

Project *Aileron* (Working Title)

Internal Code Name: "Zephyr-9"

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1. Executive Summary

Project *Aileron* is a next-generation, high-fidelity MMORPG set in a topography of wind and rust, spanning from the icy, industrial ruins of the Kaltic Wastes to the acoustic, turbine-driven chasms of Torgaux. Moving away from traditional EXP-grinding and instanced gameplay, *Aileron* focuses on a server-authoritative, persistent world where player actions - like building new bridges and roads - permanently alter the landscape.

The game combines the tactical precision of tab-target sub-targeting with a unique "Armor" system for character progression.

2. Core Pillars

- **No Instances:** Every player, character, item, and building exists in a shared, persistent space. *Aileron* abandons traditional loading screens. The client dynamically streams models and environments based on player zone and coordinates, with aggressive frustum culling.

- **Tactical Combat:** Combat is won by disabling specific vital nodes (Head, Arms, Torso, Legs) to strip them of equipment and mobility.
- **Sovereign Economy:** A player-driven economy where some classes have roles (e.g. Merchants can scrap goods for profit, Navigators can operate transit).
- **Legacy Through Discovery:** Progression is marked by leveling, and the acquisition of gear and items.

3. Technical Specifications

Feature	Specification
Genre	MMORPG
Perspective	3D Third-Person Orbit (Scroll to First-Person)
Physics	Kinematic with Gravity; Object Collisions (No Player-to-Player Clipping)
Networking	Server-Authoritative with Client-Side Prediction
Timing	Real-Time, Tick-Based (Global Cooldown System)
Platform	Next-Gen, Web Browser

4. Combat & Progression Systems

4.1 Sub-Targeting & Vital Nodes

Combat utilizes a refined tab-target system with sub-targeting nodes. Players cycle targets with Tab and Shift+Tab.

- **Head:** 1 Hit = Lethal.
- **Torso:** Base 1 Hit = Lethal. Each active Arm adds +1 hit requirement.

- **Arms (L/R):** 1 Hit (each) = Disable. Disabling an arm removes the abilities/equipment associated with that slot.
- **Legs (L/R):** 1 Hit (each) = Slow. 2 Hits = 2x Slow.
- **Special:** [Extra Arm, Tentacle, Head, etc.] nodes available for non-humanoids.

4.2 The Armor-Health Paradigm

Beyond your vital nodes, Armor is your "health bar".

- **Visual Interface:** The armor bar is segmented (similar in appearance to video chapters). Each segment represents a piece of equipped gear (Head, Torso, L-Arm, etc.).
- **Vulnerability State:** When a piece of armor is destroyed or removed, that node becomes "Vulnerable".
- **Maintenance & Healing:** Players use Repair and Replace mechanics and "Healing Spells" for Armor restoration, facilitated by Alchemists/Smiths/Priests.

4.3 Player Progression

Progression is mostly horizontal through item (gear) acquisition, and there are level-gated items and areas. Level does not affect player stats directly, but grants access to items and places.

- **Abilities:** Granted by items and class specialization. Weapons (1-4 abilities), Armor (1-2 abilities), Cards (1 ability). Some abilities have Class requirements beyond the Weapon Class requirement.
- **Stats:** Simplified to Armor (Defense/Health) and Power (Output).
- **Movement:** Dictated by abilities and flight/mount capabilities.
- **Experience (EXP):** EXP gain and leveling up is weighted on a gradient, such that more EXP is gained (and lost) at lower levels and stabilizes as the player levels up.
- **EXP Loss:** While leveling, a player may lose EXP (and levels) upon death, until after reaching the stable level cap.
- **Level Cap:** The effective level cap is 75, because by Level 75 the EXP gain/loss gradient will have reached 0 - that is, no more EXP can be gained or lost.

