

Large Scale Sim/Game Framework
Hadean, SpatialOS and GameBus

Hadean

- One of the founding members of O3DE
- Rust-based software development kit (SDK)
- Spatial simulation, gaming

Hadean Join O3DE Project as Founding Members

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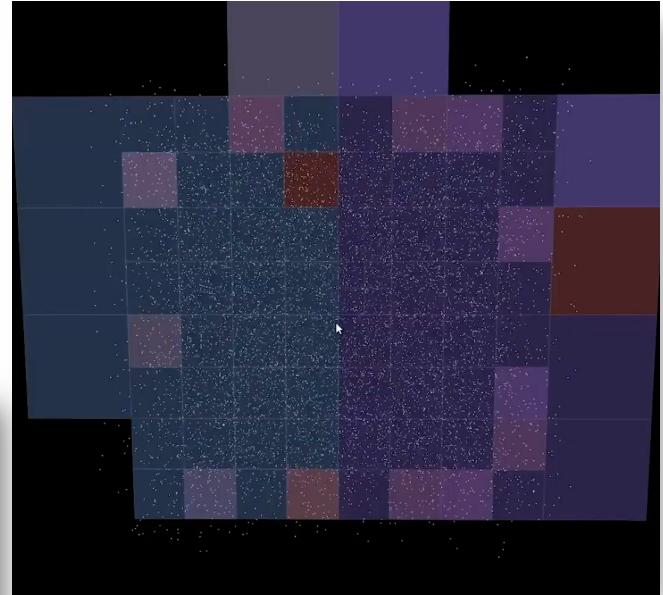
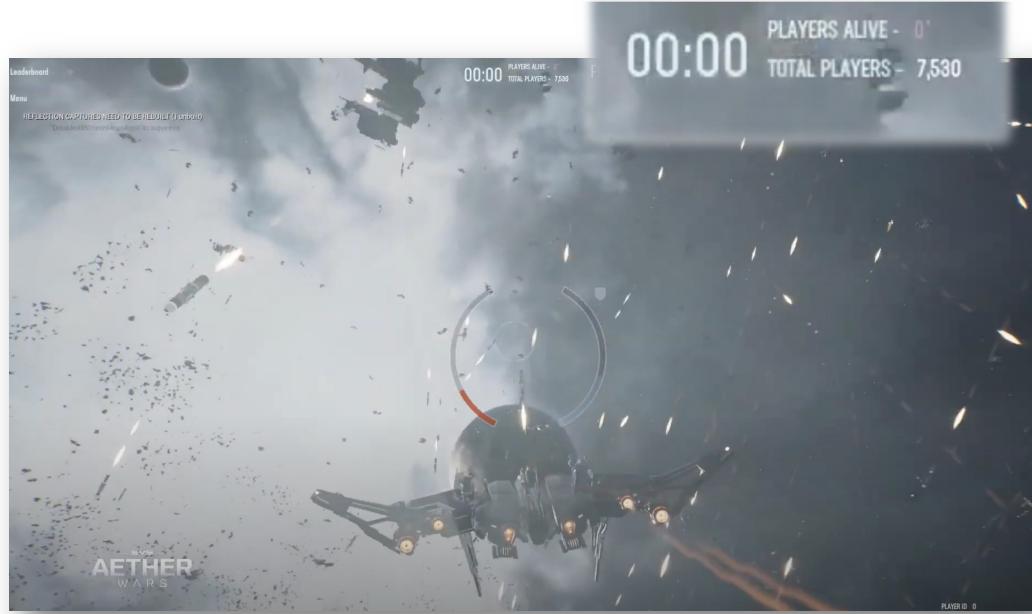
LONDON, July 6, 2021 /PRNewswire/ -- Hadean, the distributed computing start-up, are delighted to announce that they will join as founding members of the Open 3D Engine (O3DE) Project. The Linux Foundation's collaborative project will allow for an open and empowered community, to which Hadean will bring experience in delivering massive scale and immersive game worlds.

The O3DE project is based on the AWS Lumberyard game engine - under the permissive Apache 2.0 license. It is the first engine to be integrated with cloud services to allow developers to independently host their games, perform simulations as well as provide support for live streaming via Twitch and other services. Developers will find a comprehensive suite of tools to build the most realistic 3D worlds, AAA games, and simulations. Other major components of the 3D Engine include an editor, best in class Vulkan/DirectX 12/Metal based PBR renderer, animation and integrated packaging and asset pipeline system. Developers will find the flexibility in designing code with visual scripting, C++, LUA, and Python language support, along with full cloud, multiplayer network stack, and cross-platform support for Mobile and PC devices.



Hadean

- Spatial simulation, gaming



[Link](#)

Hadean vs K8s

- **Distributed system (e.g. K8s)**

- Performance: latency, throughput, etc.
- Scalability
- Reliability

- **HPC**

- Performance (GFlop/s)
- “As little barrier as possible between application and hardware”

Hadean chief technology officer and co-founder [Aidan Hobson-Sayers](#) admits that the value proposition may sound familiar, but Hadean takes it and adds on a bit of something else: supercomputing.

“Really, it’s about trying to take some of the good parts of Kubernetes, which is the kind of the elephant in the marketplace, the number one thing that everyone uses, but identifying some of the limitations of that, and combining it with some of our learning from other technologies,” said Hobson-Sayers. “The supercomputing space has a whole set of tools and ways of writing applications that allows you to create very powerful applications like weather simulations, and so on, that you wouldn’t really run on Kubernetes. What we’ve said is, what if we could take the good parts of Kubernetes, the good parts of supercomputing, and bring them together, allowing you to write these very high performance, large scale applications on the cloud?”

