



At-a-Glance

Aether Engine is a spatial simulation application built on Hadean. It scales across different processors and physical machines, utilising more computing power as the simulations grow in complexity and size.

FEATURES

- ✓ Scale invariance
- ✓ Unlimited connections
- ✓ Single sharded worlds
- ✓ Dynamic scaling
- ✓ Cloud-native simulation
- ✓ Low-latency simulation
- ✓ Technology agnostic
- ✓ User-friendly SDK

About Hadean

The Hadean Platform implements a unique process model that transforms the performance, reliability and scalability of cloud computing. It underpins a number of libraries that solve intractable distributed problems, instilling a set of core properties that allows them to run at massive scale. These libraries act as an interface for developers looking to build out complex, high-performance applications across a distributed cloud and edge network.

“Hadean’s technology has the potential to unlock huge creative and design-orientated freedom within virtual worlds.”

– Hilmar V. Pétursson, Chief Executive Officer, CCP Games

Create Simulations of Unprecedented Scale

Simulations are currently constrained by a lack of processing power, which limits scale, complexity and fidelity, as well as restricting the number of connections. Overloading a simulation with too many computationally intensive activities will cause it to slow and eventually crash. In sectors such as online gaming, military training, and virtual events this is unacceptable - speed, reliability and user experience are all vital components of the simulation.

Typically, it forces developers and architects to trade off the scale of their simulations in exchange for the seamlessness of experience. Aether Engine, however, breaks this paradigm and dynamically scales to meet the computational demand, whether that’s an influx of connections, simulating millions of entities or adapting to changes in real-time data. The initial vision of a project can be fully realised and vast immersive worlds can be brought to life without fear of overwhelming the simulation, or the spiralling costs typically associated with over-provisioned architectures.

Key Benefits

Performance at Scale

Aether Engine is scale invariant and provides the computing power to guarantee performance and reliability in simulations involving vast numbers of entities. Resources are dynamically distributed, with Aether Engine allocating more cores to areas of high compute density and spinning up (and down) new machines on demand. Its model drastically improves the speed, scalability and reliability of cloud computing systems, enabling persistent states, complex physics, increasingly sophisticated artificial intelligence and unprecedented scale.

Unlimited Connection and User Counts

Current technology limits the number of connected users to 100-200 - any more and the server is likely to crash. Even when the networking topology can support greater connections, current computing models mean the CPU is unable to scale to meet increased demands. Current solutions require sharding worlds and running self contained simulations with a finite number of connections. Aether Engine by contrast provides a single global simulation and uses a distributed network layer to enable unlimited connections from across the world to join a persistent simulation.

Optimised Resource Allocation

Automatic allocation and deallocation of resources eliminates the threat of under/over provisioning. The large upfront cost of the server backend for one-off or seasonal events is eliminated making large one off virtual world events viable.

Rapid Development and Testing Cycles

By eliminating excessive middleware, orchestration and overengineering, developers can build, ship and scale their applications quickly and effectively. Code behaves the same locally as it does when deployed to the cloud, enabling faster iteration times and removing the need for specialist cloud infrastructure expertise.

How it Works

Spatial Simulation Optimisation

Entity based simulations can sometimes run into $O(N^2)$ complexity, resulting in inefficient, hard-to-scale systems. Aether Engine helps mitigate this with APIs that get to $O(N \log N)$ complexity and by seamlessly distributing the computation across cores and machines. This allows simulations to dramatically scale up the number of interacting entities and players.

Distributed Load Balancing

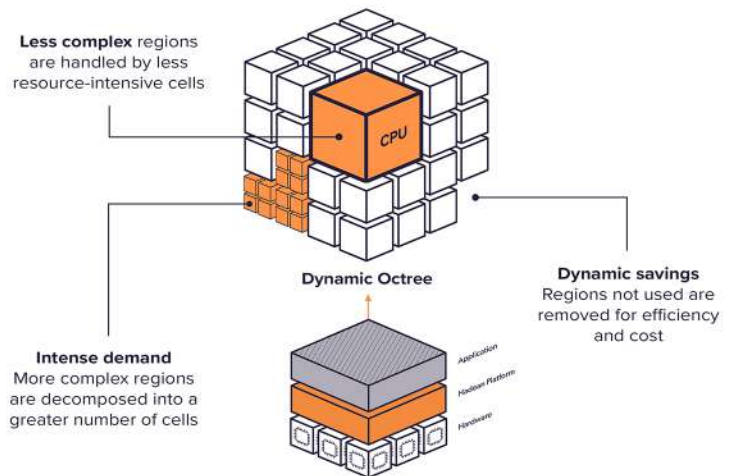
The density of entities affects computational load on a particular area and can cause a simulation to slow or crash. Aether Engine uses a lightweight distributed octree structure to repartition space and balance load across CPUs, decomposing more complex regions into a greater number of cells. It enables simulations to dynamically grow (or shrink) as required, ensuring they are fully optimised and unconstrained by processing power.

Entity Component System

An entity component system manages the data associated with entities and the functionality that updates them. It separates data from logic, and makes explicit the dependencies between systems and components, ensuring code be distributed across multiple cores.

Technology Agnostic

The Aether Engine enables integrations with a number of libraries, including Physx, EnTT and Recast/Detour. It also provides a deep integration with client engines such as Unity and Unreal.



A distributed octree data structure

Bandwidth Optimisation

Bandwidth usage is dramatically reduced (by up to 98% in real at-scale runs) with our net-relevancy (interest management) algorithm. The algorithm will reduce frequency for entities based on distance, with close entities being sent frequently and further entities less frequently. The muxer improves latency by placing machines in edge datacenters, connected via backbone datacenter links, to reduce latency and jitter.

Asynchronous Architecture

Asynchronous I/O enables parallelised computation, all on a single thread. Multiple connections are handled simultaneously, while data ingestion is considerably faster.

Practical Applications

MMOs

Aether Engine provides the power and scalability to create new games of immeasurable complexity and detail. Vast immersive worlds will be brought to life by high-fidelity landscapes, characters and cities, and underpinned by true to life physics that directly impacts gameplay. In terms of scope, player numbers, and increasingly sophisticated AI, the scale of these games is boundless.

Single Synthetic Environments

Aether Engine can power thousands of AI behaviour trees and stream vast quantities of external data in near-real time to create high-fidelity simulations. It enables highly realistic simulated worlds, built on an array of data, including geospatial information, 3D environments and real-time weather systems. Scenarios can be played out ahead of time, providing advanced insight into planning strategies, including the design of smart cities, defence planning, and epidemic and disaster management.

Virtual Events

Aether Engine removes design constraints and allows hundreds of thousands of users all on a single shard, without prohibitive infrastructure costs. It provides a framework for easily deploying virtual events with a greater deal of scale and immersion, creating a truly global experience that transforms the way we communicate, learn and interact.