



Computer Network

Lecture 13

Game Networking

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Department of Software Convergence

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Contents

- **Definition**
- MMO Game Servers
- Public Cloud Solutions
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- Conclusion

What is Game Server?

- A game server is a server which is the authoritative source of events in a multiplayer video game.
- The server transmits enough data about its internal state to allow its connected clients to maintain their own accurate version of the game world for display to players.
- They also receive and process each player's input.

Types of Game Server

- Dedicated server

- Dedicated servers simulate game worlds without supporting direct input or output, except that required for their administration. Players must connect to the server with separate client programs in order to see and interact with the game.
- The foremost advantage of dedicated servers is their suitability for hosting in professional data centers, with all of the reliability and performance benefits that entails. Remote hosting also eliminates the low-latency advantage that would otherwise be held by any player who hosts and connects to a server from the same machine or local network.
- Dedicated servers cost money to run, however. Cost are sometimes met by a game's developers and sometimes by clan groups, but in either case, the public is reliant on third parties providing servers to connect to. For this reason, most games which use dedicated servers.

Definition of Game Server

Types of Game Server

- Dedicated server

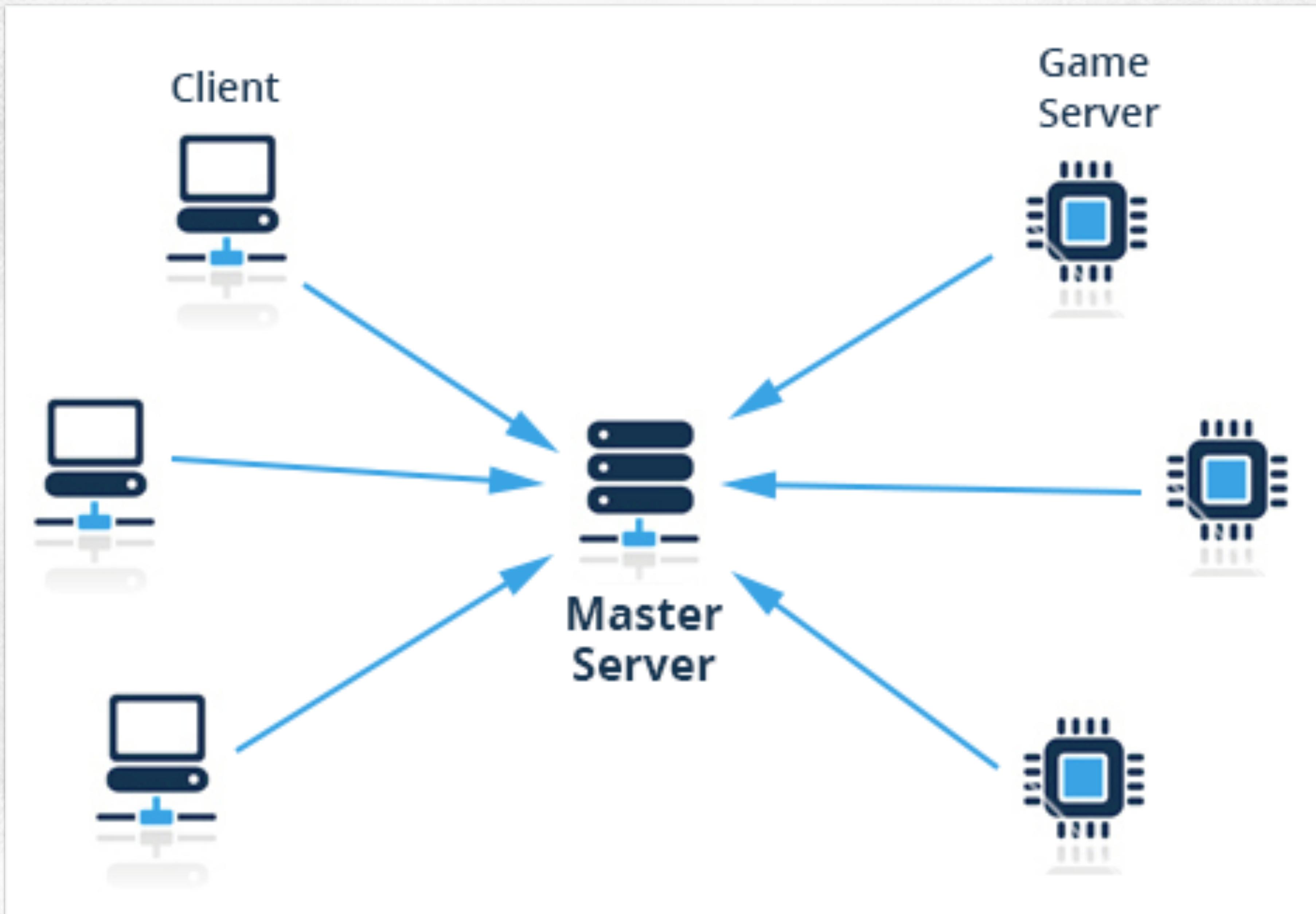
- Master Server (in general)

- * Master Server is a type of server to which everything connects. Not just clients (players), but game servers and other types of servers too.
 - * This means that master server knows about everyone who connected to it, and can use this information to do various things:
 - Tell players which game servers are running
 - Assign players to game servers
 - Allow players to communicate to each other when they play in different servers

Definition of Game Server

Types of Game Server

- Dedicated server
 - ❖ Master Server (in general)



Types of Game Server

- Dedicated server

- Game Server (in general)

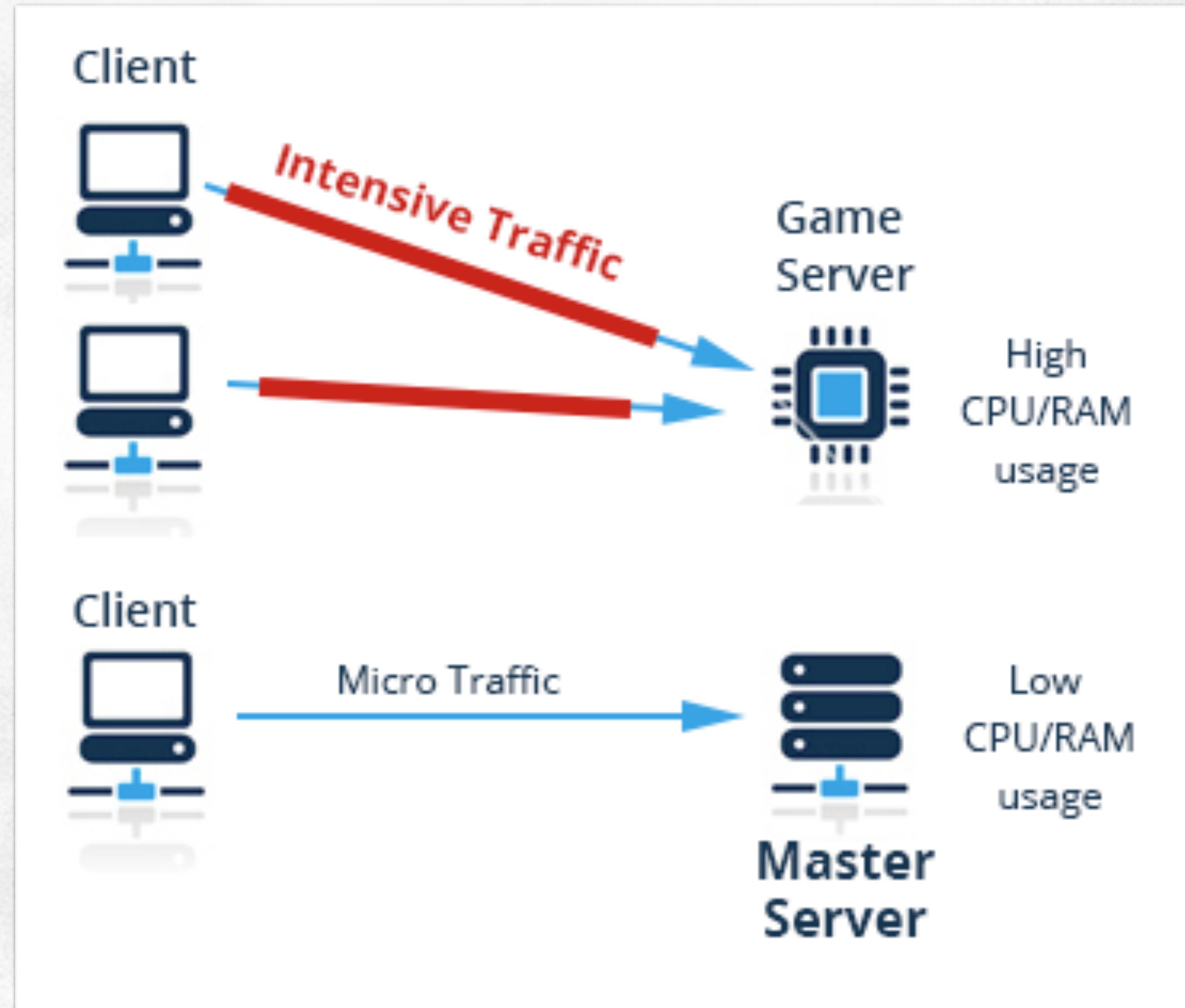
- * Game server is a server which is responsible for gameplay logic.
 - * Usually, game servers have these characteristics:
 - Large network traffic consumption - all the flying bullets, all the moving objects and characters need to be constantly synchronized between players, and it consumes a lot of traffic
 - Higher CPU usage - quite often, it needs to run physics, calculate collisions, do raycasting, process inputs from all of the players and etc.
 - * This "intensive" nature of game servers creates a limit on how many game servers you can run within a single machine. Master Server mitigates that problem by allowing you to have game servers running on multiple machines, and redirecting users to seamlessly connect to them.

Definition of Game Server

Types of Game Server

- Dedicated server

- Game Server (in general)



Types of Game Server

● Peer-to-Peer (1/2)

- In the client/server model outlined elsewhere in this article, clients receive processed data from the server and display it without much thought. In the alternative "peer-to-peer" model there is no server: each "peer" instead receives the raw input streams of each other player and determines the results itself.
- Peer-to-peer is generally considered obsolete for action games, but it still common in the real-time strategy genre due to its suitability for games with large numbers of tokens and small numbers of players. Instead of constantly transmitting the positions of 1000 troops, the game can make a one-off transmission of the fact that 1000 troops are selected and that the player in command of them just issued a move order.

Types of Game Server

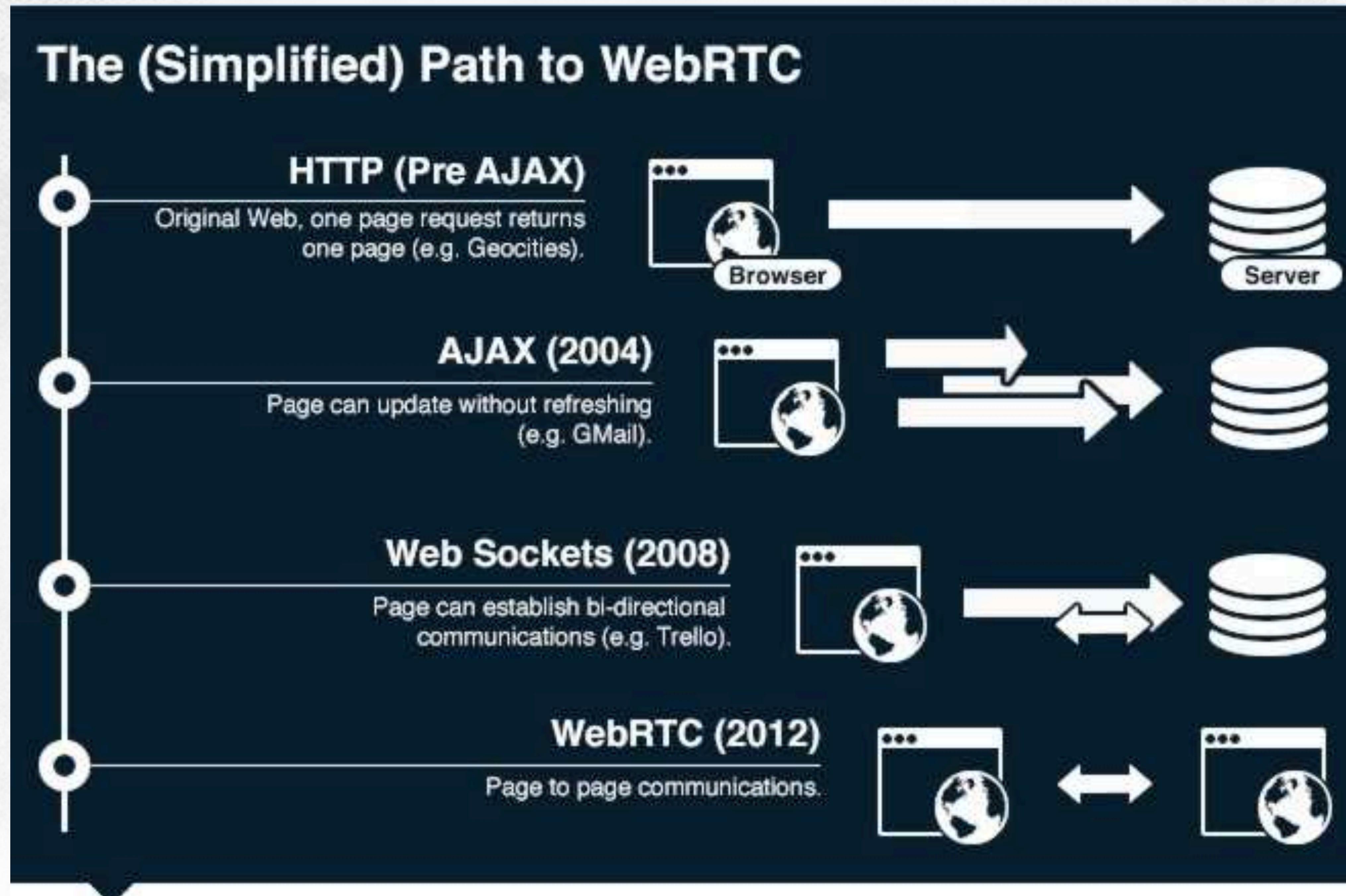
- Peer-to-Peer (2/2)

- However, peer-to-peer has many disadvantages:
 - (1) It is very difficult to keep all peers synchronised. Minute differences between peers can escalate over time to game-breaking paradoxes.
 - (2) It is very difficult to support new peers joining part-way through a game.
 - (3) Each peer must communicate with all other peers, limiting the number of connected players.
 - (4) Each peer must wait for every other peer's message before simulating the next "network frame", resulting in all players experiencing the same latency as the player with the worst connection.