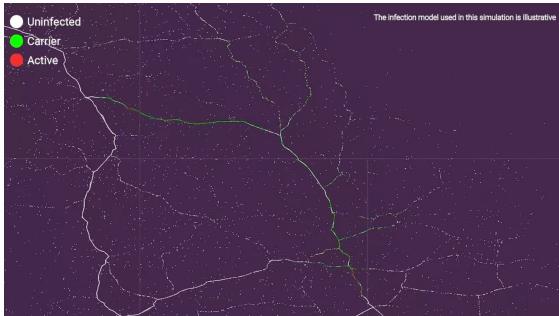
[Link](#)

Hadean for HPC

- Supercomputing/HPC

- Performance (GFlop/s)

- Simulation
 - Weather
 - Weapon
 - SARS-CoV-2



[link](#)

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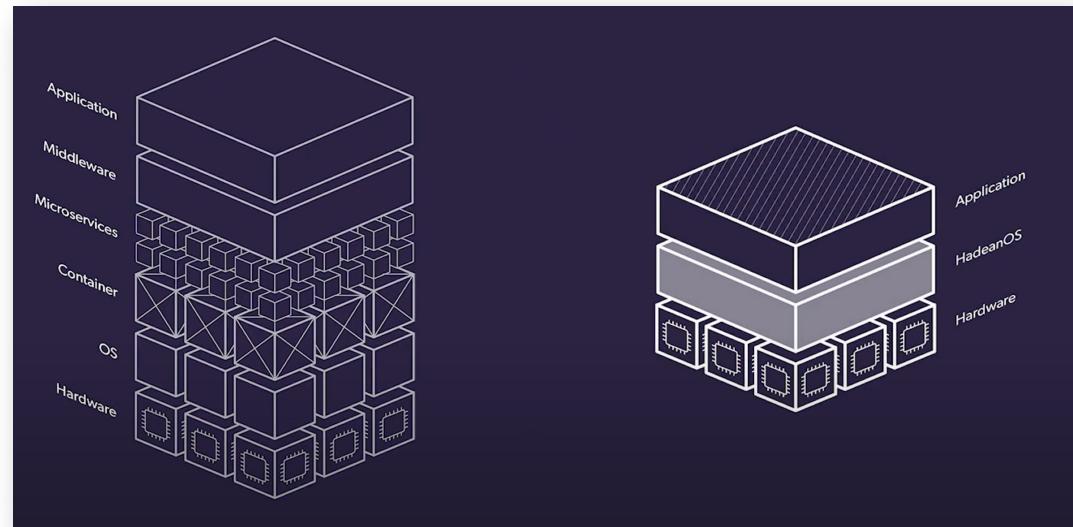
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Rank	System	Cores	Rmax (TFlop/s)	Rpeak (TFlop/s)	Power (kW)
1	Supercomputer Fugaku - Supercomputer Fugaku, A64FX 48C 2.2GHz, Tofu interconnect D, Fujitsu RIKEN Center for Computational Science Japan	7,630,848	442,010.0	537,212.0	29,899
2	Summit - IBM Power System AC922, IBM POWER9 22C 3.07GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband, IBM DOE/SC/Oak Ridge National Laboratory United States	2,414,592	148,600.0	200,794.9	10,096
3	Sierra - IBM Power System AC922, IBM POWER9 22C 3.1GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband, IBM / NVIDIA / Mellanox DOE/NNSA/LLNL United States	1,572,480	94,640.0	125,712.0	7,438
4	Sunway TaihuLight - Sunway MPP, Sunway SW26010 260C 1.45GHz, Sunway, NRCPC National Supercomputing Center in Wuxi China	10,649,600	93,014.6	125,435.9	15,371
5	Perlmutter - HPE Cray EX235n, AMD EPYC 7763 64C 2.45GHz, NVIDIA A100 5XM4 40 GB, Slingshot-10, HPE DOE/SC/RL/NERSC	761,856	70,870.0	93,750.0	2,589

[2021 top 500](#)

Hadean vs K8s

“As little barrier as possible between application and hardware”



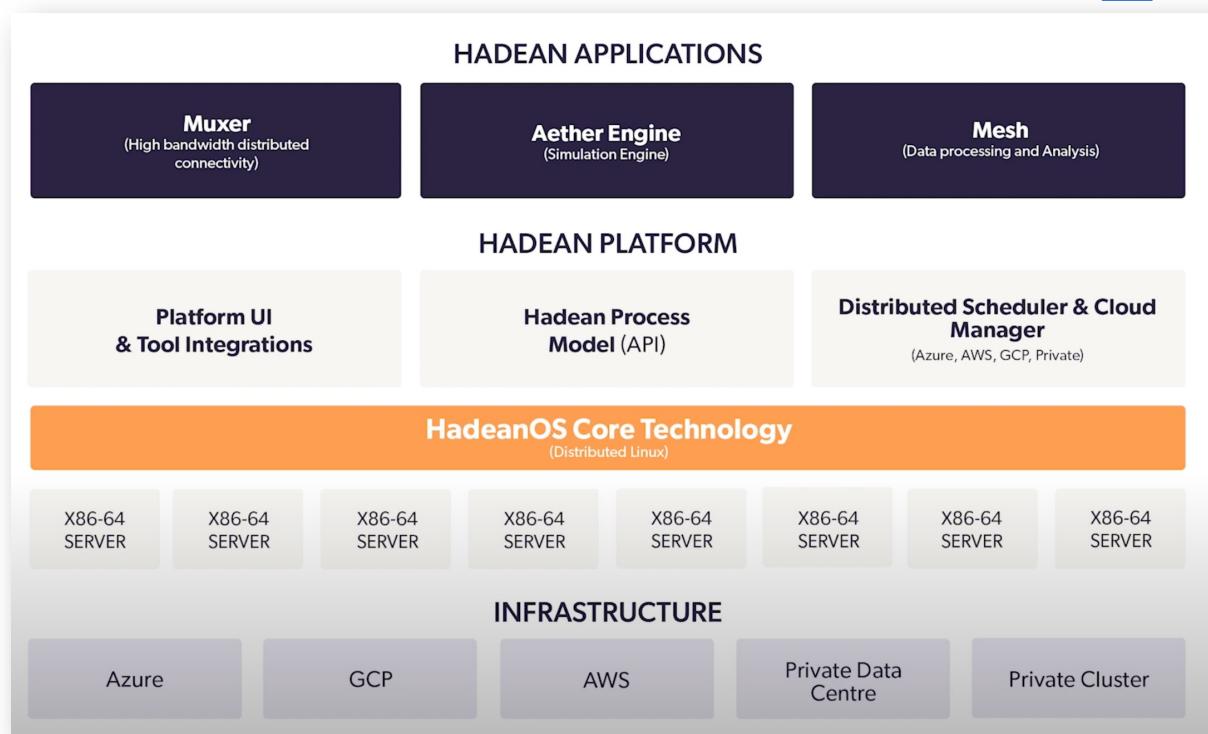
But can you be cloud native too?

