ext4` for manual access.

Performance Optimizations

- Mount Options: noatime,nodiratime,commit=30s,quota for reduced metadata writes and SSD longevity.
- Journal Tuning: data=writeback mode balances speed/safety; extents for large media files.
- Benchmark Edge: 500+ MB/s sequential reads, 40% faster random I/O than NTFS on Chromebook SSDs.

FEATURES

Chrome OS features prioritize security, performance, and seamless cloud integration across two conceptual pages of content.

1: Core Performance & Security Features

- Fast Boot (6-10s): SSD-optimized Linux kernel achieves sub-10 second startups and instant sleep resume
- Seamless Updates: Background patches apply without reboots via A/B partitioning
- Virus Protection: Continuous scanning blocks malware at download/web layers
- Sandboxing: Isolates apps/tabs/extensions to contain breaches
- Verified Boot: Cryptographic checks rollback tampering automatically
- TPM Encryption: Hardware-rooted full-disk protection unlocks post-auth

2: Productivity, Apps & Accessibility

- Unified Launcher: AI-enhanced search across apps/Drive/web/settings

- Web/PWA Apps: Chrome Web Store with offline caching
- Android Apps: Full Play Store via ARC++ runtime
- Linux Apps: Crostini VM (VS Code/Docker) with GPU passthrough
- Virtual Desks: Multiple workspaces with per-desk audio
- Accessibility: ChromeVox reader, Live Translate, dictation
- Enterprise: Zero-touch enrollment, kiosk mode

APPLICATION

Chrome OS applications span consumer, education, enterprise, and specialized deployments, leveraging its web/Android/Linux app ecosystem.

Primary Applications

- Education: Powers 50M+ student Chromebooks for Google Classroom, safe browsing, and managed profiles in K-12 schools worldwide.
- Enterprise Productivity: Runs Google Workspace (Docs, Sheets, Meet) with Chrome Enterprise for secure remote work and zero-touch fleets.
- Digital Signage/Kiosks: Kiosk Mode deploys fullscreen web apps for retail displays, menus, or self-service terminals without user login.
- Healthcare: HIPAA-compliant Chromeboxes for patient check-in, telehealth via Meet, and Epic MyChart web access in clinics.

Deployment Modes

- Managed Guest Sessions: Shared devices for contractors/libraries with browsing but no personal data storage.

- User Sessions: Auto-installs organizational apps on login for corporate/education OUs (Organizational Units).
- BYOD Support: Secure SaaS access on personal devices via Chrome Enterprise Premium policies.

Development Use Cases

- Web App Development: PWAs with File System Access API, Service Workers for offline ChromeOS apps.
- Linux Development: Crostini runs VS Code, Git, Docker for full-stack coding on Chromebooks.
- Android Testing: ARC++ emulator for app devs targeting Play Store compatibility.

COMPARISON

Aspect	Chrome OS	Windows 11	macOS Sequoia	Linux (Ubuntu)
Boot Time	6-10s	20-45s	12-25s	8-20s
Update Model	Seamless background A/B	Feature/reboot-heavy	Quarterly staged	Manual/LTS
Security	Verified Boot + Sandbox + fscrypt	Defender + TPM2	Gatekeeper + FileVault	AppArmor + SELinux
File System	ext4 + OverlayFS	NTFS + BitLocker	APFS	Ext4 + LUKS
App Support	Web/Android/Linux VM	Native/Win32/.NET	App Store + Rosetta	Native/Flatpak/Wine
Battery Life	12-15hrs	8-10hrs	15-20hrs	10-12hrs
Hardware Cost	$200-1000	$400-3000+	$999-5000+	$300-1500
Market Share 2026	18% desktop	68%	11%	2.5%
Best For	Education/Enterprise/Cloud	Gaming/Productivity	Creative Pro	Developers/Servers