5. Archetypes

5.1 Classes

Players choose one of 8 Base Classes, which branch into Advanced and optional Vocational specializations to unlock more class features:

Base Class	Advanced Class	Vocational Class
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Knight	Templar	Mason
Mercenary	Paladin	Priest
Witch	Reaper	Harvester
Explorer	Navigator	Starfighter
Thief		Merchant / Smith
Wrangler	Beast / Dragon Master	Handler
Arcanist	Sorcerer	Alchemyst
Dancer	Shapeshifter	

5.2 Races

There are 4 playable races and other non-playable races that are heavily involved in the lore.

- **Terans** (*Playable*): The most populous race, primarily inhabiting Torgaux and Hylvorn on Orizaya, and the underground city of Argaueren Ranks on Aurelion; known for their industrial ingenuity and political volatility.
- **Hylvari** (*Playable*): A war-like, hardy tribe native to the Kaltic Mountains; famous for their history as dragonriders and their reclamation of Hylvorn.
- **Elves**: An ancient, reclusive lineage often found in the deep reaches of the Amaruna Wilds and less populated areas between the Frozen Wastes and Gnarling Spires, maintaining a tenuous peace with industrial society.
- **Oresk**: Powerful, thick-skinned humanoids who often serve as the backbone of heavy labor and high-altitude and underwater mining operations.

- **Reveren** (*Playable*): An ancient, offshoot lineage of Terans who migrated to the frontiers of Orizaya epochs ago. Millennia of isolation have left them with a distinct photosensitivity, leading them to favor tinted eyewear and the cool shade of covered porches.
- **Pleiadians**: An ethereal, ancient race directly descended from the Seven Sisters who possess advanced biological technology and a deep connection to the stars. Though they have no home world, they live peacefully among the natives on most planets.
- **Nobu** (*Playable*): Small, hooded natives of Aurelion; expert scavengers and miners who hold a monopoly on the production of Fulgurite batteries.
- **Fairies**: Tiny, energetic beings like the Fire Fairies of Bells, whose biological emissions provide light and power to the pressurized depths of the ocean.

5.3 Notable Figures

There are some notable characters in the game who are heavily involved in the lore.

- **The Exarch** (*Teran*): The enigmatic leader of the Inter-Stellar Imperion (ISI) on Aurelion; he governs from the floating fortress of Apex Null.
- **Alcyone** (*Pleiadian*): One of the legendary Seven Sisters; she acts as a cosmic guide and a bridge between the ancient past and the industrial present.
- **Duchess Ornelia Victoria Reinford IX** (*Teran*): The sovereign of Torgaux whose family has overseen the city for generations.
- **President Ive Noen** (*Teran*): A figurehead leader in Hylvorn who manages the fragile social contract between the Hylvari warriors and the Terans.
- **High Sage Rulgumat Orani** (*Oresk*): A respected scholar and diplomat who translated the ancient texts found within the Pressure Gate near Bells.
- **Elcyne Jetorix** (*Teran*): A charismatic, high-ranking ISI defector currently hiding in the Amaruna Wilds, providing players with intel on the Exarch's movements.
- **Asteryn Brennorix** (*Teran*): The chief engineer behind the Aileron Gate in Torgaux; a genius obsessed with perfecting atmospheric flight.
- **Cookie** (*Reveren*): Bar maid at Mearle's in Sweetwater.
- **Skardovar** (*Hylvari*): A legendary warrior who played a vital role in the siege against Austergarde to liberate Hylvorn.
- **Maglothar** (*Hylvari*): A master tamer who oversees the Irongale Nursery, ensuring the next generation of mounts is ready for war.
- **Arduwyn** (*Hylvari*): A sharp-tongued Hylvari leader who views President Noen's diplomacy as a weakness; she constantly pushes for more aggressive taxation to fund Hylvorn's military expansion.
- **Flick** (*Fire Fairy*): A particularly bright and vocal fairy in Bells who serves as a local guide through the crushing darkness of the Midnight Zone.
- **Grozlo** (*Nobu*): The wealthiest merchant in Fulgur Gap; he manages the primary battery contracts between the Nobu and the ISI.
- **Mogway** (*Nobu*): A rebel miner who secretly smuggles raw Fulgurite to the Masons of Orizaya to aid their construction efforts.