“Building the **next generation of leading edge HPC systems** will require rethinking many fundamentals and historical approaches by embracing end-to-end co-design; custom hardware configurations and packaging; large-scale prototyping, as was common thirty years ago; and **collaborative partnerships with** the dominant computing ecosystem companies, smartphone and **cloud computing vendors.**”

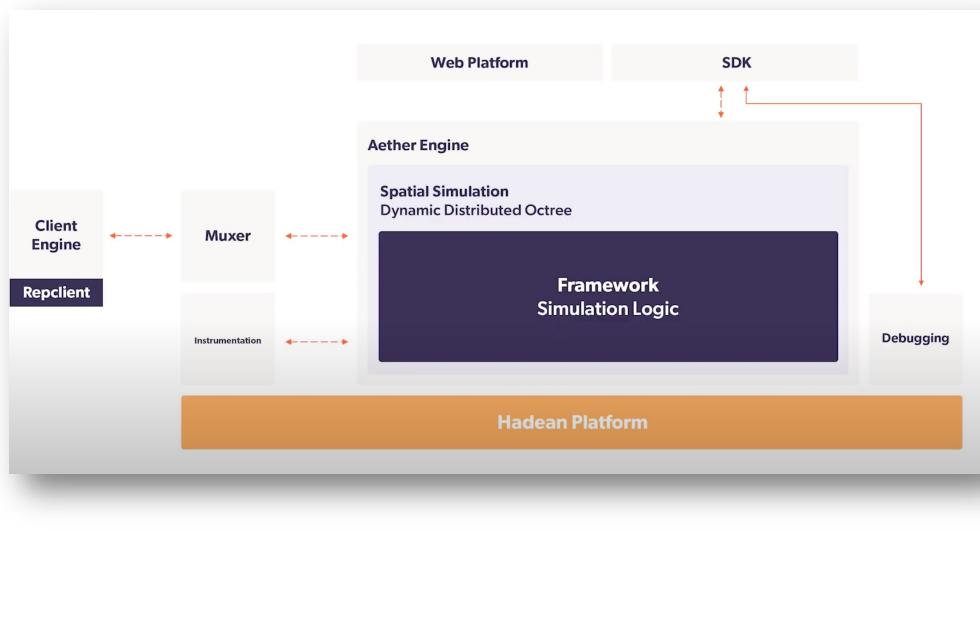
TITLE	Reinventing High Performance Computing: Challenges and Opportunities
PUBLICATION TYPE	Report
YEAR OF PUBLICATION	2022
AUTHORS	Reed, D., D. Gannon, and J. Dongarra
SERIES TITLE	ICL Report
DOCUMENT NUMBER	ICL-UT-22-03

Hadean Architecture

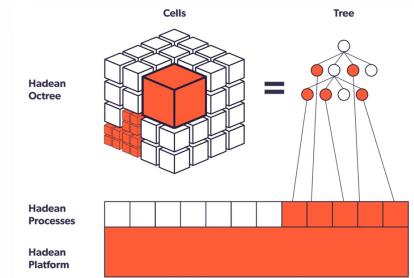
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Aether Engine (for Spatial Sim)



Spatial Simulation Management
To manage its simulation, the framework utilises a distributed octree data structure. As more entities condense into a single spot, the octree data structure is used to repartition space to balance load across CPUs. More complex regions are decomposed into a greater number of cells, while less complex regions are handled by fewer cells.



Muxer

As a **standalone library**, Muxer **connects** vast numbers of disparate **clients** across a distributed cloud and edge **network**.

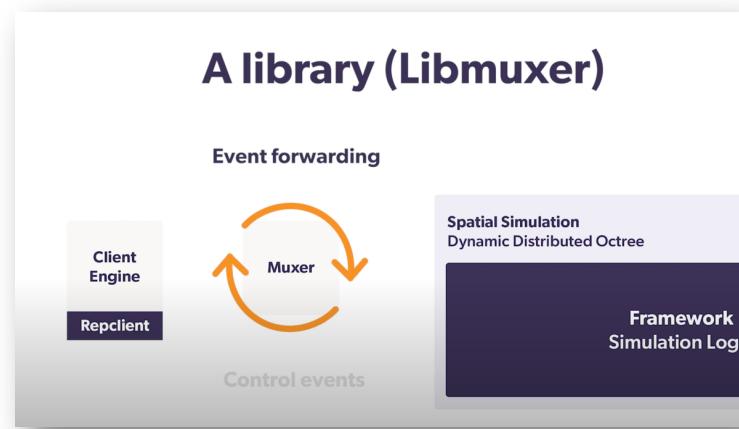


Edge servers

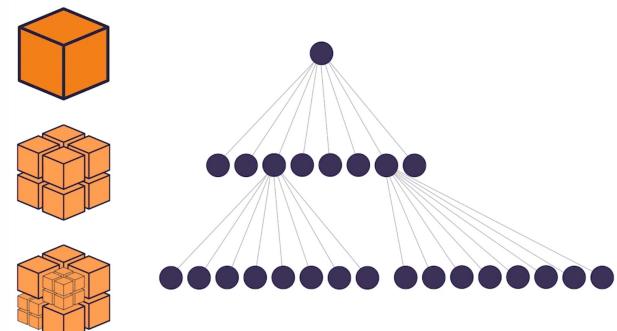


Muxer

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Interest management (Network Relevancy)



Hadean Distributed Process Model

A Distributed Process Model

Unlike existing operating systems, Hadean treats distributed computing as a first-class concern, underpinning all applications with a set of core properties. It uses a hybrid approach to its design, providing a full distributed computing environment as a native feature within Linux. The model integrates with other technologies consistent with the properties Hadean holds as essential for effortless scaling.

