



## 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.



**AETHER  
ENGINE**

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.



**MUXER**

Aether Engine includes a component called Muxer, which provides low-latency, bidirectional, mass scale information streaming between simulation and

**“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

## Virtual Worlds

Global connectivity has seen the rapid growth of virtual worlds from social networks, through to digital concerts, and of course, MMOs. Originating with video games, the applications of virtual worlds are rapidly expanding into other fields, including education, medicine, events and military training. They are transforming the way we communicate, learn and interact.

The global shift to remote working has only accelerated the need to create and deliver world class virtual experiences. But these environments all require a vast number of connections, often across distributed geographies. At the same time, users expect these virtual worlds to be as detailed as possible and desire a more immersive and realistic experience.

Currently, development is held back by the inability to efficiently maximise resources and harness cloud computing. Developers have been left searching for a way to improve the speed, scalability and reliability of distributed systems, and overcome the restrictions current infrastructure imposes on virtual worlds, including limited user counts, and a lack of rich interactions.

## Key Challenges

### Limited Connections

Virtual world’s employ the same technology as MMO games, which limits the number of connected users to 100-200 - any more and the server is likely to crash. These worlds also demand rich social interactions, resulting in extremely high, and oftentimes unachievable, network messages per second. It inhibits the scope of the world and denies the opportunity of turning a virtual world into a truly social platform.

### Poor User Experience

Latency, crashes, and anything less than a seamless experience is unacceptable and will affect the likelihood of users returning.

### Lack of Depth and Realism

Sophisticated artificial intelligence, high-fidelity and complex physics are all computationally intensive and therefore limited in their use, stunting the creative vision of designers.

### Inefficient Use of Data

At the moment it is impossible to replicate small localised simulations on a global scale, combining the millions of entities with real-world, real-time data. Virtual worlds that intend to mimic reality by feeding data from IoT devices are unable to do so.

### Complexity of Configuration

Tracking a large number of entities and their interactions across complex environments, requires enormous investment in both specialist engineers, as well as cloud resources to configure and manage the simulations. If that investment isn’t made, the user experience is poor; if it is made, it increases long-term costs.

## Aether Engine and Virtual Worlds

Aether Engine creates large complex worlds that sit outside the confines of limited connections, entity counts and realism. It uses a distributed octree data structure to dynamically partition physical simulations, providing additional computing power to complex regions and enabling unprecedented levels of scale and fidelity.

### Features

#### Muxer

Running in edge datacentres and operating an asynchronous architecture, a content delivery network opens up virtual worlds to hundreds of thousands of connected clients to monitor, view and interact with in real-time.

#### Interest Management (Muxer)

Bandwidth usage is optimised through a netcode implementation which ensures a near real-time simulation irrespective of where someone is located. This means people on different sides of the world can engage with one another in almost real-time.

#### Distributed Octree

Underpinned by Hadean's distributed process model, the distributed octree allows the simulation to dynamically grow and shrink across the cloud and run at higher fidelity as needed. Virtual worlds are not constrained by computing power, making it possible to introduce new levels of complexity and realism.

#### Entity Component System

An entity component system model separates data from logic, and makes explicit the dependencies, ensuring code is distributed across multiple cores. It means that different components of any given entity within the virtual world can be simulated in parallel.

#### Technology Agnostic

Integrated with popular game engines (inc. UE4 & Unity) and 3rd party SDKs to fit into an existing workflow. Aether Engine's plugin based architecture is very flexible supporting PhysX, EnTT and Recast/Detour amongst others.

#### Cloud-Native

Code behaves the same locally as it does on the cloud, eliminating the need for specialist knowledge and expertise, and reducing overhead.

### Benefits

#### Over 10k Concurrent Users

Create and support events with hundreds and thousands of concurrent users from across the world. A single global shard allows anyone to join at unrestricted scale. It eliminates design constraints around users per room and enables rich social interactions.

#### Low Latency Simulations

Leveraging connections between distributed data centres, Aether Engine enables virtual worlds to run at a predictable, low latency.

#### Scale Invariance

Performance and reliability at scale, even in worlds involving the simulation of billions of entities.

#### Increased Realism

Dramatically increased processing power also introduces a realism previously considered impossible, including intelligent pathfinding, accurate physics and high-fidelity cityscapes.

#### Perennial Worlds

Persistence allows you to operate perennial virtual worlds, as well as seasonal events. The near limitless storage available ensures that everything that is part of a world can exist ad infinitum.

#### Reduced Total Cost of Ownership

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.

#### Simplified World Building

Lifting the technical and financial restrictions of DevOps environments, the focus of developers will shift to the creating and designing worlds rather than managing and maintaining complex toolchains and cloud servers.



### Find out more

Download The Hadean Architecture whitepaper and discover a new approach to the creation of immersive virtual worlds.

<https://hadean.com/project/the-hadean-architecture-whitepaper/>