Definition of Game Server

Types of Game Server

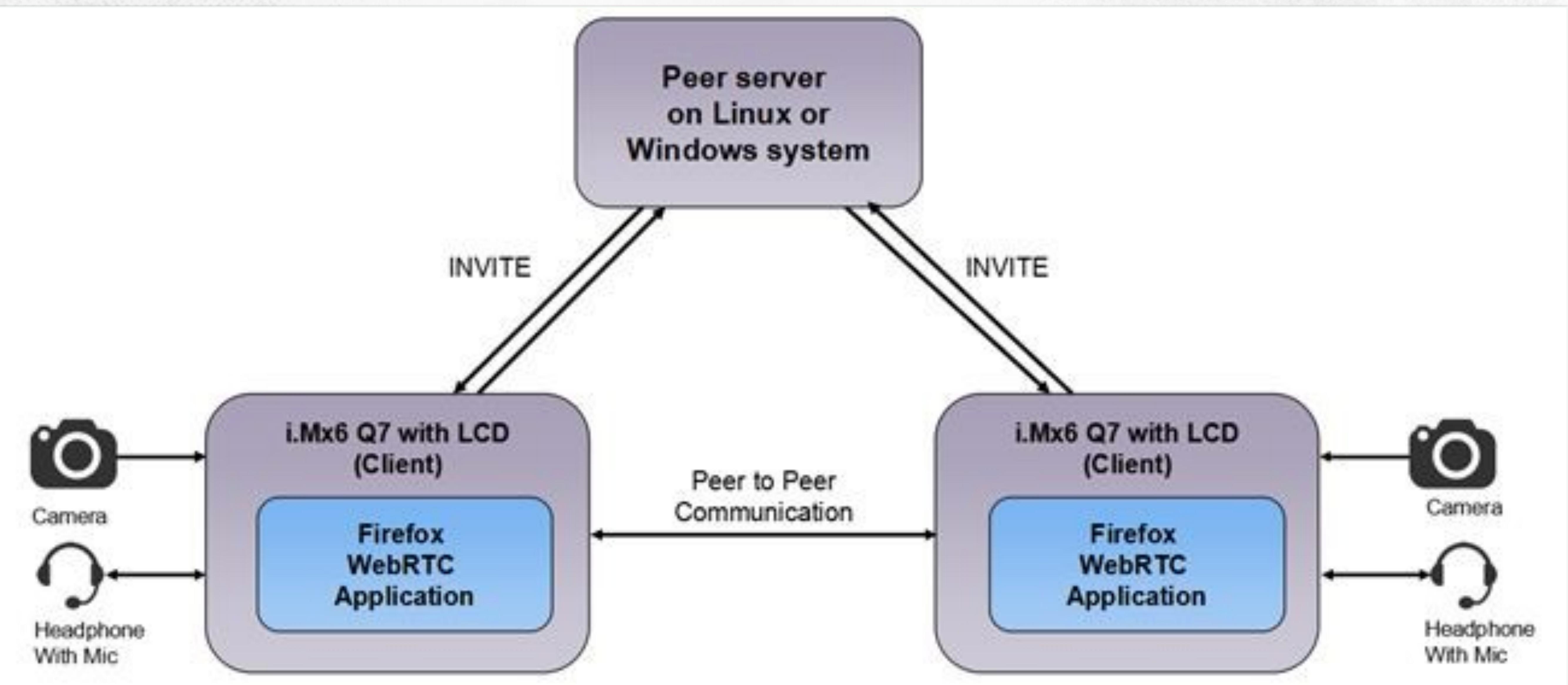
- (Semi) Peer-to-Peer Example using WebRTC



Definition of Game Server

Types of Game Server

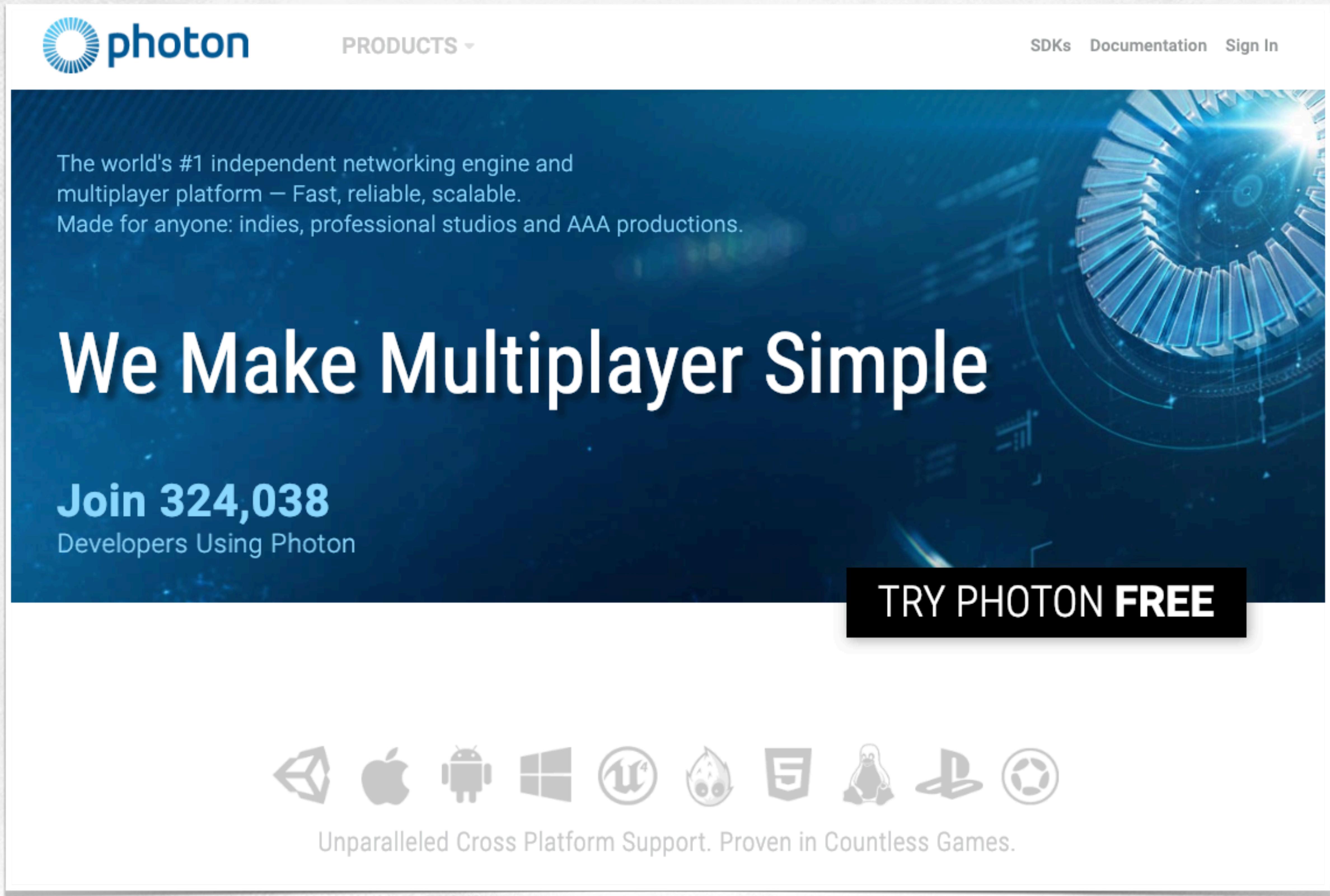
- (Semi) Peer-to-Peer Example using WebRTC



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- Definition
- **MMO Game Servers**
- Public Cloud Solutions
- Streaming Games
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What is this?



The website for Photon shows a dark blue background with a glowing blue gear and circuit board pattern on the right side. At the top left is the Photon logo. The top navigation bar includes 'PRODUCTS' with a dropdown arrow, 'SDKs', 'Documentation', and 'Sign In'. The main headline reads 'We Make Multiplayer Simple'. Below it, a callout says 'Join 324,038 Developers Using Photon' and features a large 'TRY PHOTON FREE' button. At the bottom, there's a row of platform icons: Unity, Apple, Android, Windows, Unreal Engine, Gears, HTML5, Linux, PlayStation, and Steam.

The world's #1 independent networking engine and multiplatform platform – Fast, reliable, scalable.
Made for anyone: indies, professional studios and AAA productions.

We Make Multiplayer Simple

Join 324,038 Developers Using Photon

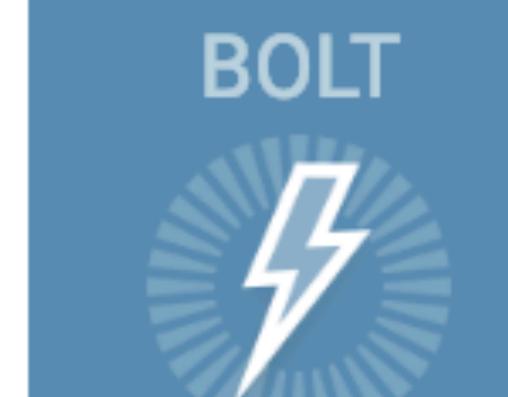
TRY PHOTON FREE

Unparalleled Cross Platform Support. Proven in Countless Games.

What is this?

Multiplayer

**PUN**
Advanced Relay

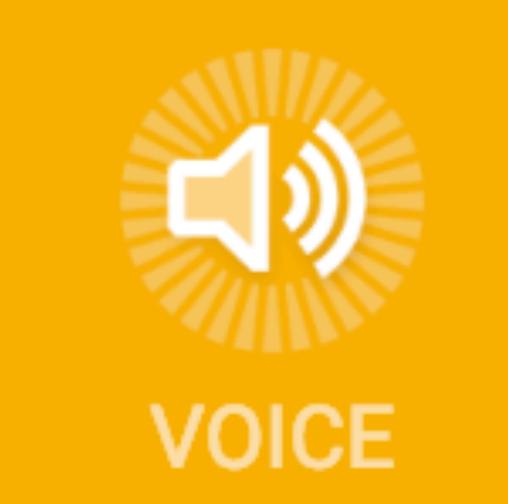
**BOLT**
Client Hosted

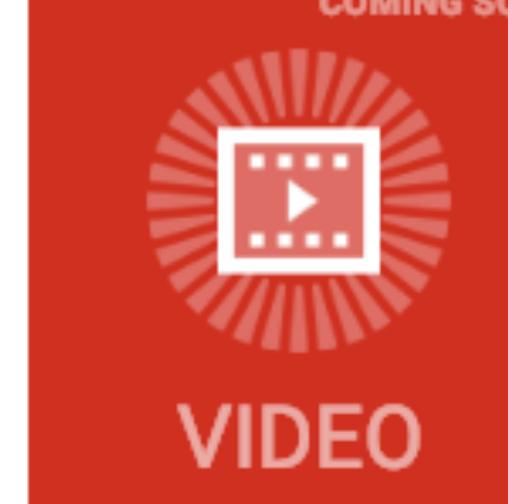
**QUANTUM**
Deterministic

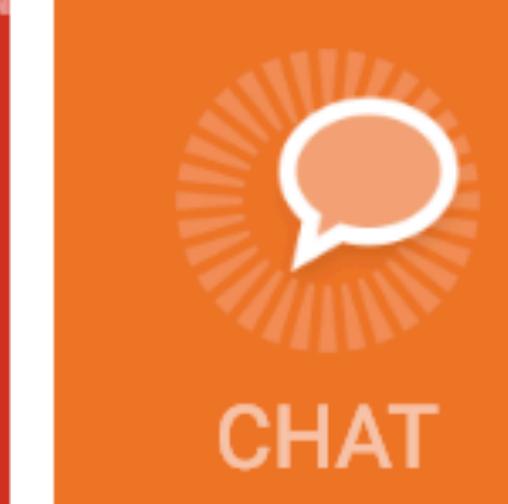
**REALTIME**

The Photon Realtime SDK is the lean and core API to access all Photon Cloud Services. It is the base for the higher level SDKs: PUN, BOLT and QUANTUM.

Communication

**VOICE**

**VIDEO**
COMING SOON

**CHAT**

Self-Hosted

**SERVER**

Build any kind of multiplayer game and create your own fully authoritative servers. Host and run them in your own premises.

