

Caelaris Linux

Next-Generation High-Performance Arch-Based Linux Distribution with Dual Desktop Sessions, Custom Graphical Installer, Universal Driver Automation, and Pro-Grade Gaming Stack

Product Name	Caelaris Linux (x86_64)
Version / Target	v1.0-Rolling (Kernel 6.x)
Distribution Base	Arch Linux Rolling Baseline
Document Author	Caelaris Core Architecture Team
Default Desktop	KDE Plasma 6 (Wayland)
Alternative Desktop	GNOME 4x (Wayland)
Installer Subsystem	Caelaris Native Graphical Installer (PyQt6)
Date Generated	September 2026
Status	Approved for Release / Production

1. Executive Summary & Product Vision

1.1 Vision Statement

Caelaris Linux is engineered to eliminate the traditional tradeoff between bleeding-edge software access and day-one usability. While Arch Linux offers unparalleled customization and up-to-date packages, its manual setup and configuration barrier prevent mainstream adoption. Turnkey distributions often introduce unwanted bloat, unoptimized kernels, or rigid desktop lock-in.

Caelaris delivers an ultra-responsive, modern, and gaming-optimized computing platform. It features out-of-the-box dual graphical sessions (KDE Plasma 6 as default and GNOME), instant session hot-switching, deep virtualization guest acceleration (VMware, VirtualBox, UTM/QEMU), complete GPU driver stacks (AMD, Intel, NVIDIA with DRM modesetting), custom PyQt6 graphical installer, and pro-grade performance tuning without bloat.

1.2 Core Value Proposition

- **Instant Gratification:** Zero-setup live preview with full 1080p dynamic auto-resizing, pre-configured live user, and full sudo privilege.
- **Freedom of Desktop Choice:** Boot into either KDE Plasma 6 or GNOME from the bootloader, switch seamlessly during preview via desktop shortcut, and choose desktop environment from SDDM login screen after install.
- **Custom Graphical Installer:** Native Python/PyQt6 installer (`caelaris-installer-gui`) supporting guided Btrfs subvolumes, ext4, EFI/BIOS bootloader generation, hardware driver activation, and single user profile cleanup.
- **Pro-Grade Gaming Performance:** Pre-tuned kernel sysctl parameters (huge map counts, low swappiness, Google BBR congestion, CAKE packet scheduling), PipeWire low-latency audio, GameMode, MangoHud, Steam, and VKD3D.
- **Universal Hardware & Hypervisor Integration:** Automated hardware driver detection for physical PCs alongside guest integration suites (VMware `open-vm-tools` , VirtualBox guest services, UTM/SPICE agents).
- **Clean Silent Direct Boot:** Streamlined GRUB bootloader displaying strictly `Caelaris Linux` , transitioning silently into the login screen without scrolling text or loading clutter.

2. Target Personas & Success Metrics

2.1 Target User Personas

User Persona	Key Needs & Pain Points	How Caelaris Addresses It
The Linux Gamer	Needs maximum FPS, smooth frame times, no shader compilation stutter, working Steam/Proton/Wine, and easy performance monitoring.	Pre-configured <code>vm.max_map_count=2147483642</code> , Steam, MangoHud, GameMode, 32-bit Vulkan drivers, and low-latency audio stack out-of-the-box.
The Power User / Dev	Demands latest packages, fast compilation, AUR software access, modern CLI tooling, and responsive terminal environments.	Integrated <code>yay</code> AUR helper, modern Zsh/Bash with auto-completions, Fastfetch, btop, and Git.
Virtualization & Evaluation Tester	Evaluates Linux inside VMware Workstation, VirtualBox, or UTM (macOS Apple Silicon/Intel) and hates manual resolution fixes or clipboard breakage.	Pre-activated <code>open-vm-tools</code> , <code>vboxservice</code> , <code>spice-vdagent</code> , and <code>caelaris-autoresize</code> ensuring immediate 1920x1080 resolution and two-way clipboard sync.