- **Ruzz (*Nobu*):** A master technician at Zephyr Landing capable of repairing even the most damaged interstellar gunship hulls.
- **Pug (*Elf*):** A rare, city-dwelling Elf who works as a high-stakes information broker in the shadows of the Torgaux interiors.

6. The Living World

6.1 Persistent World Crafting & Decay

The world of *Aileron* is under constant entropy.

- **Masons:** Can construct Buildings, Roads, and Bridges.
- **Decay:** All physicalized objects (dropped loot and buildings) have decay timers. Loot decays in minutes; buildings, roads, and bridges decay at variable rates depending on material used. Some materials never decay (unless deliberately deconstructed by a Mason), to allow for community megaprojects that last, and the experience of ruins.
- **Resource Management:** Large-scale construction requires Stone, Steel, and Timber.

6.2 Governance & Economy

- **Bazaars:** Players can only sell items to Merchants - who can sell items to other players or to Scrappers, often for profit. If there are no bazaars, players cannot sell (except by physically trading which carries risks). There are, however, NPC vendors to buy items from in the absence of bazaars.

6.3 AI NPCs

- **Dynamic NPCs:** AI responds based on individual player reputation. Responses range from combat to fleeing or triggering world events.

6.4 Municipal Infrastructure & Activities

Major cities serve as the heartbeat of the persistent world, offering localized services that force players to travel and interact:

- **Bazaars & Localized Trade:** There are no global auction houses. Economies are localized and do not share inventory between cities. Players can buy some items from some NPC vendors, but generally rely on player-operated bazaars for selling items or finding rare goods. Bazaars can only be established by the Merchant class.
- **Crafting Vocations:** Masons, Smiths, and Harvesters can sell raw materials to NPC vendors, in the absence of a bazaar.
- **City Utilities:** Each hub contains specialized crafting stations, stables and roosts (for beasts and dragons, respectively), and localized item storage and banking. For account-wide item storage, players must use Item Vaults, and for common funds shared

amongst guilds and other organizations and conveniences, players can establish and invite members to Trusts (non-localized).

- **PvP Arenas:** Major cities host non-instanced PvP arenas. These utilize physical queues and physical world level-gating to manage entry within the shared world.
- **The Stage:** A dedicated performance space for music. Any player can equip any instrument and manually play its notes on the action bar.
- **Training:** Functional training dummies for ability testing.

7. Lore & Atmosphere

7.1 Orizaya

A colorful bio-mechanical topography where humanity clings to the remnants of a lost industrial age.

- **The Iron Siege of Hylvorn:** Perched on the frost-shattered skirts of the Kaltic Mountains, Hylvorn is a monument to thermal endurance. Once the industrial fascist dictatorship of Austergarde, it was reclaimed by the Hylvari dragonriders in a tempest of harpoons and fire. The air here is a thick slurry of coal-dust and ice, where players navigate the skeletal iron remnants of the old regime.
- **The Resonant City of Bells:** Deep within the silent, pressured depths of the midnight zone lies Bells, a sprawling metropolis of interconnected orbs that defy the crushing weight of the sea. The city does not sit in darkness; instead, it is bathed in the perpetual, flickering amber warmth of the Fire Fairies whose chattering emissions within their lantern houses pulse against the darkness of the ocean floor.
- **Torgaux: The Engine of the West:** A metropolis carved into the throat of a massive canyon. Driven by the Gale, from the frantic whirl of golden propellers to the pools of violet and ruby light filtering through stained-glass ceilings, Torgaux is a towering shadow against the orange eternal sunset.

7.2 Orizaya's Major Transit Hubs

- **Stonepiercer IV (Hylvorn):** Also known as the "Ghost Train", this industrial marvel cuts from Hylvorn through the heart of the Kaltic Mountains, terminating at Night Oak Station near Sweetwater before making its return ascent.
- **Gerizat (Hylvorn):** Additionally, a gunship route connects Hylvorn Harbor to the sky tower at Gerizat, where it departs to and from the planet Aurelion (gunships can travel a maximum of 67 million mph, or 0.1c; so a trip from Orizaya to Aurelion takes about 3 years).
- **Gello (Bells):** A massive, leather-harnessed squid-like creature attached to a transit pod. Three times per day, Gello puffs himself with hot air to float to the surface with his passengers; once clear of the water, he expands further to achieve atmospheric flight.