**Easily Add Multiplayer
to Your Games...
Run Them in the Global
Photon Cloud...**

**...or Host Your Own
Photon Servers.**

Let's open : Lecture_13_GameNetworking_Ref1_Photon.pdf



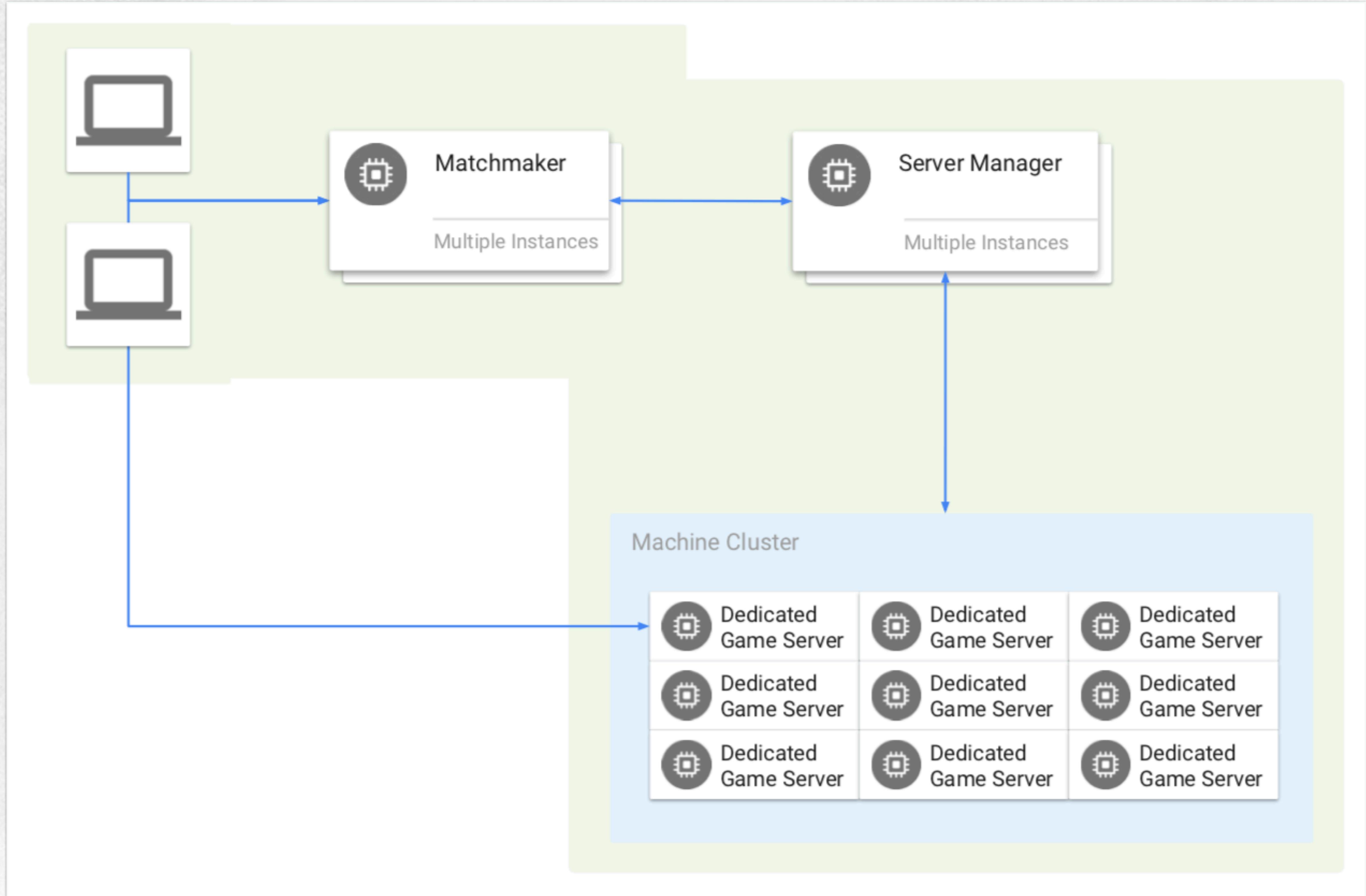
“**Agones** is designed as a batteries-included, open-source, dedicated game server hosting and scaling project built on top of **Kubernetes**, with the flexibility you need to tailor it to the needs of your multiplayer game. Currently under development in collaboration with interactive gaming giant **Ubisoft**. ”

“Agones: Scaling Multiplayer Dedicated Game Servers with Kubernetes”,
Mark Mandel,
Developer Advocate,
Google Cloud
@Kubecon 2018

YouTube: <https://www.youtube.com/watch?v=Q4RZSHTeKCY>

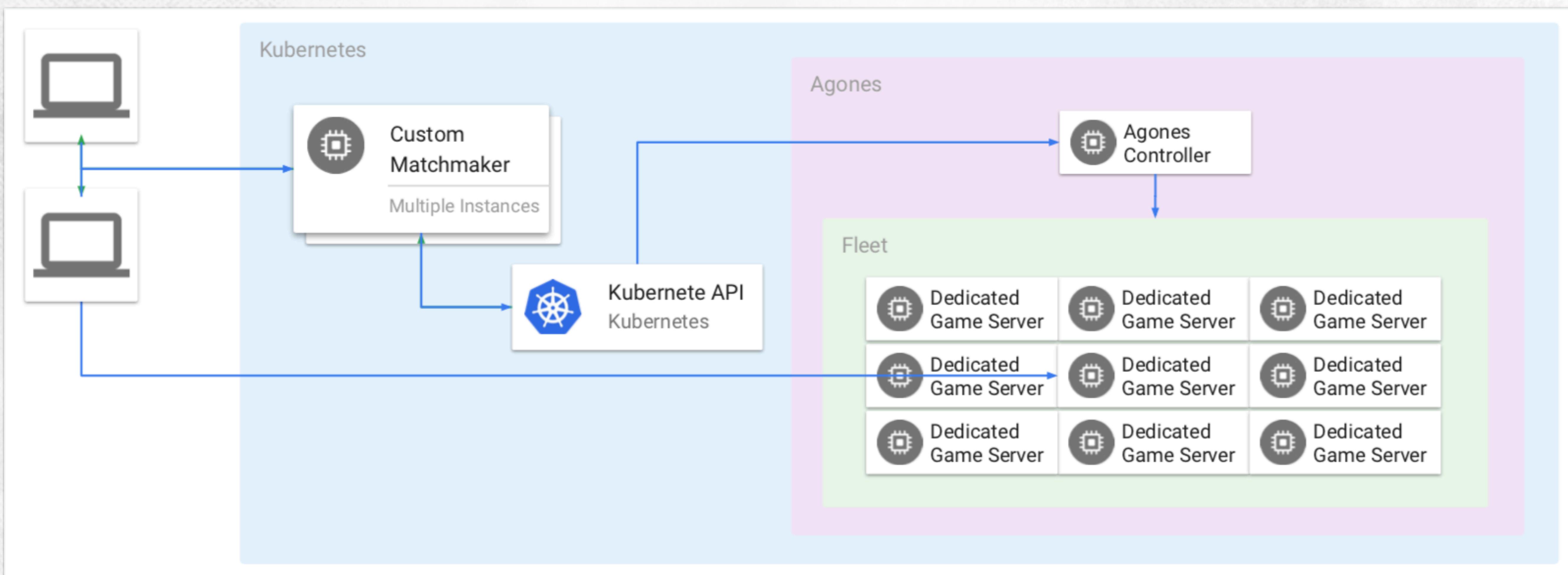
Agones

Traditional Ways



- (1) Players connect to some kind of matchmaker service, which groups them (often by skill level) to play a match.
- (2) Once players are matched for a game session, the matchmaker tells a game server manager to provide a dedicated game server process on a cluster of machines.
- (3) The game server manager creates a new instance of a dedicated game server process that runs on one of the machines in the cluster.
- (4) The game server manager determines the IP address and the port that the dedicated game server process is running on, and passes that back to the matchmaker service.
- (5) The matchmaker service passes the IP and port back to the players' clients.
- (6) The players connect directly to the dedicated game server process and play the multiplayer game against one another.

Agones's SCALABLE Way



Agones's SCALABLE Way

- Agones replaces the bespoke cluster management and game server scaling solution we discussed above, with a Kubernetes cluster that includes a custom Kubernetes Controller and matching GameServer Custom Resource Definitions.
- With Agones, Kubernetes gets native abilities to create, run, manage and scale dedicated game server processes within Kubernetes clusters using standard Kubernetes tooling and APIs. This model also allows any matchmaker to interact directly with Agones via the Kubernetes API to provision a dedicated a game server.
- Building Agones on top of Kubernetes has lots of other advantages too: it allows you to run your game workloads wherever it makes the most sense, for example, on game developers' machines via platforms like minikube, in-studio clusters for group development, on-premises machines and on hybrid-cloud or full-cloud environments, including Google Kubernetes Engine.

Agones's SCALABLE Way

- Kubernetes also simplifies operations. Multiplayer games are never just dedicated game servers—there are always supporting services, account management, inventory, marketplaces etc. Having Kubernetes as a single platform that can run both your supporting services as well as your dedicated game servers drastically reduces the required operational knowledge and complexity for the supporting development team.
- Finally, the people behind Agones aren't just one group of people building a game server platform in isolation. Agones, and the developers that use it, leverages the work of hundreds of Kubernetes contributors and the diverse ecosystem of tools that have been built around the Kubernetes platform.
- Founding contributor to the Agones project, Ubisoft brought their deep knowledge and expertise in running top-tier, AAA multiplayer games for a global audience.

Agones's SCALABLE Way



"Our goal is to continually find new ways to provide the highest-quality, most seamless services to our players so that they can focus on their games. Agones helps by providing us with the flexibility to run dedicated game servers in optimal datacenters, and by giving our teams more control over the resources they need. This collaboration makes it possible to combine Google Cloud's expertise in deploying Kubernetes at scale with our deep knowledge of game development pipelines and technologies."

Carl Dionne

Development Director, Online Technology Group,
Ubisoft

- SDKs: C++, Go, Rust, REST
- SDK Features: Readiness & Shutdown, Health Status, Access & Watch Configuration, Set Configuration values
- Server Features: Works across cloud providers, Fleet and node autoscaling, Local development tools
- Future Roadmap: Expanded Fleet auto scaling, Statistic collection and display, Commercial engine integrations, Windows hosting, Multi cluster

<https://github.com/GoogleCloudPlatform/agones>

MMO Game Server for Node.js

- Colyseus is a Authoritative Multiplayer Game Server for Node.js. It allows you to focus on your gameplay instead of bothering about networking.
- The mission of this framework is to be the easiest solution for creating your own multiplayer games in JavaScript.

<https://github.com/colyseus/colyseus>

Features

- What Colyseus provides to you:
 - WebSocket-based communication
 - Simple API in the server-side and client-side.
 - Automatic state synchronization between server and client.
 - Matchmaking clients into game sessions
 - Scale vertically or horizontally
- What Colyseus won't provide:
 - Game Engine: Colyseus is agnostic of the engine you're using. Need Physics? Add your own logic / package.
 - Database: It's up to you to configure and select which database you'd like to use.

Features

							
Real-time Multiplayer You can build modern engaging realtime multiplayer matches with a low throughput using Colyseus.	Turn-based Multiplayer Colyseus allows you to build turn-based games.	Scalable Leverage all your CPU power by using multiple processes and/or servers. More details	Client-side integration Based on Colyseus' unique binary patching algorithm, you can integrate state updates easily from the client-side.	Deploy it anywhere Colyseus is cloud-agnostic. Easily switch between cloud providers and avoid lock-in or run it on private servers. More details	Local development Use locally the exact same server as you'd run in the cloud.	Powered by Node.js Take advantage of the Node.js ecosystem by using any Node.js module in your game, such as Express.js.	MIT License Colyseus is free software, released under the permissive MIT License .

Client Integration

- Official client integration
 - JavaScript/TypeScript
 - Defold Engine (defold.com)
 - Haxe (haxe.org)
 - Construct 3 (construct3.net)
 - Unity (unity3d.com)
 - Godot (planned in roadmap)
 - Unreal Engine (planned in roadmap)
- Community client integration
 - Objective-C
 - Construct2
 - Cocos2d-x (outdated, compatible with server v0.4.0)

Simple and Easy

Server-side

```
import * as http from "http";
import { Server, Room } from "colyseus";

// Create HTTP & WebSocket servers
const server = http.createServer();
const gameServer = new Server();

class ChatRoom extends Room {
    // maximum number of clients per active session
    maxClients = 4;

    OnInit () {
        this.setState({ messages: [] });
    }

    onJoin (client) {
        this.state.messages.push(` ${ client.sessionId } joined.`);
    }

    onMessage (client, data) {
        this.state.messages.push(data);
    }
}

// Register ChatRoom as "chat"
gameServer.register("chat", ChatRoom);
gameServer.listen(2657);
```

Client-side

```
const client = new Colyseus.Client("ws://localhost:2657");
const room = client.join("chat");

room.onJoin.add(() => {
    console.log(` ${ room.sessionId } joined!`)
})

room.onStateChange.add((state) => {
    console.log("new state:", state)
});

// listen for changes on a path on the state
room.listen("messages/:index", (change) => {
    console.log(change.operation); // -> "add"
    console.log(change.path.index); // -> "1"
    console.log(change.value); // -> "Hello world!"
});

room.send("Hello world!");
```

GameSparks



The banner features the GameSparks logo at the top left, followed by navigation links: Product, Showcase, Pricing, Learn, Blog, Sign In, and Register. The main headline reads "We're Joining the Amazon Family" with a large blue ampersand symbol. Below the headline is a green "READ MORE" button with a white triangle icon. At the bottom of the banner, there's a row of logos for various game studios and partners, including Telltale Games, Gamigo, Mind Candy, Beetline, stainless games, BANDAI NAMCO ENTERTAINMENT, SQUARE ENIX, ELRAD GAMING, UBISOFT, and amazon play.