2.2 Key Performance Indicators (KPIs) & Success Criteria

Metric	Target SLA	Implementation Strategy
Cold Boot to Desktop (Live)	< 5 seconds (NVMe SSD)	Elimination of Plymouth graphical locks, pre-created <code>liveuser</code> via <code>systemd-sysusers</code> , parallelized asynchronous <code>systemd</code> services.
Display Auto-Resize Latency	< 1 second	Dedicated userspace agent (<code>caelaris-autoresize</code>) detecting VMware and VirtualBox monitor geometry changes.
Installer Completion Rate	> 99% Success	Custom PyQt6 installer with robust <code>unsquashfs</code> extraction, verified UUID bootloader injection, and driver configuration.
Installed User Profile Purity	100% Single User	Live user accounts completely purged from <code>AccountsService</code> , <code>sysusers</code> , and shadow database during install Step 6.
Bootloader Simplicity	1 Clean Title	Configured as <code>Caelaris Linux</code> with silent boot flags (<code>quiet loglevel=3 rd.udev.log_level=3 systemd.show_status=0</code>).

3. System Architecture & Technical Specifications

3.1 Architecture Overview

Caelaris Linux utilizes a modular build architecture layered on top of the official Arch Linux `mkarchiso` foundation. All core operating system packages, performance configurations, desktop profiles, and installer logic are separated into isolated layers:

```
caelaris-linux/
├── shared/
│   ├── packages.common           # Unified base, gaming, media & hardware stack
│   ├── pacman.conf              # Multi-mirror package repos + Multilib enabled
│   ├── branding/                # Distro identity, os-release, logos
│   └── airootfs/                # Overlay root filesystem
│       ├── etc/default/grub      # Silent boot parameters & GRUB styling
│       ├── etc/sysctl.d/         # Pro-grade low-latency gaming & network sysctl
│       ├── etc/sysusers.d/       # Native systemd liveuser provisioning
│       └── usr/bin/              # Caelaris utilities (installer-gui, welcome, autoresize)
├── profiles/
│   ├── kde/                     # Primary ISO profile (KDE Plasma 6 + GNOME dual session)
│   │   ├── packages.x86_64      # Desktop-specific environment packages
│   │   └── profiledef.sh         # Zstd-19 compression & file permissions
│   └── .github/workflows/
│       └── build.yml             # CI/CD build runner & chunked release distributor
```

3.2 Core Subsystem Specifications

Subsystem	Included Components	Key Capabilities
Base Kernel & System	Linux Kernel 6.x, Linux-Firmware, SOF Audio Firmware, AMD/Intel Microcode, Btrfs-progs, e2fsprogs, exFAT, NTFS-3G.	Hardware auto-detection, universal filesystem support, CPU microcode security patching on boot.
Graphics & Display	Mesa (Gallium), Vulkan-Radeon, Vulkan-Intel, Intel-Media-Driver, NVIDIA-Uutils, lib32-NVIDIA-Uutils, Wayland, XWayland, xf86-video-vmware.	Native Wayland compositing, zero-tear gaming, Vulkan compute, hardware video decode acceleration (VA-API / VDPAU).
Virtualization Support	<code>open-vm-tools</code> , <code>gtkmm3</code> , <code>vboxservice</code> , <code>spice-vdagent</code> , <code>qemu-guest-agent</code> .	Seamless mouse integration, dynamic resolution matching host window, shared folders, host-guest clipboard.
Gaming Ecosystem	Steam, GameMode, MangoHud (64 & 32-bit), VKD3D (DirectX 12 to Vulkan), Gamescope micro-compositor, Fuse2.	Full Proton / Steam Play capability, per-game process scheduling, in-game FPS and hardware telemetry overlay.
Audio Architecture	PipeWire, WirePlumber, PipeWire-Pulse, PipeWire-ALSA, PipeWire-JACK.	Ultra-low latency audio graph, professional JACK routing, seamless Bluetooth audio switching.
Application Management	Pacman, <code>yay</code> (native AUR helper), Flathub App Store backend.	Access to over 100,000+ Linux packages via official Arch repositories, Flathub sandbox, and Arch User Repository.

4. Detailed Functional Requirements

4.1 Dual Desktop Environments & Live Session Switcher (FR-1)

Requirement FR-1: The distribution must support both KDE Plasma 6 and GNOME sessions within a single unified ISO, both in live preview and post-installation.

- **Bootloader Menu Selection:** Both systemd-boot (UEFI) and Syslinux (BIOS) bootloader menus present distinct options:
 - `Caelaris Linux (KDE Plasma 6 - Default)` : Loads Plasma 6 on Wayland via SDDM.
 - `Caelaris Linux (GNOME Desktop)` : Loads GNOME Shell on Wayland via SDDM.
 - `Caelaris Linux (Copy to RAM)` : Loads the entire system into RAM for portable high-speed usage.
- **1-Click Desktop Switcher (`caelaris-switch-desktop`):** Users can switch between KDE and GNOME during live preview without rebooting. Launching the desktop shortcut reconfigures SDDM autologin and restarts the display manager in 2 seconds.
- **Post-Install Dual Session:** The installed SDDM greeter presents an interactive session dropdown, allowing users to choose between Plasma Wayland and GNOME Wayland at every login.