He docks at Sweetwater before deflating and sinking back through the Midnight Zone to Bells.

- **The Aileron Gate (Torgaux):** The towers of the Gate house twin airship terminals. The northern line docks at Austergarde Keep in central Hylvorn, while the southern line services the tropical town of Zzaba.

7.3 Aurelion

On Aurelion, the atmosphere is a hazy, orange mix of ionized gases, making the sky glow with a permanent rusty sunset hue. Because the air is so dense, massive anti-gravity structures and sleek, ominous ships are a common sight, often "docked" directly into the clouds.

- **Argauren Ranks:** The primary gateway for heavy interstellar traffic. These docks are located under a hole in the atmosphere; while exposed to dangerous radiation, ships that depart from here bypass the fuel-heavy "burn" phase usually required to escape the planet's thick atmospheric drag.
- **Apex Null:** A singular, floating black pyramid that drifts silently through the highest reaches of the atmosphere. It emits a low-frequency hum that can be felt by the inhabitants below. Inside is a military fortress and geometric, brutalist space station that hangs motionless over the planet. From its artificially intelligent command center, it coordinates the plans and movements of the massive fleets and conscripts of its Inter-Stellar Imperion who patrol the Aurelion system.
- **Fulgur Gap:** A dangerous but lucrative mining town. Built at the entrance of the deepest crystal gorge on the planet. It is known for its intense neon-purple glow that can be seen from miles away through the haze.

7.2 Aurelion's Gunship Docks

- **Launch Pad / Orbital Sky Docks (Argauren Ranks):** Heavy haulers and interstellar dreadnoughts groan under the stress of the vacuum just meters above, while the ground crews - decked in lead-lined exo-suits - scramble through the haze to finalize pre-burn sequences. It is the only place on Aurelion where the screaming of engines is drowned out by the roar of the solar winds.
- **Obsidia (Apex Null):** A hangar bay carved directly into the base of the floating black pyramid. The Gate uses a pressurized "air-curtain" rather than physical doors, allowing sleek, black Imperion interceptors to slide silently into the void. The interior is a labyrinth of cold geometry and pulsing red data-streams
- **Zephyr Landing (Fulgur Gap):** A landing pad, surrounded by the blinding neon-purple radiance of raw Fulgurite, and constantly buffeted by violent updrafts of ionized gas. The ships that frequent Fulgur Gap are often scarred and rugged, equipped with specialized grounding rods to bleed off the static electricity generated by the crystals.

Traversal: The world is contiguous and persists within a single instance. Players navigate these biomes via physics-based movement, eventually unlocking the ability to operate city transit, command high-altitude mounts, or pilot interplanetary gunships.

Time: A day on both planets is 30 hours (30 minutes real time), but Aurelion does not have a distinct day and night cycle.

8. Development Roadmap

Phase 1: Network Topology (Months 1-2)

Goal: Establish the main architecture.

- **1.1 Server-Side Core (Node.js/Socket.io/Redis)**
 - **Spatial Partitioning:**
 - **Server-Side Spatial Hash:** Implement a dynamic spatial hashing system in Node.js.
 - **Socket Room Logic:** Map zones to Socket.io rooms. Clients only subscribe to update events from their current zone.
 - **Seamless Handshake:** Logic to handle room switching without "chunk loading" stutter as players traverse zones.
 - **Authoritative Physics Loop:**
 - Implement a lightweight server-side physics engine (useCannon for custom AABB/Sphere collision).
 - **Input Validation:** Server validates move packets (velocity, position, collision) to prevent speed hacking/clipping.
 - **Database Schema (PostgreSQL & NoSQL):**
 - **PostgreSQL:** Design schemas for Users, Characters, Items, Abilities, WorldState (for persistent objects), and Inventory (JSON for complex item data).
 - **NoSQL Collections:** Implement Vaults (referenced by ID in account-wide userData), and Ledgers.
- **1.2 Client-Side Core (React-Three-Fiber)**
 - **Render Loop & Prediction:**
 - **Client-Side Spatial Hash:** Implement a dynamic spatial hashing system in React.
 - Create a level builder for easy design of zones and placement of models.
 - **Client-Side Prediction:** Reconciliation in R3F useFrame to mask latency.
 - **Character Controller:** Third-person orbit camera + Kinematic movement (WASD + Gravity). Space to jump.
 - **Asset Streaming Manager:**
 - **Model Loader:** Build a loader that dynamically fetches/unloads GLTF assets based on player distance to manage memory in a seamless world.
 - **Environment:** Dynamic audio with Audio Occlusion and Spatial Reverb; environmental VFX.
- **1.3 Prototyping**
 - **Greybox "Gerizat":** A large-scale testing zone with basic collision geometry to test the grid streaming.