Trusted by:

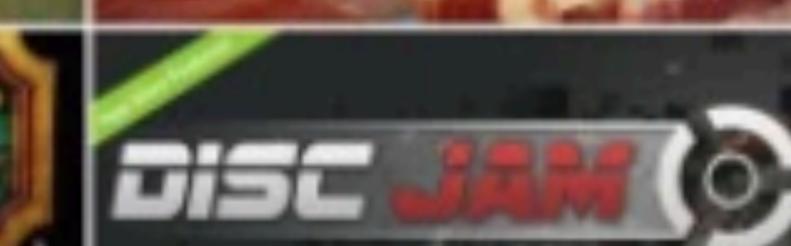
         

Amazon acquisition @ 2018

VB CHANNELS ▾ EVENTS ▾ NEWSLETTERS [f](#) [t](#) [in](#) [F](#) [RSS](#) 

[GAMES](#) EXCLUSIVE







Amazon confirms it bought GameSparks to run live game operations

DEAN TAKAHASHI @DEANTAK MARCH 5, 2018 9:00 AM

Google에 의해 종료된 광고입니다.

Above: A sampling of games that use GameSparks, now owned by Amazon.
Image Credit: GameSparks

MOST READ

PlayFab

PlayFab



PLAYFAB

Features Multiplayer Games Add-ons Docs Pricing Forums Blog **LOGIN**

Full Stack LiveOps, Real-time Control

PlayFab is a complete backend platform for live games.
Without an effective LiveOps strategy, you're leaving money on the table.

Game Services

Grow fearlessly with a complete set of backend features.

- Player management
- Multiplayer
- Commerce
- Leaderboards
- Custom logic



Real-time Analytics

Understand your players to build a better game.

- Real-time data pipeline
- Dashboards
- A/B testing
- Reports
- Snowflake data warehouse integration



LiveOps

Host events, run experiments, and reward your players.

- Messaging
- Content updates
- In-game events
- In-game promotions
- Real-time segmentation



Microsoft acquisition @ 2018

 Microsoft | Official Microsoft Blog Microsoft On the Issues The AI Blog Transform Internet of Thing

Microsoft acquires PlayFab, accelerating game development innovation in the cloud

Jan 29, 2018 | [Kareem Choudhry - Corporate Vice](#)

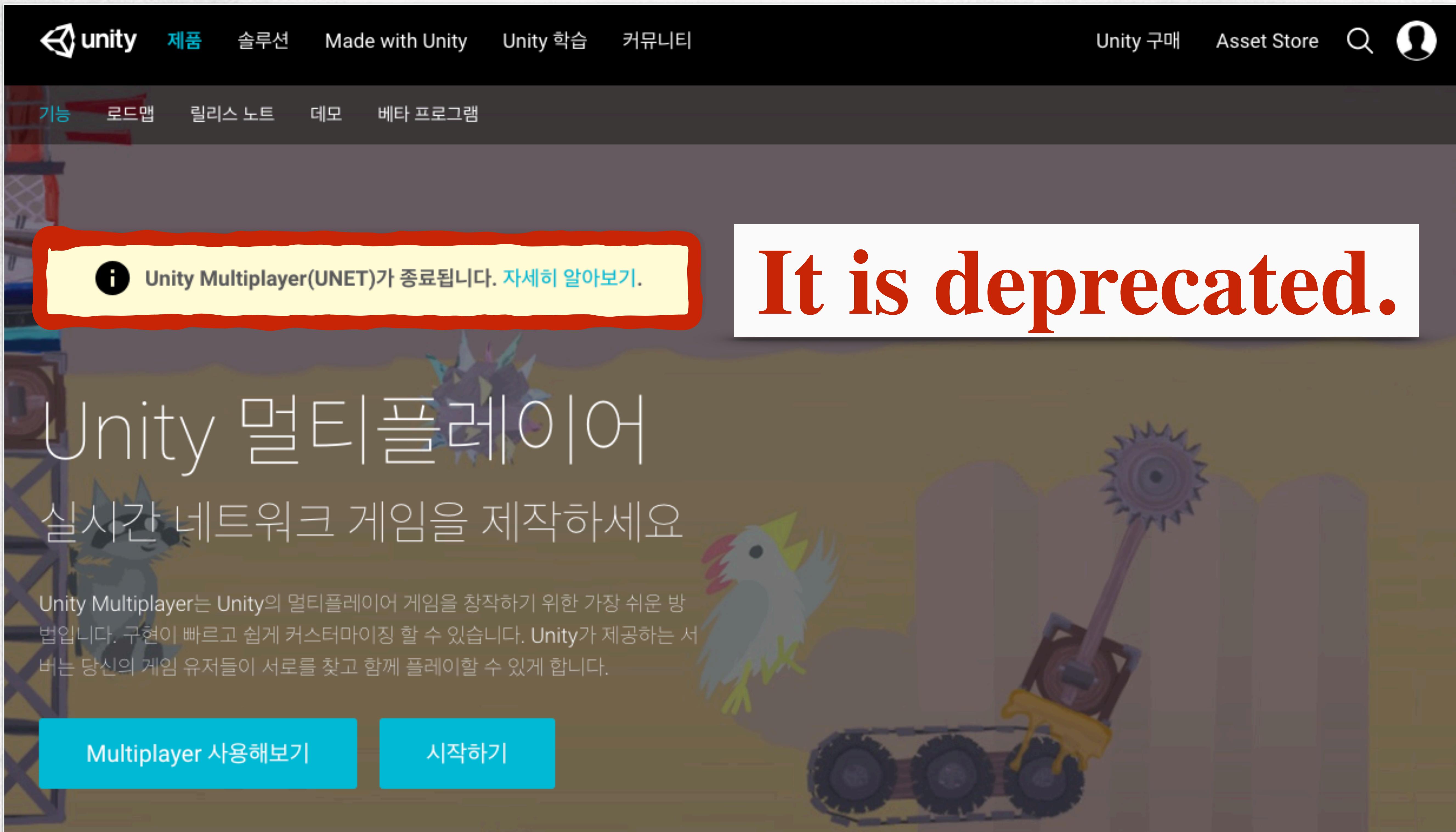
   

Today, I am pleased to welcome PlayFab to the Microsoft family. PlayFab is a provider of services to build, launch and grow cloud-based game experiences. It is used by game developers across all platforms (mobile, PC, console) to help them make better games faster. Our investments and work we've done on Microsoft Azure will help accelerate innovation in the gaming industry.

As Satya Nadella noted in our annual shareholders meeting, "We see a massive opportunity in a 100-plus-billion gaming market. This is a market that's about more than just playing games. It's about gaming end to end, about starting with games and ending with the data that they're played and viewed."



UNET: Unity Multiplayer



unity 제품 솔루션 Made with Unity Unity 학습 커뮤니티

Unity 구매 Asset Store

기능 로드맵 릴리스 노트 데모 베타 프로그램

i Unity Multiplayer(UNET)가 종료됩니다. [자세히 알아보기](#).

It is deprecated.

Unity 멀티플레이어

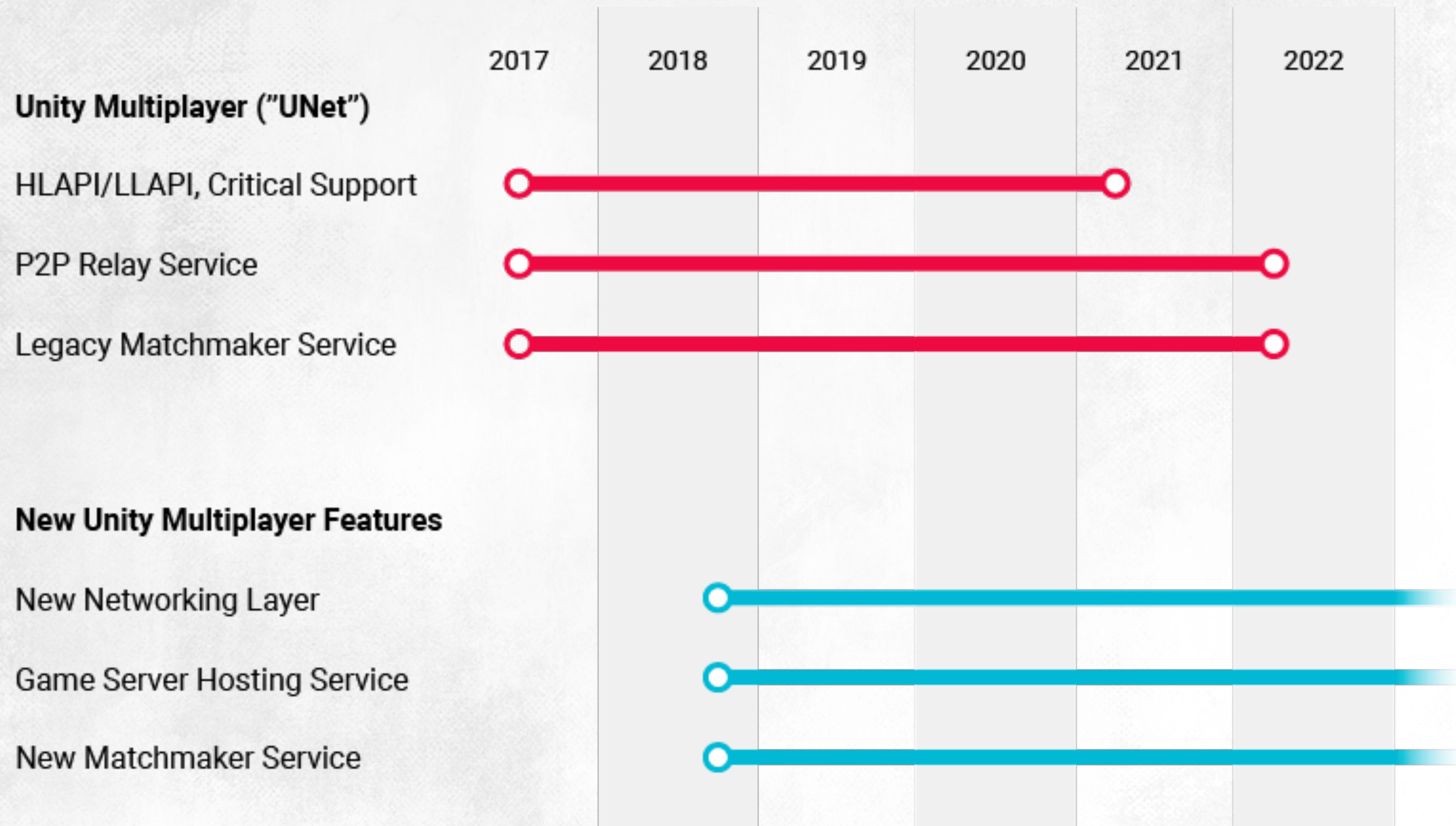
실시간 네트워크 게임을 제작하세요

Unity Multiplayer는 Unity의 멀티플레이어 게임을 창작하기 위한 가장 쉬운 방법입니다. 구현이 빠르고 쉽게 커스터마이징 할 수 있습니다. Unity가 제공하는 서버는 당신의 게임 유저들이 서로를 찾고 함께 플레이할 수 있게 합니다.