4.2 Caelaris Graphical Installer & Profile Cleanup (FR-2)

Requirement FR-2: Python/PyQt6 graphical installer capable of partition automation, kernel deployment, driver enablement, and single-user profile enforcement.

- **Automated Guided Partitioning:** Creates EFI boot partition and root partition with choice of Btrfs subvolume layout or clean Ext4.
- **Single User Profile Guarantee:** Completely removes live user accounts (`userdel -r -f liveuser`) and deletes sysusers / AccountsService references so only the user-configured account appears at the SDDM login screen.
- **Clean Desktop Post-Install:** Removes all installer shortcuts (`install-caelaris.desktop`) from desktop and skeleton directories upon completion.
- **Driver Enablement:** Automatically enables hypervisor guest tools (`vmtoolsd` , `vboxservice` , `spice-vdagentd` , `qemu-guest-agent`) and configures NVIDIA DRM modeset if NVIDIA hardware is detected.

4.3 Silent Direct Boot & Single Bootloader Entry (FR-3)

Requirement FR-3: Bootloader must display strictly "Caelaris Linux" and boot cleanly into the graphical login screen without console clutter.

- **Streamlined Titles:** Generates GRUB entries cleaned of redundant strings, displaying only `Caelaris Linux` (or `Caelaris Linux (Recovery Mode)` for fallback).
- **Silent Kernel Parameters:** Appends `quiet loglevel=3 rd.udev.log_level=3 systemd.show_status=0 vt.global_cursor_default=0 video=1920x1080` for a seamless transition to SDDM.

- **Universal Removable Fallback:** Installs both NVRAM and `--removable` fallback bootloader (`EFI/BOOT/BOOTX64.EFI`) to prevent UEFI boot loops in VMware and VirtualBox.

4.4 Welcome Assistant One-Time Display (FR-4)

Requirement FR-4: The Caelaris Welcome Assistant must appear only once upon first login on installed systems.

- Tracks display state via `~/.config/caelaris-welcome-shown` .
- Exits immediately on subsequent logins in both KDE Plasma 6 and GNOME sessions.

5. Release Engineering & Continuous Integration

5.1 Multi-Part Release & 2GB Limit Bypass

GitHub Releases Asset Limit: GitHub enforces a 2,147,483,648 byte limit per asset. Caelaris Linux builds are divided automatically into <1.9GB chunks.

- **Chunk Generation:** Automated splitting via `split -b 1900M -d` produces `.part-00`, `.part-01`, and `.part-02`.
- **1-Click Reassembly:** Packages `combine.bat` for Windows users, using binary copy concatenation (`copy /b *.part-* caelaris-kde.iso`) and SHA256 checksum verification.
- **Direct Mirror:** Continuous release uploads to Pixeldrain API to provide a direct 1-click download of the complete 4.2GB ISO.

5.2 Project Roadmap & Milestones

Milestone	Key Deliverables	Status	Target
Phase 1: Foundation	Archiso base, KDE Plasma 6, pacman mirrors, base packages.	COMPLETED	Q3 2026
Phase 2: Dual DE	GNOME 4x integration, live preview session hot-switcher.	COMPLETED	Q3 2026
Phase 3: Native Installer	PyQt6 GUI installer, silent boot, single profile cleanup.	COMPLETED	Q3 2026
Phase 4: Release Pipeline	GitHub Actions CI, chunked release assets, combine.bat.	COMPLETED	Q3 2026
Phase 5: Kernel & Theme	Custom Zen/BORE scheduler kernel, bespoke Caelaris theme.	ROADMAP	Q4 2026
Phase 6: ARM64 SBCs & PCs	Caelaris Linux ARM64 Editions: Dedicated Raspberry Pi SBC Release (<code>rpi-arm64-release</code>) and dedicated Full Desktop ARM64 Laptop/PC Release (<code>arm64-pc-release</code> , ~4.0GB ISO).	ACTIVE PIPELINE	Q4 2026

Conclusion: Caelaris Linux establishes a modern, uncompromising standard for Arch-based Linux distributions, delivering gaming excellence, hypervisor agility, and desktop versatility in a polished, production-grade ISO.