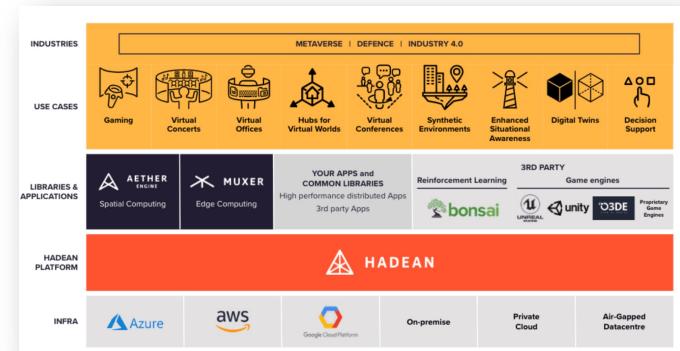
The implementation of the platform is referred to as the Hadean Process Model and instils the following capabilities:

- **Core distributed resource allocation and distributed IPC in the systems layer**
- **Strong process and resource isolation**
- **Distributed operating system scheduling**
- **Dynamic scale at run-time**

For example, take a twenty line program executing a series of functions on a dataset. It could run on a single server when operating on a small dataset, but through the process of program execution, if the computation becomes too large, it may scale up at runtime to a 100 servers in order to compute the task.

Hadean Platform (PAAS)

HADEAN
PLATFORM

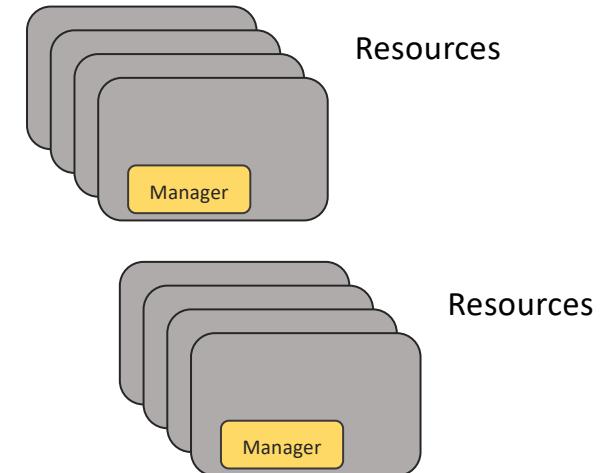


User
Code

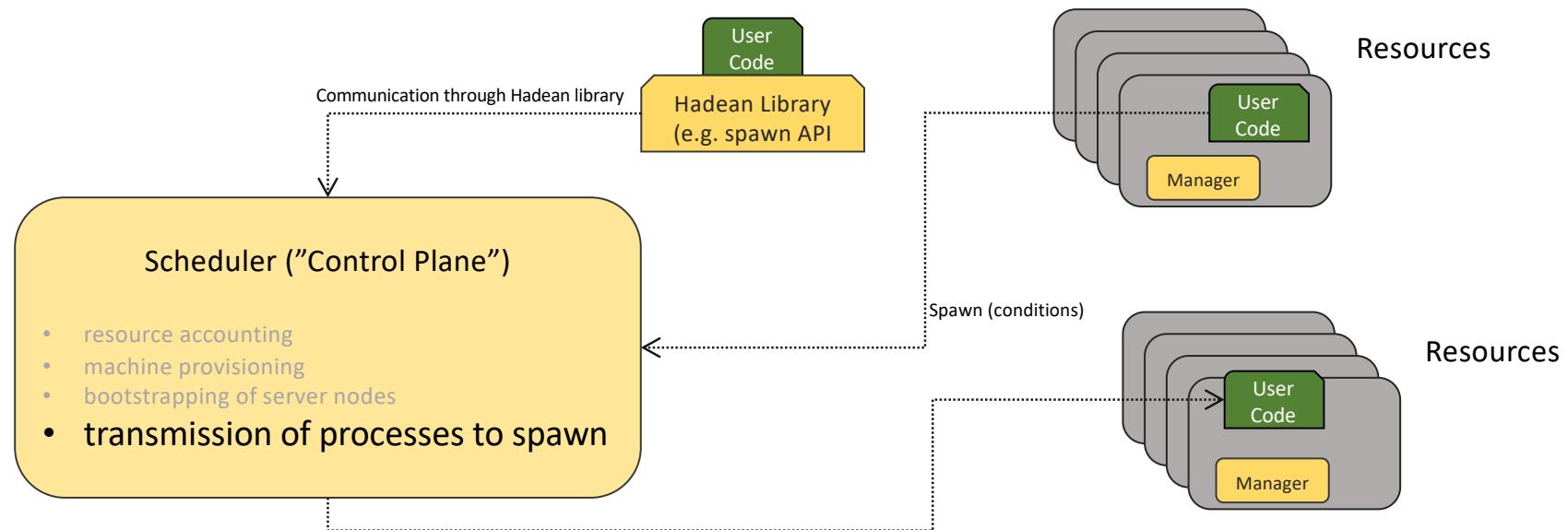
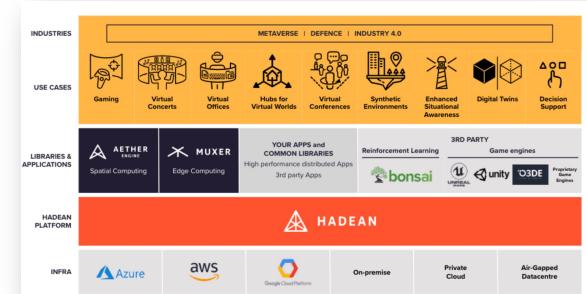
Hadean Library
(e.g. spawn API)