Phase 2: Combat - Nodes & Armor (Months 3-6)

Goal: Build the specific "Vital Node" combat mechanic and the HUD.

- **2.1 Combat Logic (Server & Client)**
 - **Sub-Mesh Raycasting:**
 - **Client:** R3F Raycaster identifies specific bone names/meshes (Head, Chest, Arm_L, Leg_R).
 - **Server:** Validates the hit against the target's state and applies logic.
 - **Node Effects:**
 - **Head:** 1 Hit = Lethal.
 - **Torso:** Base 1 Hit lethal. Protected by Arms; each active arm adds +1 hit requirement to the Torso.
 - **Arms (L/R):** 1 Hit = Disable. Disabling an arm removes the abilities/equipment associated with that slot.
 - **Legs (L/R):** 1 Hit = Slow. 2 Hits = 2x Slow.
 - **Targeting System:**
 - **Tab/Shift+Tab:** Cycle nearest enemies.
 - **Visuals:** Target "hitbox" and crosshair for the selected sub-node.
- **2.2 The Armor-as-Health Interface (React)**
 - **Segmented Armor Bar:** Compound Armor Bar component rendering the Armor array as inline progress bars.
 - **Vulnerability State:** Visual feedback (tiny red icon above the bar) when an Armor segment reaches 0.

Phase 3: Economy, Progression & Classes (Months 7-10)

Goal: Implement horizontal progression and the Merchant-controlled economy.

- **3.1 Itemization & Abilities (Postgres/NoSQL)**
 - **Item Data:** Items utilize JSON data with references to ability IDs.
 - **Serialized Items:** Each item exists uniquely in the database in order to track the history and provenance of each item.
 - **Inventory Logic:** Logic and UI for game inventory. Derived from each players' Inventory Ledger (NoSQL). Update the Ledger and the player's Inventory state (ownership snapshot) on item transfer.
 - **Actionbar Logic:** Logic and UI to equip gear and fetch associated abilities to the client, dynamically populating the action bar and updating player state.
 - **Crafting:**
 - **Card Forge:** Logic and UI to generate "Cards" at Card Forges based on item or exploration (location) and relic (item) triggers.
 - **Black/Goldsmith Forge:** Logic and UI to generate items at Forges based on material requirements.
 - **Alchemy Lab:** Logic and UI to generate items at Labs based on material requirements.

- **3.2 Player Economy (Part 1: Revenues)**
 - **Merchant Bazaars:** Bazaar creation UX and persistence logic (bazaar remains even if player logs off).
 - **Investment & Transaction:** Merchants can "invest" funds of a certain budget, or "hire" NPCs to set prices and scrap items (depositing earnings automatically).
 - **Scrap System:** NPCs that Merchants can sell to.
- **3.3 Base Classes**
 - **Architecture:** Implement the 8 Base Classes and the logic for upgrading to Advanced and Vocational tiers (stat requirements + item checks).

Phase 4: Governance & Entropy (Months 11-13)

Goal: Enable Masons to build and the world to decay.