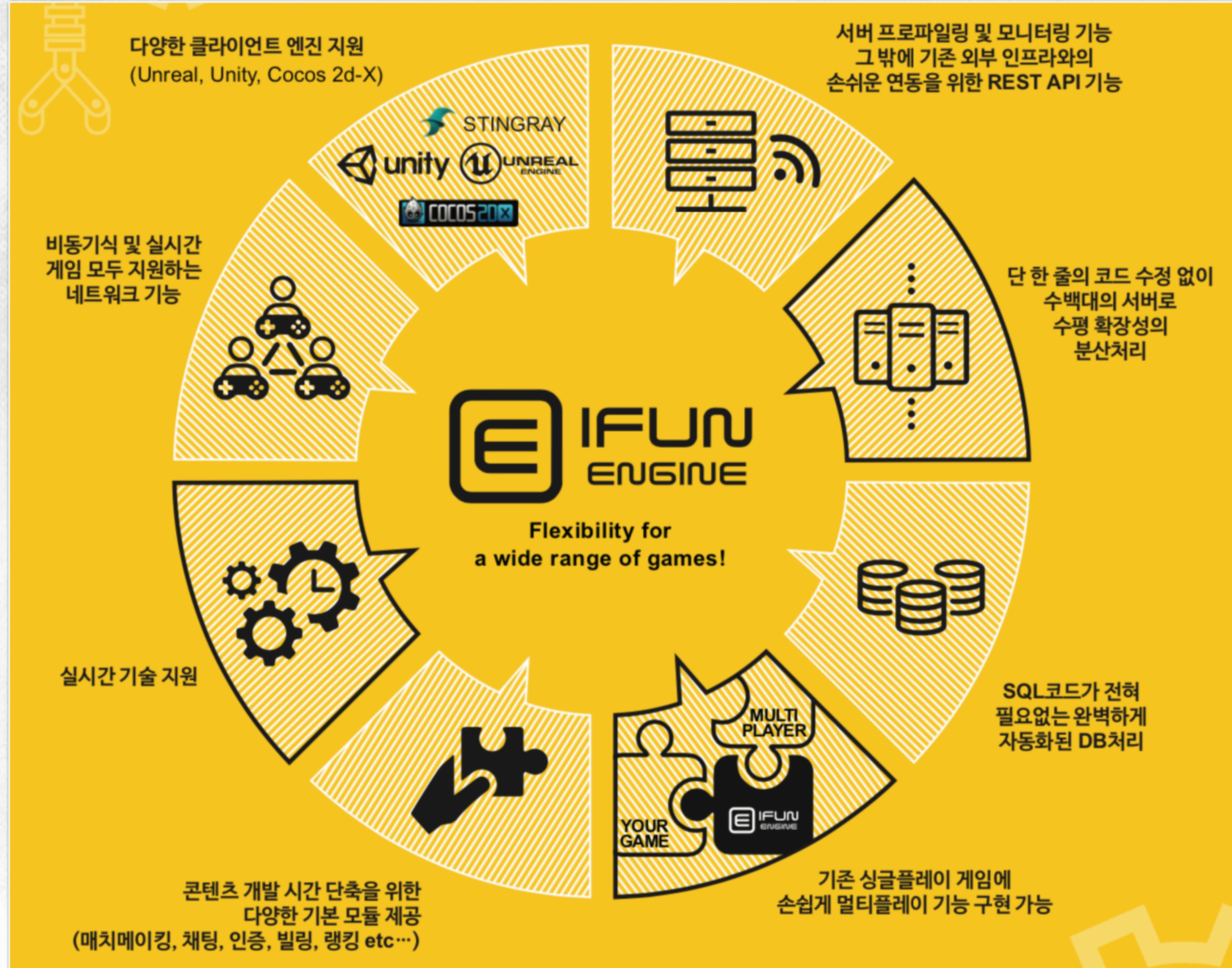
Multiplayer 사용해보기

시작하기

New Multiplayer Roadmap



아이펀 엔진



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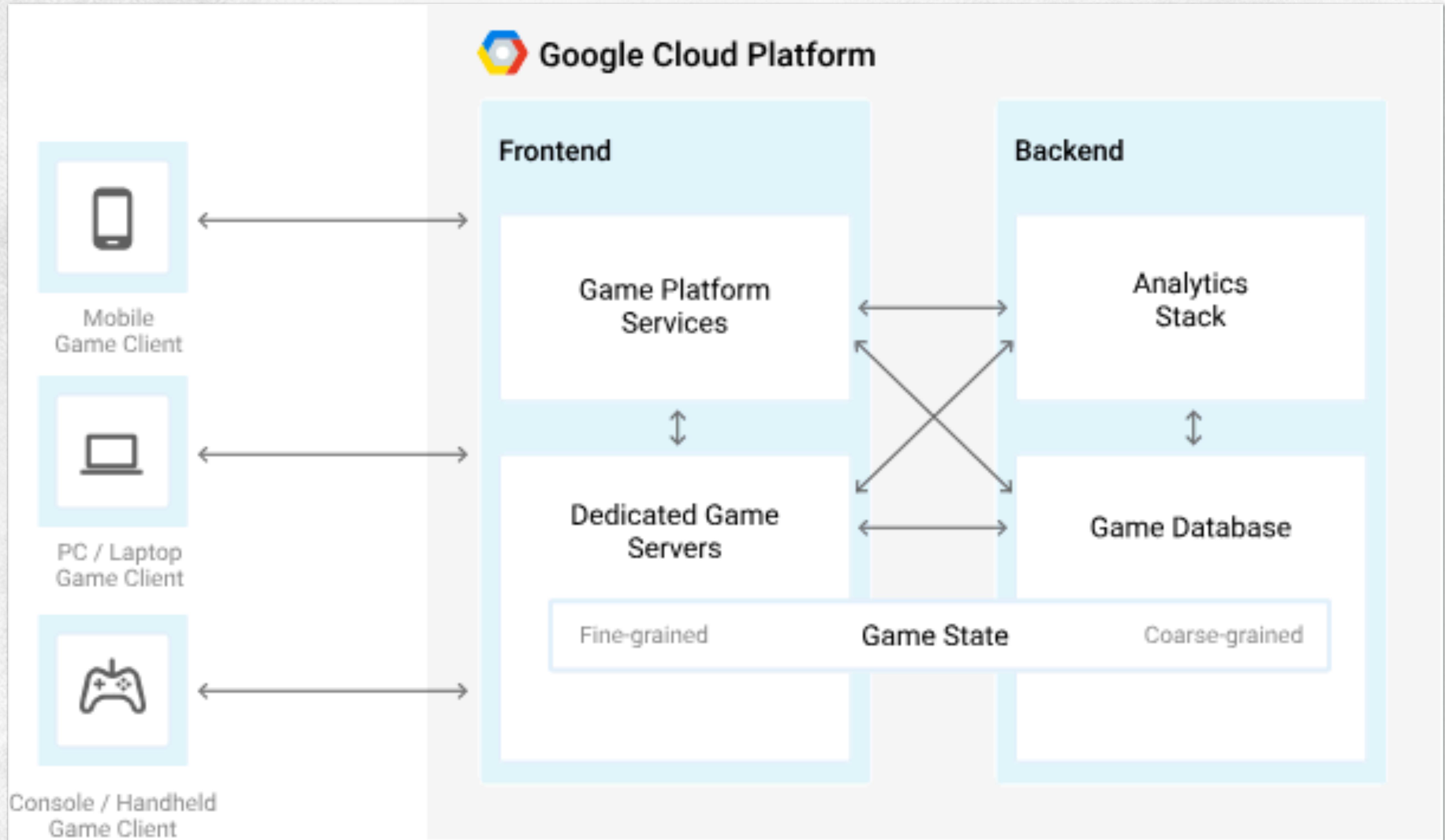
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- **Public Cloud Solutions**
- Streaming Games
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Overall

- GCP presents a highly scalable and reliable gaming implementation that leverages Google App Engine and Google Compute Engine for real-time player interactions. Core game elements, such as **game matchmaking and player customization**, are **powered by *App Engine*** while ***Compute Engine* is utilized for running dedicated game servers and common game engines.**

Google Cloud Platform

Big Picture



Key Features

- Scaling to serve hundreds to millions of players.
- Utilizing the Google Cloud Platform to build a fully featured game experience.
- Leveraging App Engine for front-end interactions and maintaining game state in the datastore.
- Orchestrating and autoscaling Compute Engine dedicated game servers with App Engine.
- Gaining business insights by analyzing massive user and game datasets.

- Google App Engine
 - Powers the main graphical user interface to provide game and user settings
 - Provides Matchmaking and server browsing
 - Distributes load to Compute Engine instances
 - Maintains clusters to handle player gameplay load

- Google Compute Engine
 - Runs custom game servers

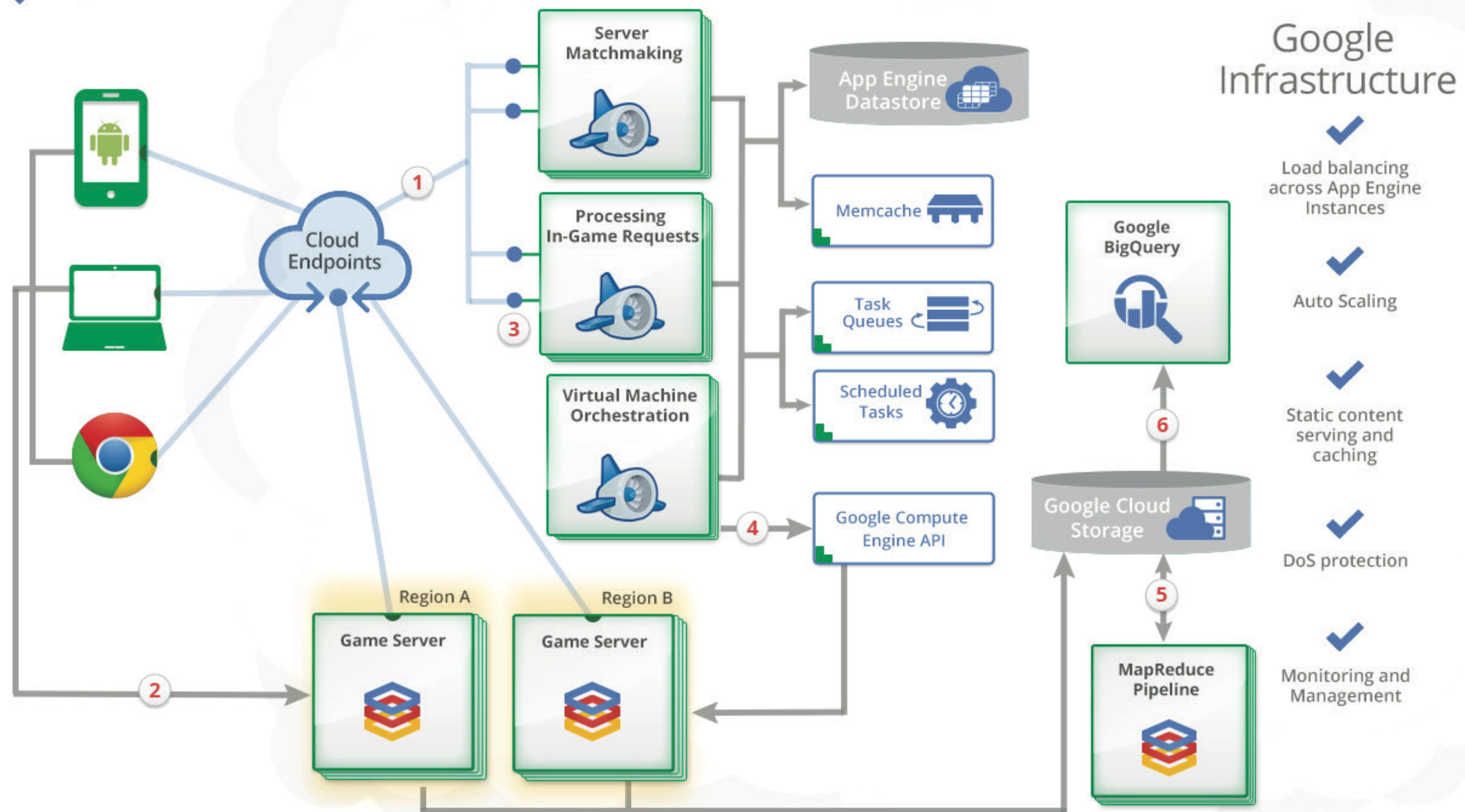
Solutions

- Google BigQuery
 - Analyzes massive game and user data sets

- Google Cloud Storage
 - Stores game server binaries
 - Distributes game client binaries and game assets
 - Stores backup logs to process and ingest into BigQuery

Dedicated Server Gaming Solution on the Google Cloud Platform

- Your Application Code running on Google App Engine, Google Compute Engine, and Client Devices
- Google Cloud Platform Services
- ✓ Capabilities Included



Key Components

- Game Server Selection
- Player's Game Client Connecting to Dedicated Game Server
- In-Game Requests and Google Compute Engine Instance Health Checks
- Autoscale Game Servers
- Store Logs for Analysis and MapReduce
- Google BigQuery Analysis of Massive User and Game Datasets

FYI: Game Server Selection

- Allowing players to join a game server and interact with other players is one of the most important components of the main interface.
- Matchmaking is an integral part of this gaming solution because it matches players with people in the same region and game modes.
- Depending on the search, performance, and scalability requirements, this solution can also be extended to include a full featured server browser and search capability by leveraging Google Cloud SQL, Search API, or Datastore.

FYI: Player's Game Client Connecting to Dedicated Game Server

- Once the player selects a server to join and the game client receives the dedicated server's IP address, the player's game client establishes a connection to the dedicated server running on Compute Engine and loads in-game assets.
- The Compute Engine game servers are responsible for handling all player interactions through low latency client server communication. Information about designing a multiplayer game server is beyond the scope of this paper. When designing multiplayer game servers, it is recommended to leverage existing game servers and software development kits.

FYI: In-Game Requests and Compute Engine Instance Health Checks

- When a dedicated game server is running on Compute Engine, it may need to send in-game requests to App Engine. If a player has purchased items from a store or created custom game configurations, App Engine can serve as the source of truth for this information. Additionally, the dedicated game server can communicate back to App Engine to update player scores, statistics, and experience.
- After a game match has completed, players can either remain on a game server for a new round or be redirected towards server matchmaking. Player's scores, match statistics, and in-game store recommendations can be displayed between matches. If a dedicated game server terminates unexpectedly, the game client must handle this event and redirect players towards server matchmaking for a new session.

FYI: Autoscale Game Servers

- Autoscaling is one of the first background tasks that does not significantly affect gameplay, but is critical to building a scalable, fully featured game.
- This step indicates the dedicated game server autoscaling logic implemented by a developer in App Engine.
- As the number of players increases, virtual machine orchestration logic creates new dedicated servers to handle the increased load.
- Similarly, if the number of players decreases during the day, unused dedicated servers can be terminated to eliminate unnecessary expense.