Scheduler

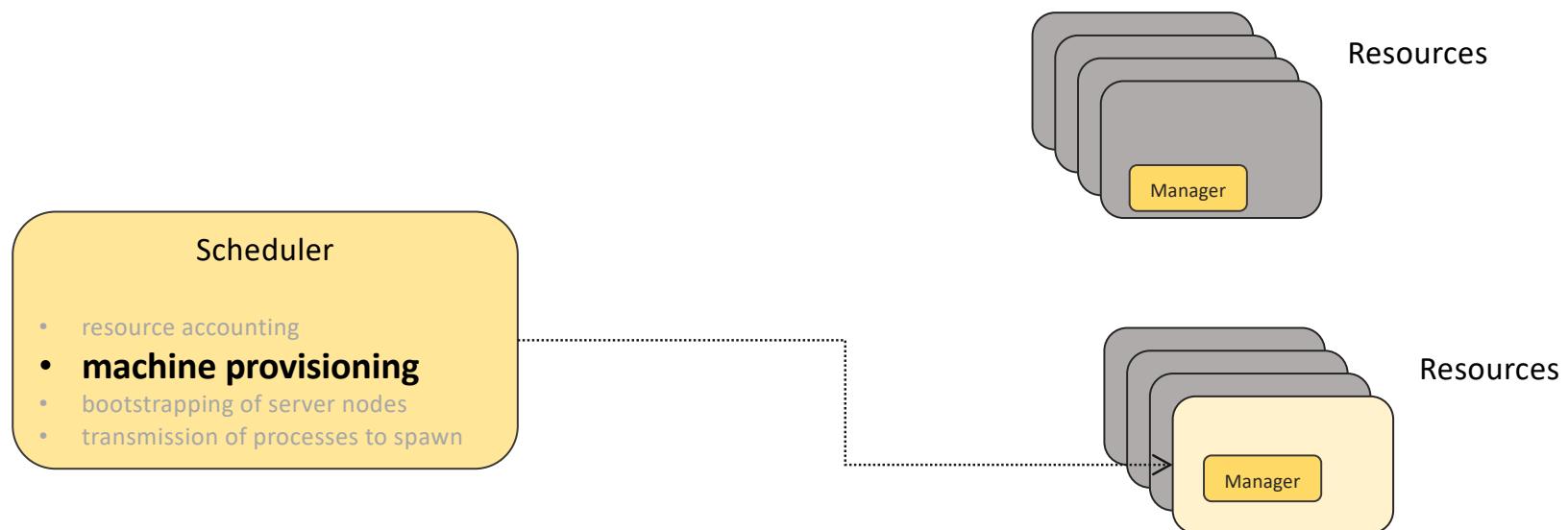
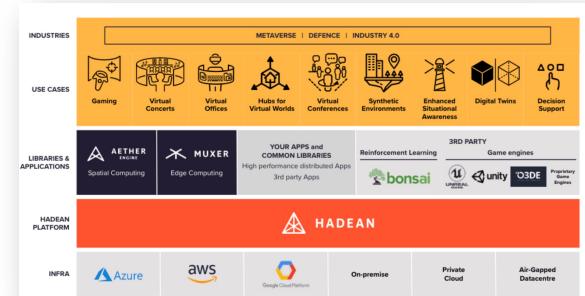
- resource accounting
- machine provisioning
- bootstrapping of server nodes
- transmission of processes to spawn



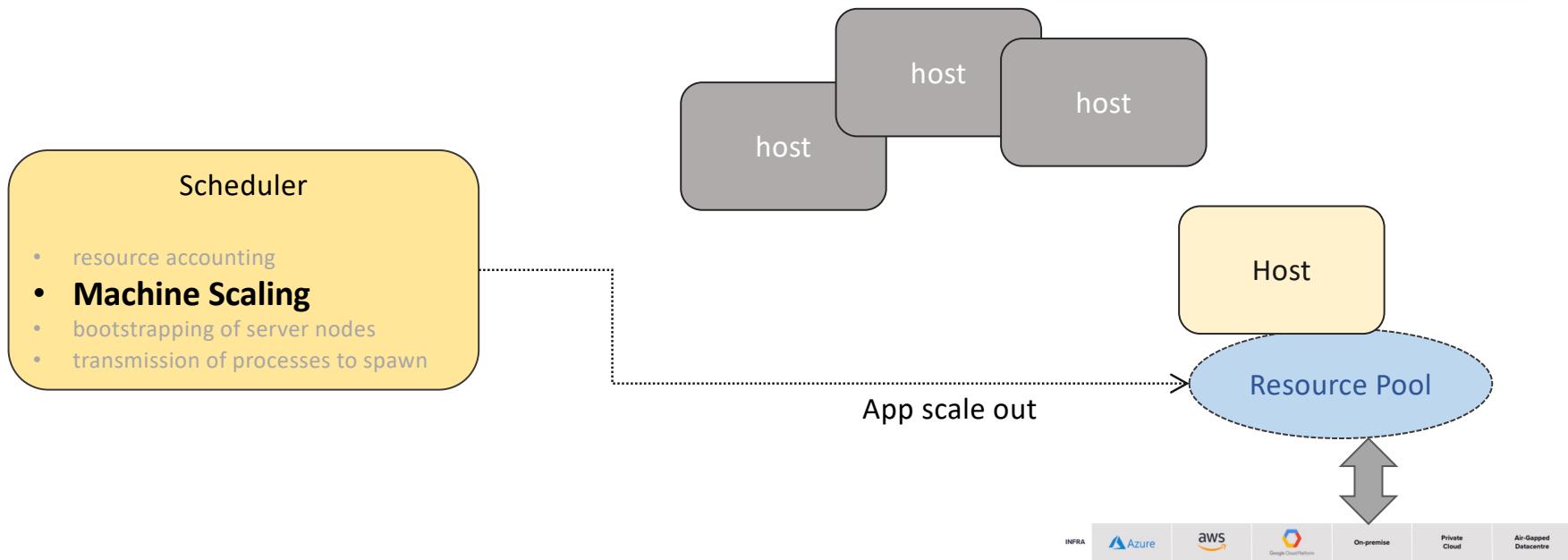
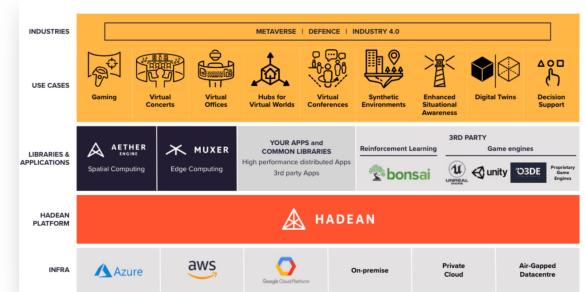
Hadean Platform (PAAS)