- **4.1 Construction & Decay**
 - **Masonry System:**
 - **Client:** "Ghost" placement tool for structures (Roads, Buildings, Bridges).
 - **Server:** Validate placement (collision check).
 - **The Entropy Engine:**
 - **Decay Cron:** A scheduled job (Redis/Node) that decays world objects.
 - **Logic:** Variable Decay - rate depends on item or material quality (e.g. { decay: 10 })
- **4.2 World Building**
 - **Construction Flow:** Build phases and cooldowns are defined in blueprints (JSON).
- **4.3 Immersion**
 - **Stages & Playing Music:** Low-latency socket broadcasting for musical notes mapped to action bar.
 - **Meteorological Cycles:** Location of sun/lighting and randomized weather.

Phase 5: Environments, AI & Traversal Mastery (Months 14-17)

Goal: Build the biomes and complex traversal.

- **5.1 Biome Specifics**
 - **Torgaux:** Verticality logic (elevators) and optimized culling.
 - **Bells (Underwater):** Shaders for underwater distortion and luminescence.
- **5.2 AI & Reputation**
 - **Dynamic AI:** SocialAction types and Reputation Ledger to determine NPC response on aggro/interaction.
 - **Social Action Types:** PersonalFame, PersonalVerbal, PersonalPhysical, PersonalGift (e.g. PersonalVerbal with positive value represents "kind words", PersonalGift with negative value represents "stealing"). Scaling penalties when used on the same target.

- **Social Action Labels (Earned):** Famous, Infamous, Friendly, Unfriendly, Savior, PlayerKiller, Generous, Thief. Earning all labels also grants: Veteran. (only one visible at a time)
 - **AI Reasoning:** Vector analysis of Reputation Ledger, Labels, and SocialActions to determine NPC responses (e.g. Friendly/Low Verbal vs Friendly/High Verbal, etc.)
 - **AI Response Types:** null, Dialog, NPCAction, PlayerEvent, GameEvent.
 - **AI Dialog:** Scoped text-to-text LLM interaction (RAG).
- **5.3 Travel**
 - **Dynamic Parenting:** Implementation for player physics to parent to ground mounts and moving platforms.
 - **Global Transit & Planetary Flight:** Parenting player physics to transit; flight physics with gravity scales and high-altitude velocity dampening.
 - **Deep Space Physics Module:**
 - **Sky Transition:** Logic to transition from terrestrial skyboxed terrain to space scenes featuring giant planetary models.
 - **Space Flight:** Transition physics to handle zero-gravity/"high-speed" space flight.

Phase 6: Content Pop, Polishing & Alpha (Months 18-22)

Goal: Fill the map and stress test.

- **6.1 Zone Rollout (North to South)**
 - **Northern:** Hylvorn, Frostscorn (Ice shaders/physics).
 - **Central:** Sweetwater, Bells (Water physics).
 - **Southern:** Torgaux, Vijbidar Desert (Sand storms, Heat haze).
- **6.2 Optimization & Stress Tests**
 - **Bot Swarms:** Simulate 500-1000 headless clients to tune Socket.io performance and binary packing.
 - **Load Balancing:** Move physics/AI processing to Node.js worker threads.

Phase 7: Additional Immersion & Beta (Months 23-24+)

Goal: Finalize world immersion and implement beta feedback.

- **Lesser Towns:** Add the towns of Galespind, Sweetwater, Zzaba, and Lost Pines.
- **Full World Map Completion (North-to-South):**
 - **Orizaya (North):** Gerizat, Hylvorn Harbor, Hylvorn, Frozen Wastes, The Frostscorn, Three Rivers, Gnarlign Spire, Sweetwater, The Pressure Gate, Bells, The Library, The Floor, Natural Salt Mines.
 - **Orizaya (South):** Orloum Fields, Amaruna Wilds, Galespind, Irongale Nursery, Torgaux, Five Terrors, Vijbidar Desert, Zzaba, Lost Pines, The Remnant, Lost Cavern.
 - **Aurelion:** Argaueren Ranks, Apex Null, Fulgur Gap, Chasma Tharsus.

- **Balance:** Final adjustments to items and mechanics based on player feedback and Alpha data.