FYI: Store Logs for Analysis and MapReduce

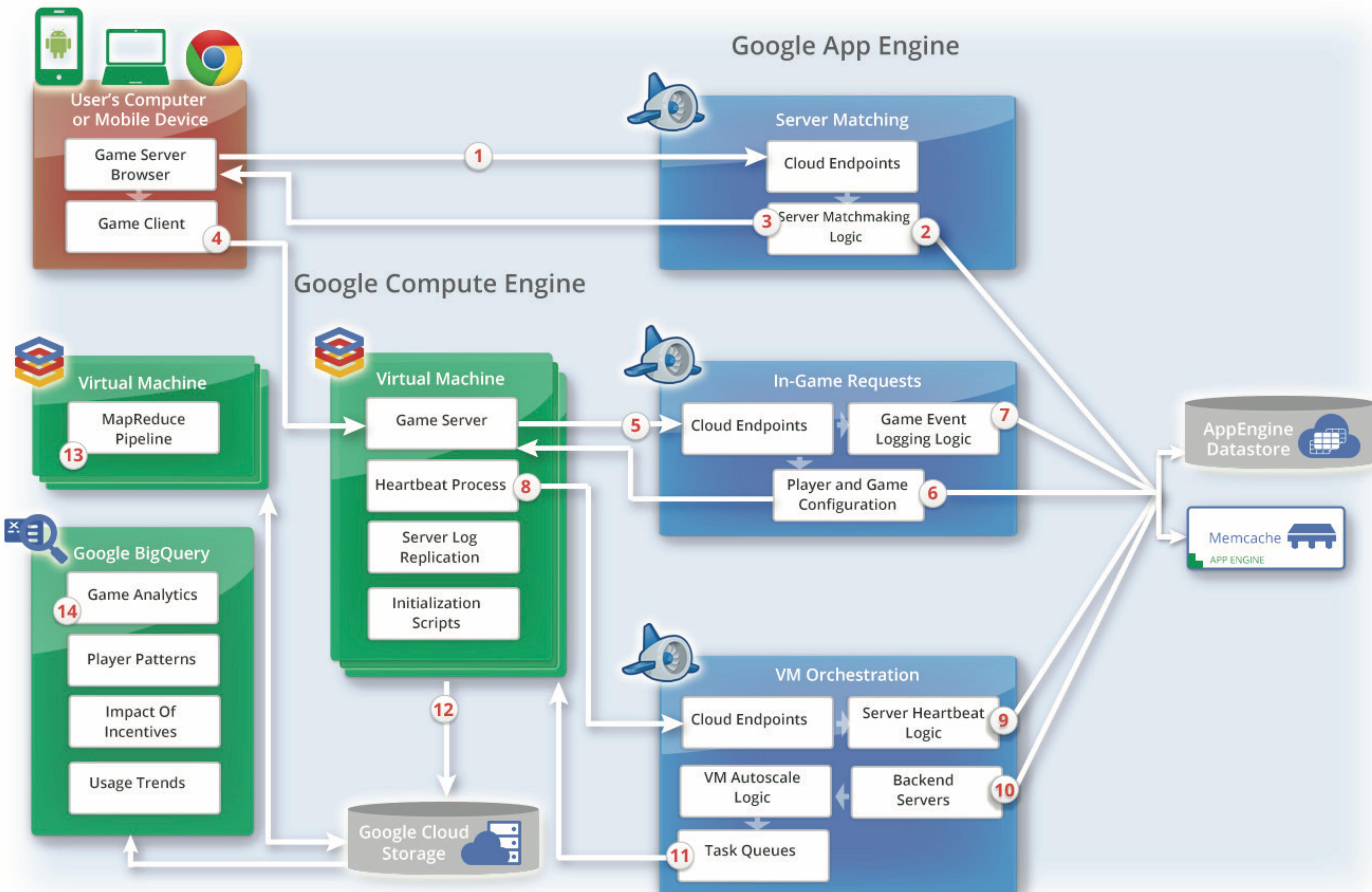
- Google Cloud Storage is recommended for storing files, such as server logs and output from MapReduce pipelines.
- The dedicated game servers on Compute Engine produce a significant amount of valuable data for understanding player behavior and troubleshooting software bugs.
- In order to store this data long-term, files should be regularly uploaded to Google Cloud Storage from Compute Engine Instances using a background process.
- If MapReduce pipelines are required for transforming and aggregating data, the relevant files can be downloaded from Google Cloud Storage and processed on additional Compute Engine instances.
- Output from the MapReduce jobs can be stored in Google Cloud Storage where it can be used as input for additional pipelines, ingested into Google BigQuery, or compiled into reports.

Google Cloud Platform

FYI: Google BigQuery Analysis of Massive User and Game Datasets

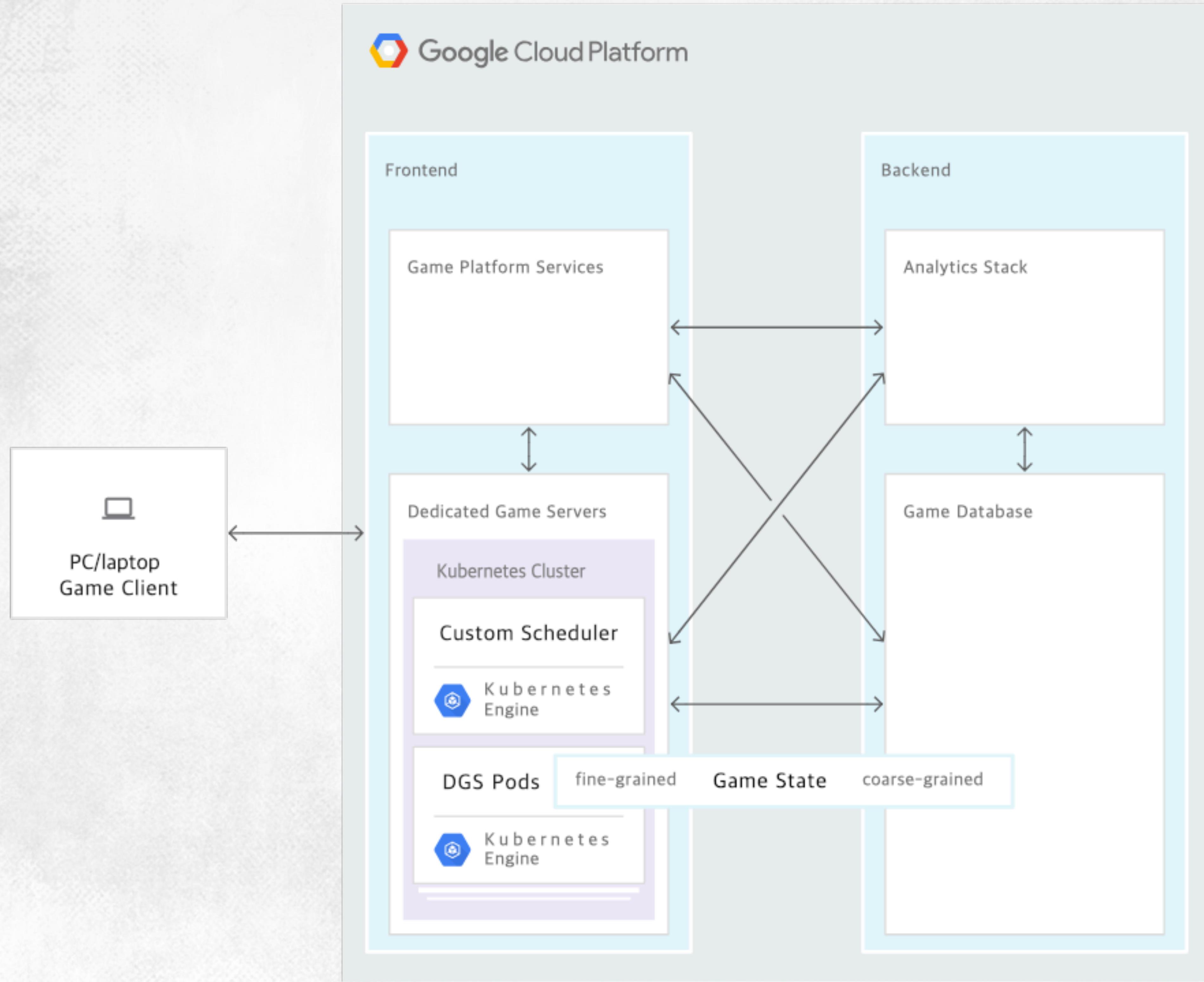
- Integrated into this solution is Google BigQuery, an ad-hoc query tool for analyzing massive datasets in real-time.
- When dedicated game servers are hosting millions of active players, billions of rows of useful data can be produced.
- Whether it is raw game logs or MapReduce output, the data can be ingested into Google BigQuery from Google Cloud Storage with a predefined schema.
- After ingestion has finished, SQL-like queries complete within seconds and can be used to obtain valuable information such as user engagement and the impact of game incentives.

Implementation Details for an dedicated server gaming solution



Google Cloud Platform

Kubernetes based Approach



Dedicated Service Hosting via AWS

Contact Sales Support English ▾ My Account ▾ [Create an AWS Account](#)

Products Solutions Pricing Documentation Learn Partner Network AWS Marketplace Explore More Q

Amazon GameLift [Overview](#) Features Pricing Getting Started FAQs Resources

Amazon GameLift

Dedication makes all the difference. Get best in-class dedicated game server hosting with Amazon GameLift.

[Sign Up for Free](#)

[Contact sales »](#)

Trusted by studios of all sizes

UBISOFT

Bethesda

gearbox software

High Horse Entertainment

CHERRYPICK GAMES

MISSION Ctrl STUDIOS

Dedicated Service Hosting vis AWS

- Easy-to-use service for hosting dedicated game servers for multiplayer games
- Automatically scale capacity up and down based on real-time player demand, so you can provide low-latency, high-availability games to players, without paying for capacity you don't need
- GameLift abstracts away hardware, server, and session management, presenting a few simple API's for placing players into available games

Key Differentiators

The Amazon GameLift Difference

Let's face it. Server infrastructure can make or break your multiplayer game. Without reliable gameplay experiences, players will go elsewhere. That's where Amazon GameLift comes into play. Dedicated game server hosting in the cloud means minimizing latency and wait time, and maximizing cost savings. The difference is in the numbers:

45 ms

global median latency

Deliver games to players around the world without adding lag. [Learn more »](#)

Up to 70%

**compute cost savings compared to
colocation solutions**

Autoscaling and Spot instances mean you get reliable compute for reliably low costs. [Learn how»](#)

100 ms

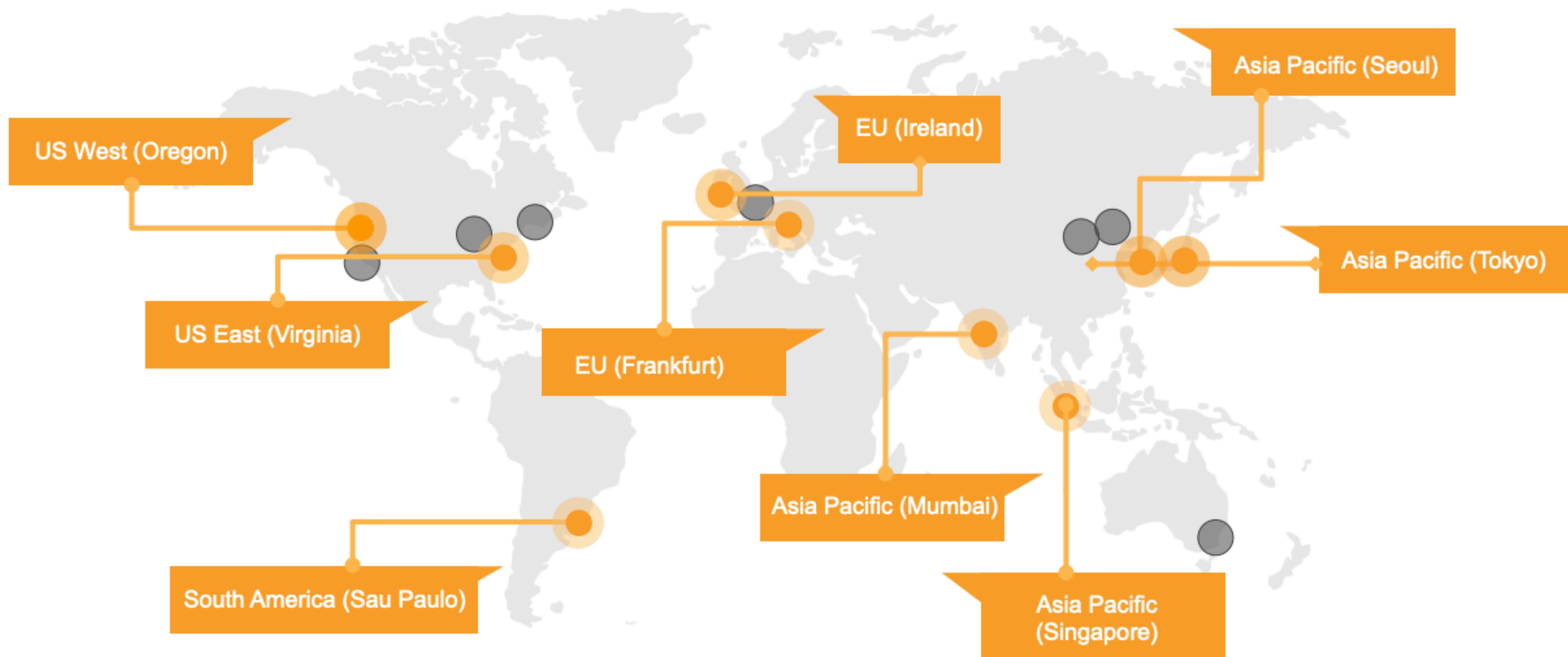
match start time

Instantly get player groups into game sessions.

[Sign Up For Free](#)

Key Differentiators

Deliver low-latency player experiences



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Key Features (1/2)

- Automatically scale server capacity with player traffic: Be prepared for unexpected spikes in player traffic, but stop paying for idle server capacity when there's low player traffic.
- Flexible Matchmaking: Use your own matchmaking service or our customizable solution, FlexMatch, to create competitive matches based on rules you define.
- No downtime for updates: Keep servers live and players playing 24/7 by using Amazon GameLift, even when releasing updates or new content.
- Support Cross-Platform Play: Connect your community across devices and broaden your pool of players for potential matches.