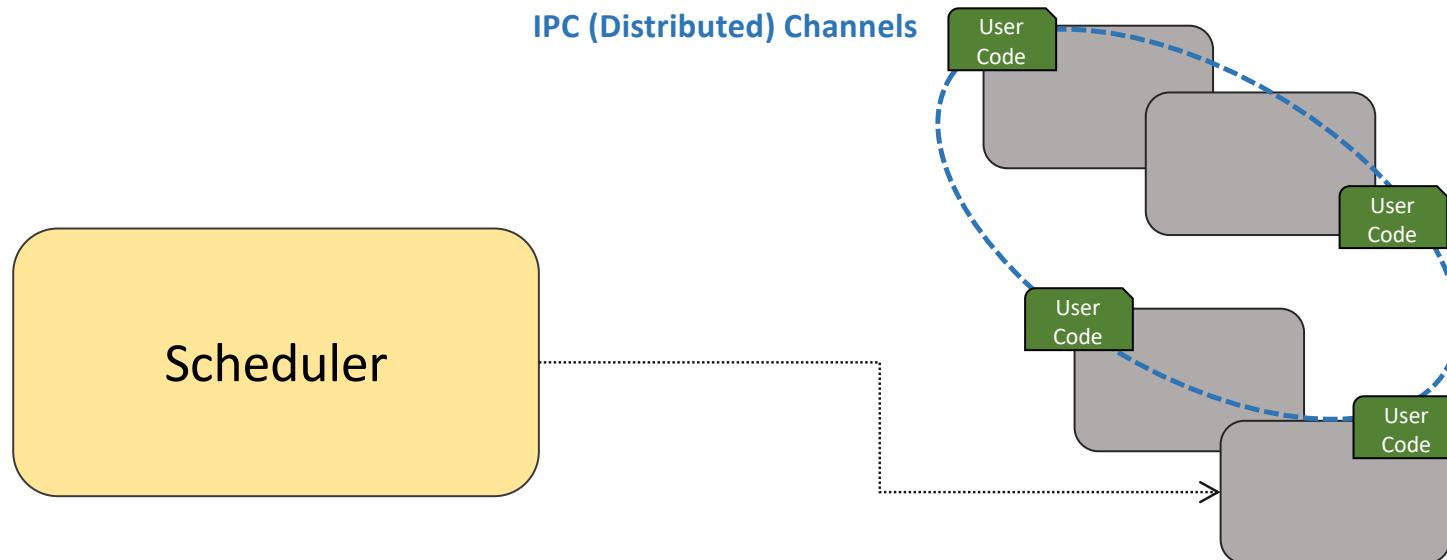
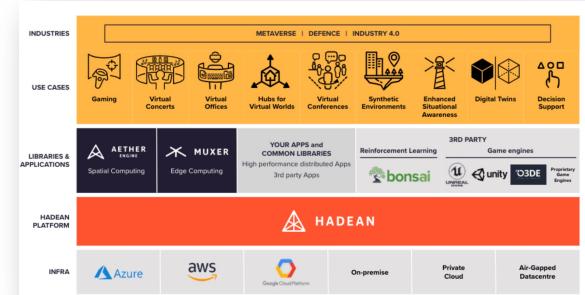
Hadean Platform (PAAS)



Hadean Platform (PAAS)



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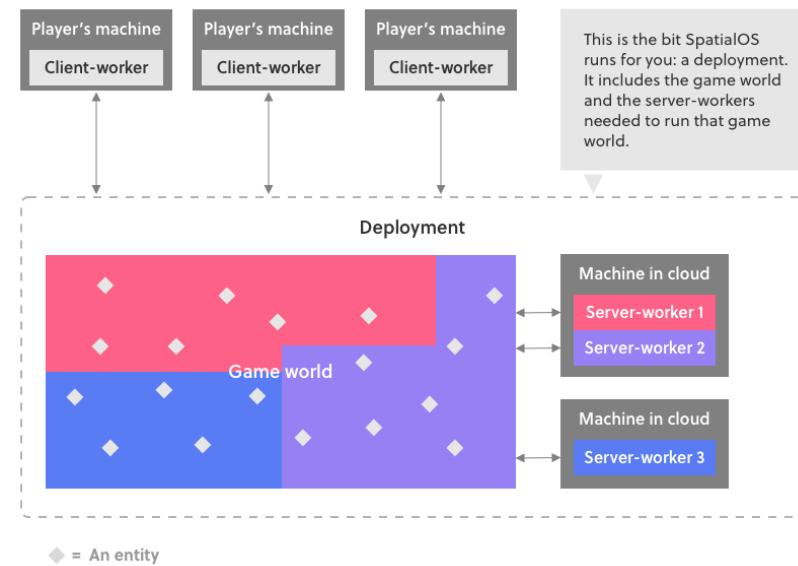
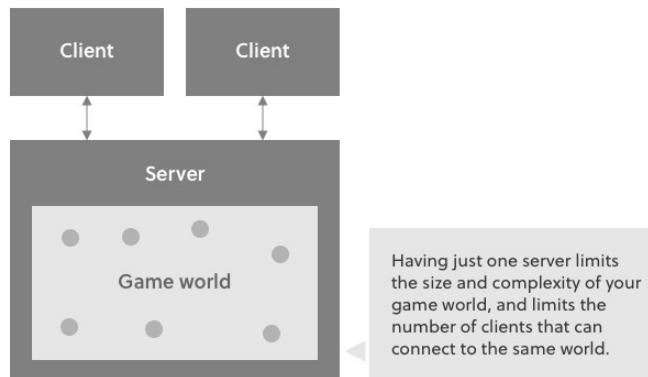


SpatialOS

SpatialOS enables game creators to build **rich, large-scale multiplayer experiences** where hundreds or even thousands of players can play together in new and dynamic virtual worlds.