Key Features (2/2)

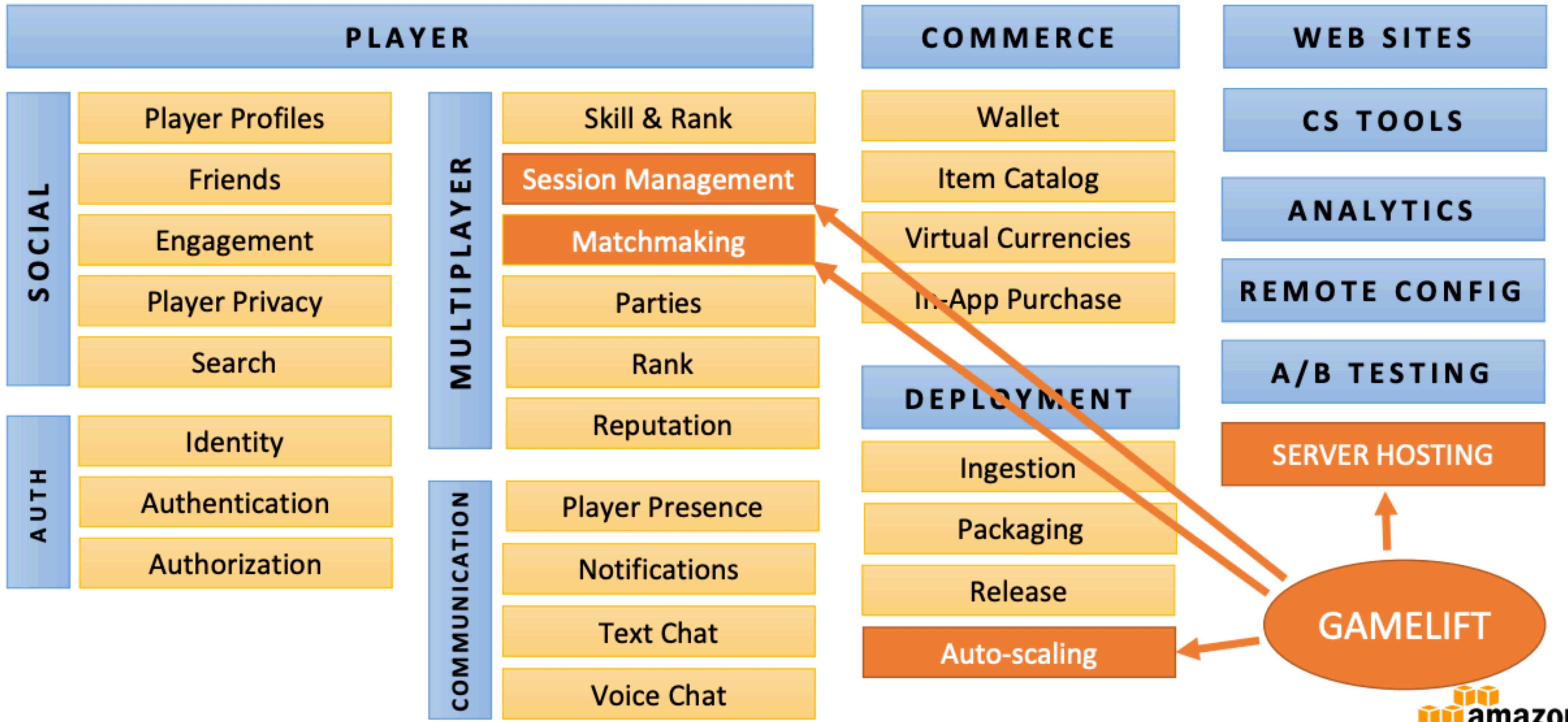
- Works with your existing engine and workflows: Whether you use a AAA engine like Unity, Unreal, Lumberyard or a homegrown C++ solution, the Amazon GameLift SDK easily integrates to get your servers up and running in the cloud.

Amazon GameLift

Positioning



Where GameLift fits today into a game backend



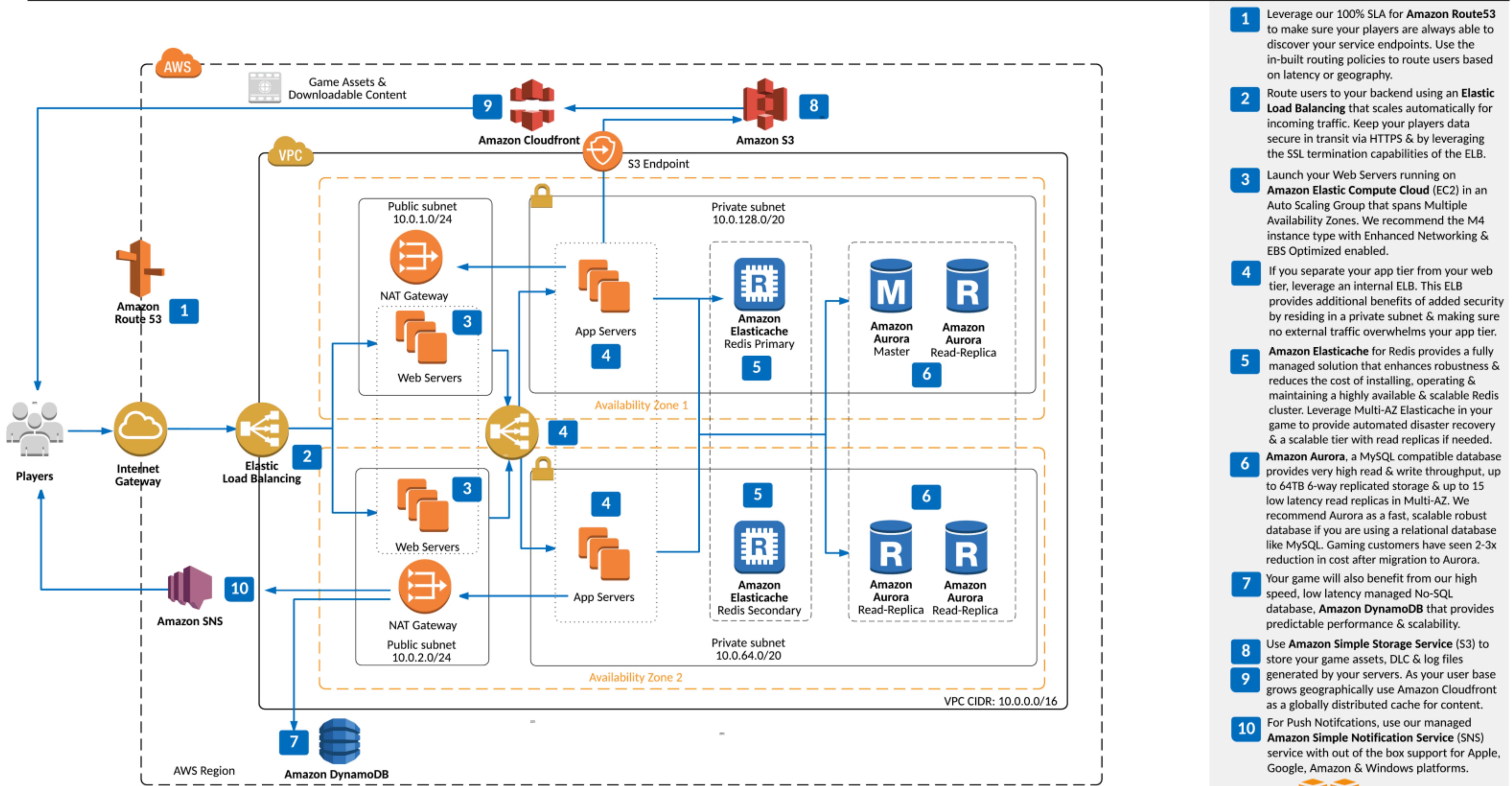
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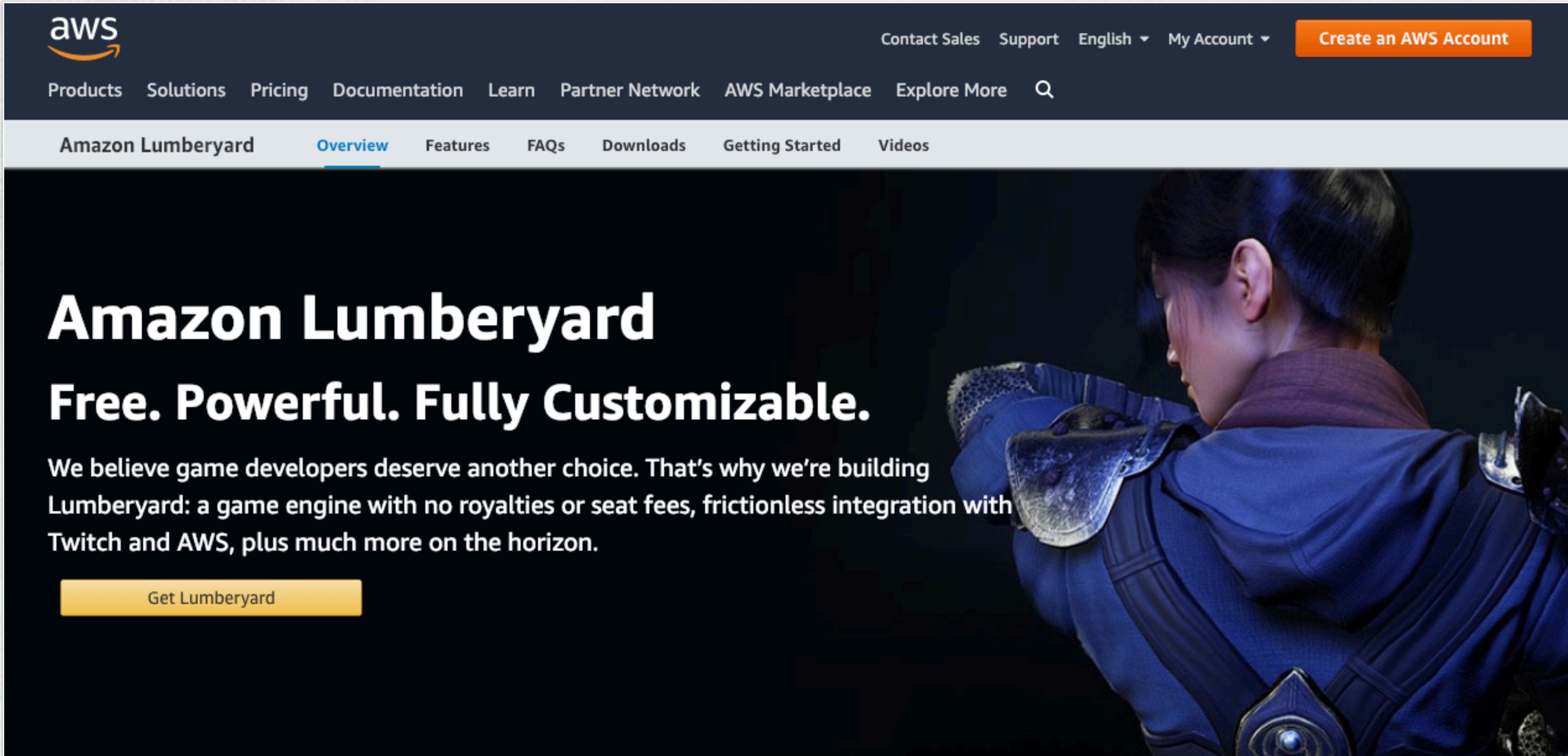
Reference Architecture for Dedicated Game Servers

Asynchronous Online Gaming Highly Available, Scalable & Elastic to Support Millions of Players

This architecture is intended for Mobile & Online Games. These workloads are a natural fit for running on Amazon Web Services, due to unexpected traffic patterns & highly demanding request rates. AWS provides the flexibility to start small & power up your architecture in response to your players. Scale up & scale down your architecture to make sure you are only paying for resources that are driving the best experience for your game. Use our managed services for popular caching & database technologies, & leverage this architecture that captures the best practices of some of the largest games running on AWS today.



Close Relationship with Lumberyard



The screenshot shows the Amazon Lumberyard landing page. At the top, there's a navigation bar with links for Contact Sales, Support, English (dropdown), My Account (dropdown), and a prominent orange "Create an AWS Account" button. Below the navigation is a secondary menu with links for Products, Solutions, Pricing, Documentation, Learn, Partner Network, AWS Marketplace, Explore More, and a search icon. Underneath this is a third-level navigation bar for Amazon Lumberyard, with "Overview" highlighted in blue and other options like Features, FAQs, Downloads, Getting Started, and Videos. The main content area features a large, bold title "Amazon Lumberyard" followed by the subtitle "Free. Powerful. Fully Customizable." Below the title is a paragraph of text: "We believe game developers deserve another choice. That's why we're building Lumberyard: a game engine with no royalties or seat fees, frictionless integration with Twitch and AWS, plus much more on the horizon." At the bottom left is a yellow "Get Lumberyard" button. To the right of the text is a close-up, low-angle shot of a character's shoulder and arm, wearing a detailed blue and gold armor plate.

Amazon Lumberyard

Free. Powerful. Fully Customizable.

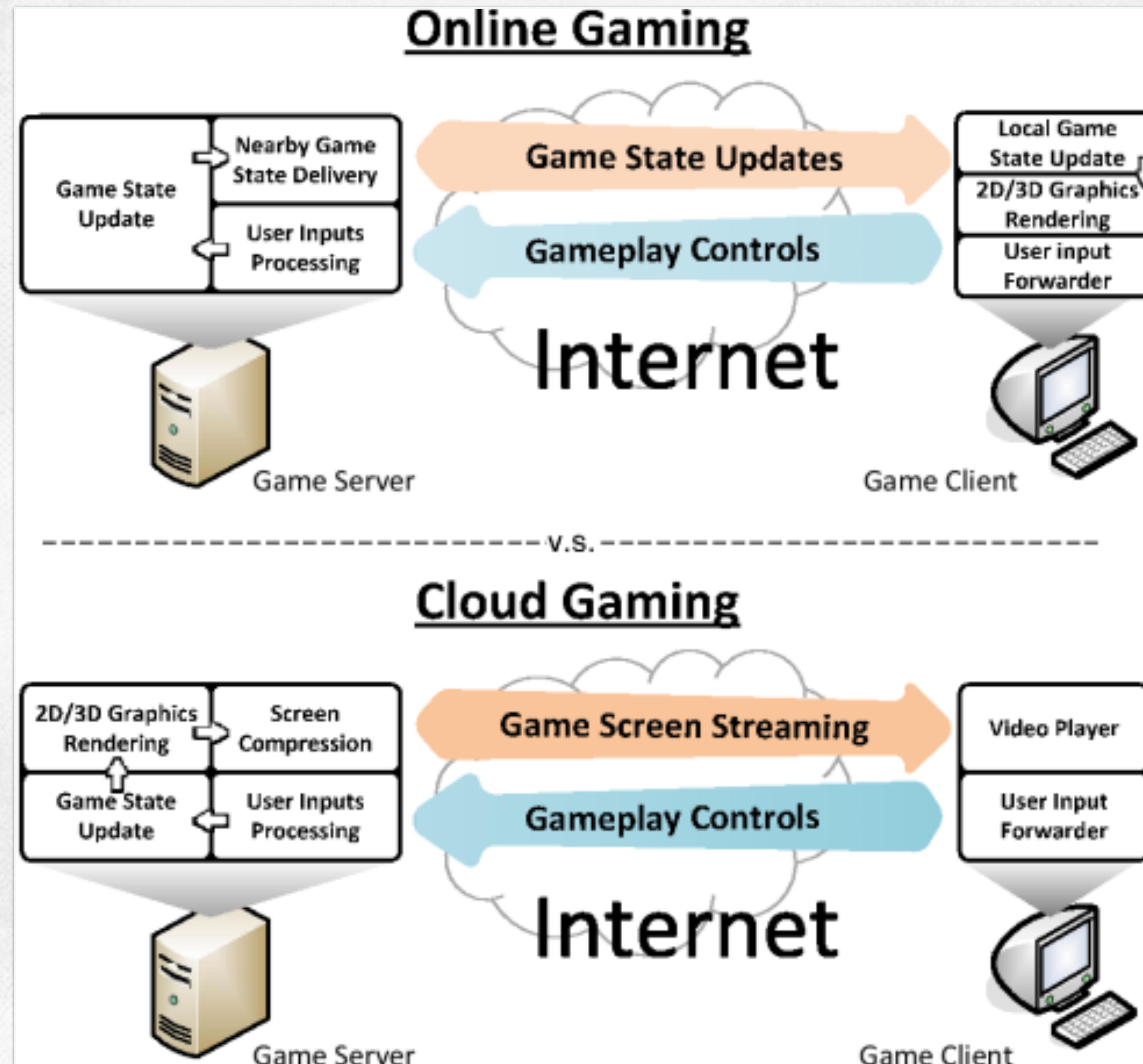
We believe game developers deserve another choice. That's why we're building Lumberyard: a game engine with no royalties or seat fees, frictionless integration with Twitch and AWS, plus much more on the horizon.

[Get Lumberyard](#)

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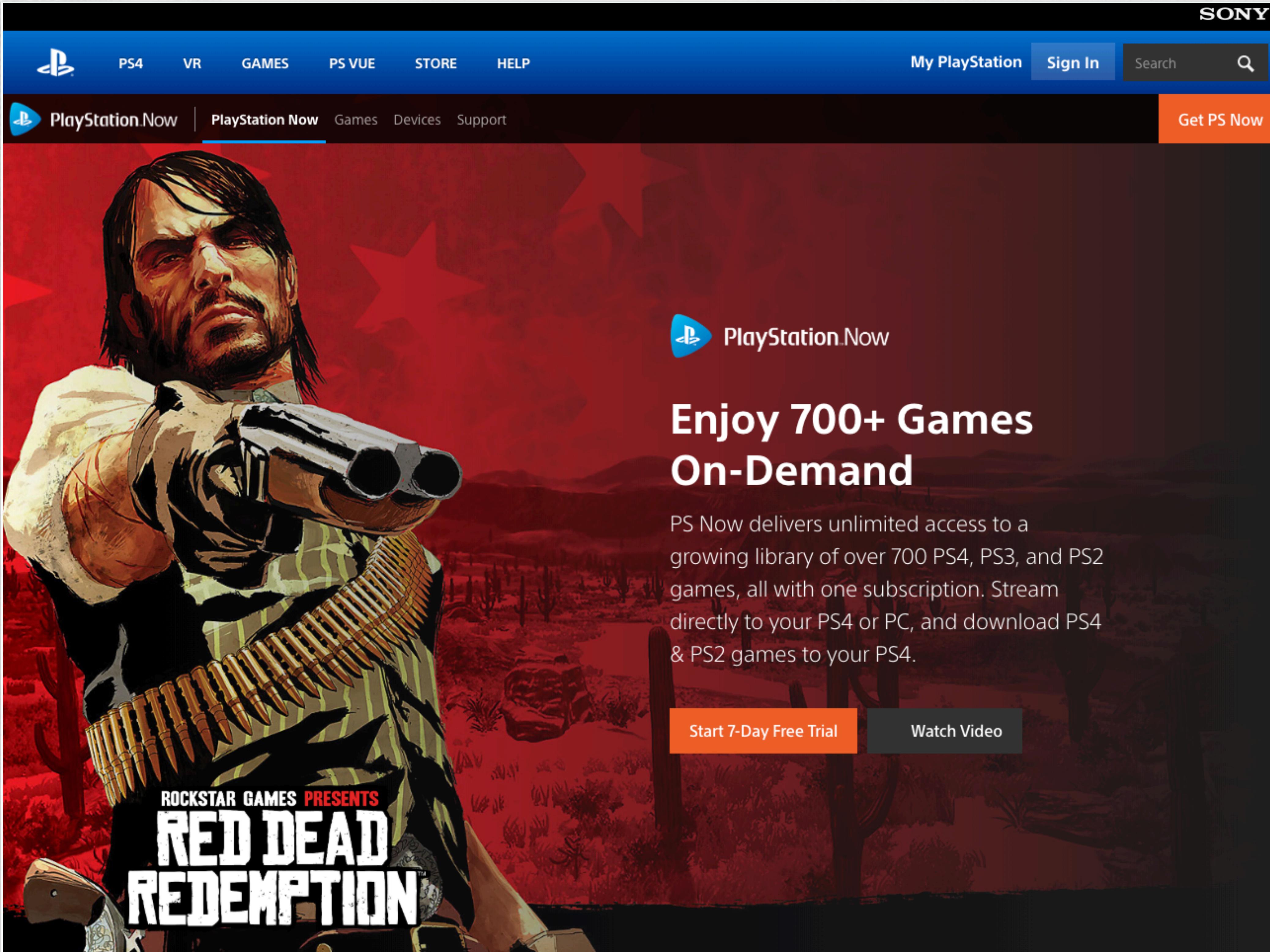
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- Networking Issues
- Conclusion

Streaming Game Concept



Sony PlayStation Now

Subscription based Commercial Service



Sony PlayStation Now Special Hardware in Cloud Server



EUROGAMER

[PC](#) [PlayStation 4](#) [Xbox One](#) [Switch](#) [Digital Foundry](#) [News](#) [Reviews](#) [Videos](#) [Features](#)



17/01/2014

News

PlayStation 3 / PlayStation 4 / PlayStation Network / PlayStation Vita

Sony creates custom PS3 hardware for PlayStation Now

Dedicated servers house eight PS3s, built from the ground up for cloud gameplay.



Richard Leadbetter
Technology Editor, Digital Foundry
[@digitalfoundry](#)

Sony has developed brand new PS3 hardware to power its PlayStation Now streaming service, revealed earlier this month at CES in Las Vegas. Sources who have been briefed on the project suggest that the new PlayStation 3 consists of eight custom console units built into [a single rack server](#). It's

the new PlayStation hardware that everyone will have access to, but few will actually see.

Microsoft xCloud

Under development



Official Microsoft Blog

Microsoft On the Issues

The AI Blog

Transform

Internet of Things

Project xCloud: Gaming with you at the center

Oct 8, 2018 | Kareem Choudhry - Corporate Vice President, Gaming Cloud, Microsoft



The future of gaming is a world where you are empowered to play the games you want, with the people you want, whenever you want, wherever you are, and on any device of your choosing. Our vision for the evolution of gaming is similar to music and movies — entertainment should be available on demand and accessible from any screen. Today, I'm excited to share with you one of our key projects that will take us on an accelerated journey to that future world: **Project xCloud**.

Today, the games you play are very much dictated by the device you are using. Project xCloud's state-of-the-art global game-streaming technology will offer you the freedom to play on the device you want without being locked to a particular device, empowering YOU, the gamers, to be at the center of your gaming experience.

Google Project Stream Under development

The screenshot shows a news article from CNET. At the top, there's a navigation bar with the CNET logo, CES 2019 badge, and links for Best Products, Reviews, News, Video, How To (which is highlighted), Smart Home, Cars, Deals, and Download. There's also a search icon, a globe icon, and a 'Join / Sign In' button. Below the navigation, the article has a subcategory 'EXPLAINER | VIDEO GAMES'. The main title is 'Google Project Stream: Beta sign-ups, how to play and more'. A subtitle below it reads: 'If you get into the beta, you can start playing Assassin's Creed: Odyssey for free in your Chrome browser.' The author is Morgan Little, and the date is October 12, 2018, 11:43 AM PDT. There are social sharing icons for Facebook, Twitter, LinkedIn, Reddit, Email, and Print. The article content starts with a paragraph about Project Stream being an ambitious joint experiment between Google and Ubisoft.

That's what it's like to use [Project Stream](#), Google's ambitious joint experiment with [Ubisoft](#) that allows beta testers to play the recently released [Assassin's Creed: Odyssey](#) for free. What's the catch? You're subject to the whims of your wallet and internet provider. Project Stream is the latest in a long string of attempts to replicate the experience of playing blockbuster games over the internet, without a physical or digital copy required.

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Latency

QUIC deployment over OLD TCP

Let's open : Lecture_13_GameNetworking_Ref2_LineQuic.pdf

QUIC을 이용한 네트워크 성능 개선

Naver D2, DEVIEW2016

이준성
데브시스터즈 개발팀
DEVSISTERS

Latency

Deep Traffic Analysis

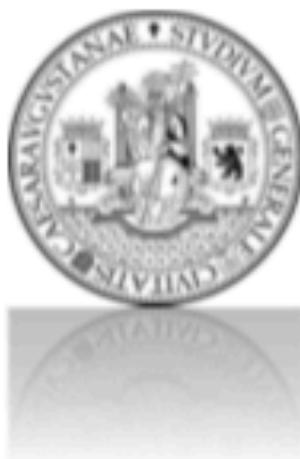
Lecture_13_GameNetworking_Ref3_TrafficAnalysis.pdf

CCNC 2014

Online Games: Traffic Characterization and Network Support

Jose Saldana

University of Zaragoza, Spain



GTC
Communication
Technologies Group

Mirko Suznjevic

University of Zagreb, Croatia

 **ACROSS**
Centre of Research Excellence
for Advanced Cooperative Systems



University of Zagreb

CCNC, Las Vegas, January 10th, 2014

10.01.2014.

1



KYUNG HEE UNIVERSITY

Reference: <https://www.slideshare.net/josemariasaldana/online-games-traffic-characterization-and-network-support>

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PUT IT ALL TOGETHER

SF to Reality

- Interactive Ultra Low Latency Massive Online Object Control
 - Angel Has Fallen: <https://www.youtube.com/watch?v=aYywnZFPe6g>
 - US Military Released Micro Drone Swarm From FA 18: <https://www.youtube.com/watch?v=CGAk5gRD-t0>
 - Navy's LOCUST launcher fire a swarm of drones: <https://www.youtube.com/watch?v=qW77hVqux10>
 - A Swarm of One Thousand Robots: <https://www.youtube.com/watch?v=G1t4M2Xnlhl>
 - Nano-Quadcopter Drone Swarm: <https://www.youtube.com/watch?v=ZbkPJPg4kJY>
 - Swarm Robots Cooperate with AR Drone: <https://www.youtube.com/watch?v=i3ernrkZ91E>
 - Drone control over public LTE: <https://www.youtube.com/watch?v=twsDFQqS7vU>
 - Control Drone Fleet Remotely over Internet: <https://www.youtube.com/watch?v=NIXdCbbOW7g>
- Streaming Game
 - Watch Assassin's Creed Odyssey Running On Google Chrome: <https://www.youtube.com/watch?v=GUn8UcyZR5U>
 - Project Stream compared to a console: https://www.youtube.com/watch?v=IRK2WJRyR_8
 - PlayStation Now Review: 5Mbps vs. 100Mbps: <https://www.youtube.com/watch?v=90RuhIEDFdQ>
 - GFORCE-NOW: <https://www.nvidia.com/ko-kr/geforce/products/geforce-now/>
 - GFORCE-NOW: <https://www.youtube.com/watch?v=NpccT7DWdHA>
 - GeForce Now in 2019: <https://www.youtube.com/watch?v=o7Vilh6sdRw>
- Web Assembly
 - WebAssembly overview: <https://www.youtube.com/watch?v=1J6Z5wBfSnQ>



Thank you