SpatialOS



[link](#)

SpatialOS

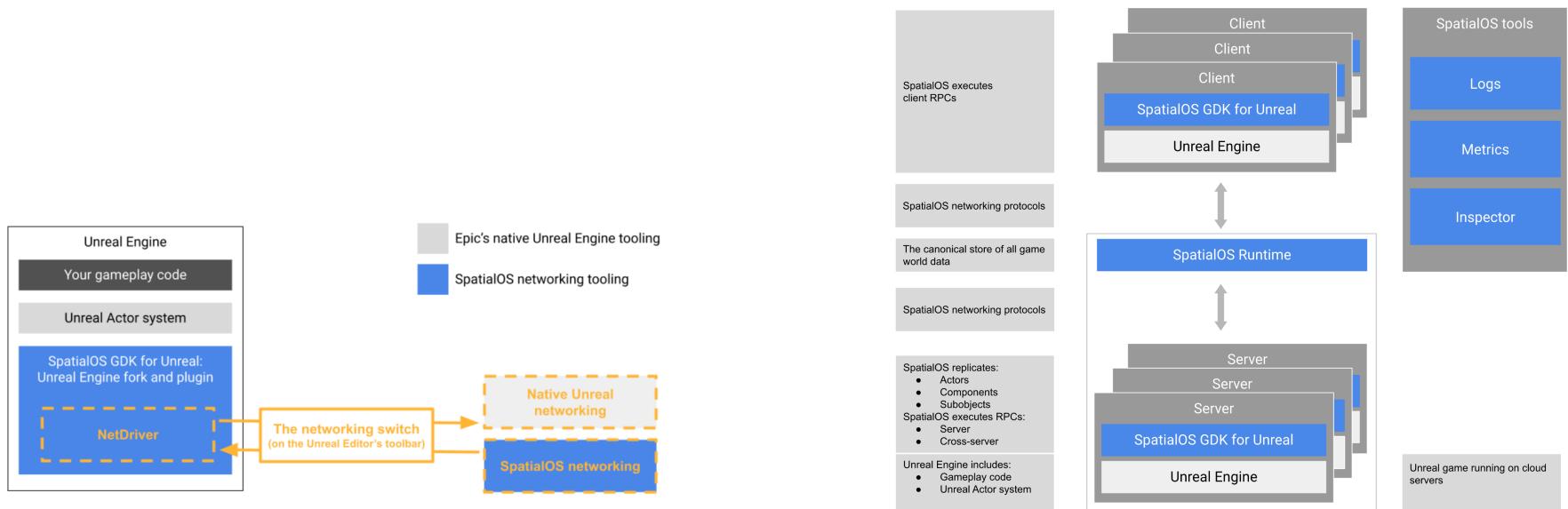


Image: Architecture of a game developed with the SpatialOS GDK for Unreal.

SpatialOS

Advanced AI is a good candidate for offloading as it is computationally expensive but can be latency-tolerant, leaving your game's out-of-the-box main Unreal server to run other game systems at a larger scale.

The SpatialOS Runtime co-ordinates both servers. It handles server and client connections, and co-ordinates each server and client's write and read access to the entity database.

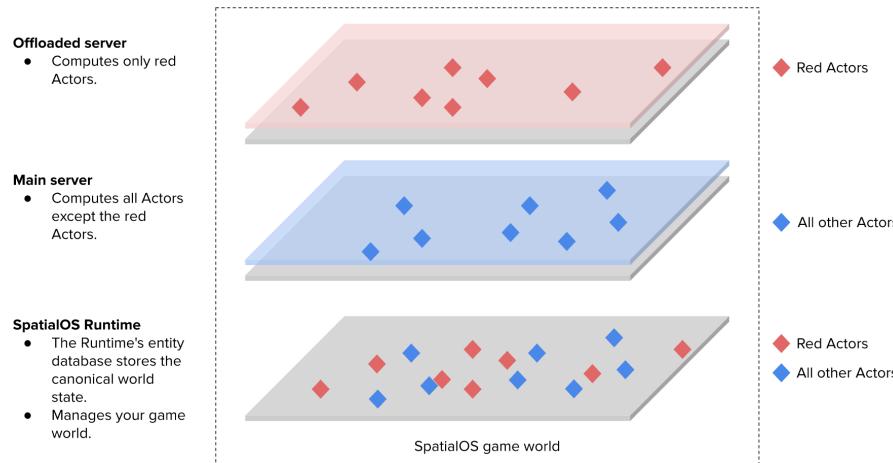
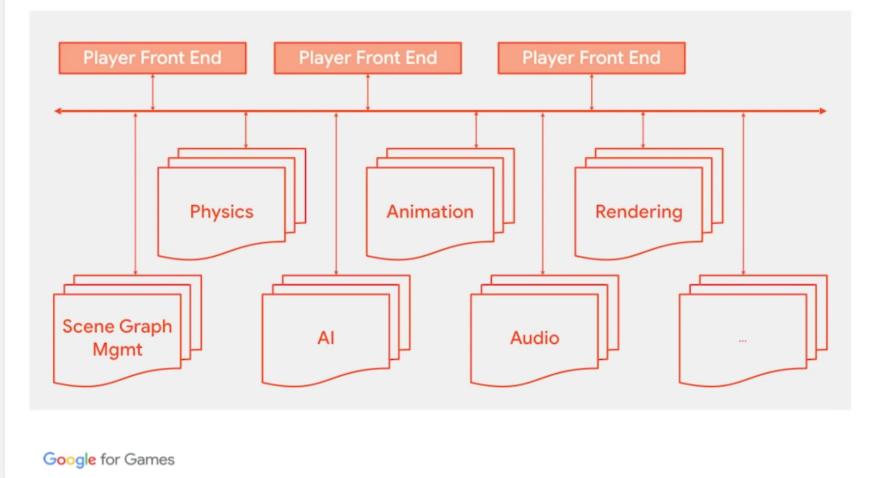


Image: Offloading - The offloaded server has authority over Red Actors, and the main Unreal server that runs major game systems has authority over all other Actors.

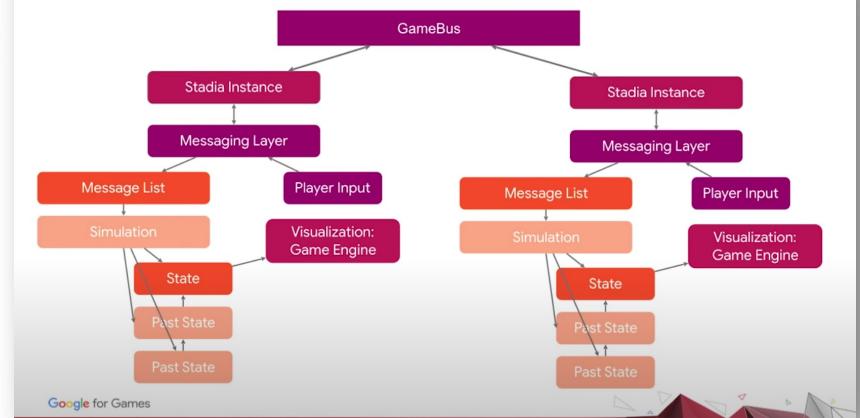
Google GameBus

[link](#)

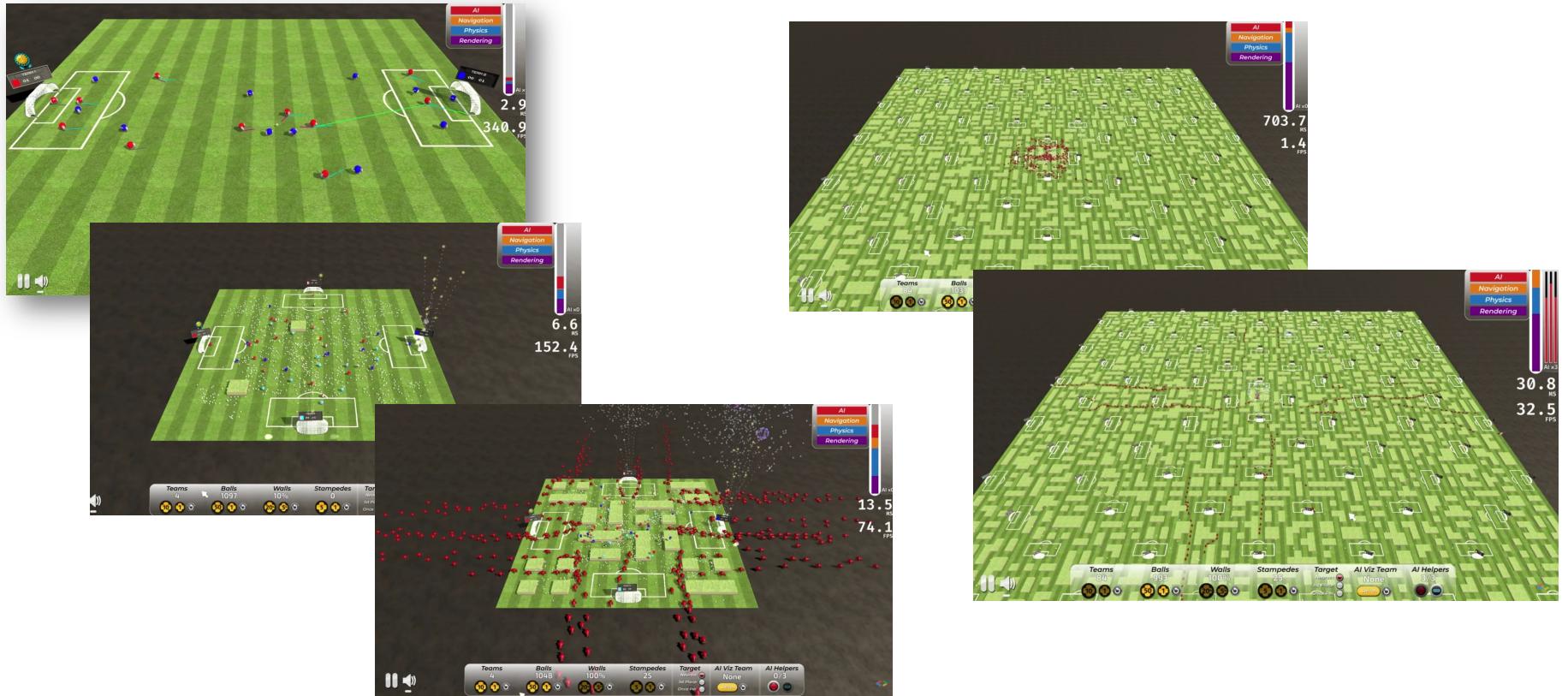
GameBus
From monolithic to distributed architecture



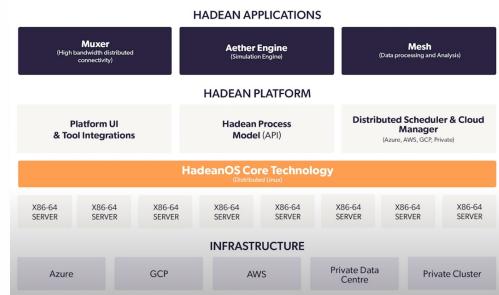
Stadia Massive Peer to Peer Architecture



Google GameBus

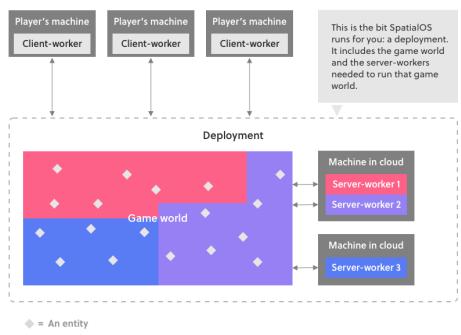


Hadean OS



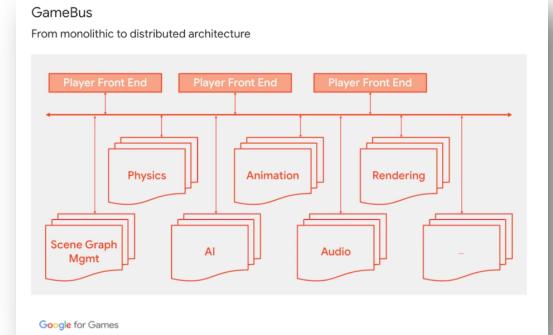
"Kubernetes for Large scale
Gaming/HPC/Simulation"

SpatialOS



"handle low-latency, high-volume,
high-throughput data replication"

GameBus



Message Bus