Original Article

When Work is Play: A Comparative Study of Game-Backend-as-a-Service Platforms for Live Service Games

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Abstract - The gaming industry has significantly shifted with the rise of live service games. These games require robust backend infrastructure to delight players with engaging and relevant content and to ensure a seamless player experience. This paper explores the unique technological challenges of live service games, focusing on solutions that can support continuous updates, player engagement loops, dynamic content delivery and massive scale. Through a comparative study of six leading Game-Backend-as-a-Service platforms, this research evaluates each platform's feature depth, scalability, and operational complexity.

Keywords - Gaming, Game Backend Technology, Live Service Games, Game Backends as a Service.

1. Introduction

In 2022, more than a billion global players were playing online video games. [1] Gaming is no longer a niche but the primary form of entertainment for Millennials and Gen-Z. According to Forbes, global revenue generated by the gaming industry is greater than the global revenue by the music and movie industries combined. In Fiscal Year (FY) 2022, the gaming industry generated ~$184 billion, music generated $26.2 billion, and movies generated $26 billion. [2] Advances in graphics, animation, networking and computing are significant factors in the rise of gaming. In recent years, there has been a rise in the number of live-service games. These games have unique technology and scaling needs and have, in turn, seen the rise of many Game-Backend-as-a-Service Products. This paper will cover an overview of the technology needs of Live Service Games and perform a comparative study of six of the top Game-Backend-as-a-Service platforms.

2. The Rise of Live Service Games

Video games have always been central to digital entertainment, from the evolution of arcades to at-home consoles to mobile phones. As technology has evolved, so has the nature of how users interact with them. Most initial games were single-player experiences - one where a player navigated the levels of a game to battle for top scores or occasionally played against the computer. Gaming, however, has become an increasingly social phenomenon, with players finding the most joy when facing off against each other. [3] The first iterations of this were games that supported multiple players, but they had to be physically present next to one another and connected to the same console. As networking technology improved, gamers, hungry for new experiences, started hosting LAN parties: gatherings where friends would connect their computers in the same physical space to play multiplayer games together. Today, much online gaming occurs over the internet. With the rise of online gaming, another trend emerged - Live Service Games. Video games are expensive and time-consuming to develop, and they take longer to develop with each passing year. The average game takes between 3 - 7 years to develop. [4] In order to make the most of this development effort and extend playability, today's games are constantly evolving -- with regular updates to keep the community engaged. This could be in the form of new maps, characters, challenges, etc.

Done correctly, live service games have the power to:
- Sustain and grow a player base for years
- Help games react to community sentiment in real time
- Transform the game in real-time in response to market and user preferences

3. The Live Service Revenue Model

As the scope and interactivity of live service games increase, so does their potential for revenue generation. This is largely due to their dynamic nature, which allows for ongoing player engagement and monetization strategies. Let us now explore how the revenue model for these games is intricately tied to their evolving design and player interactions. Live service games drive a significant portion of the revenue of gaming companies. In 2018, its popular live service game, Fortnite, generated $5B out of Epic Games' $5.6B revenue.[5] Over 70% of Electronic Arts' revenue comes from live services. More than 70% of the top 15 games on Steam's gaming platform are live service games.[6]

Many live service games are 'free to play'. This reduces the barrier of entry and allows developers to get more players in the game. Revenue is largely generated from in-game 'microtransactions' where players spend in small increments to help them progress through the game faster or bypass other in-game restrictions. Some examples could be paying to jump levels, purchasing items to enhance gameplay or the look and feel of the game, unlocking custom challenges, or paying to skip ads. Each of these transactions for small amounts adds up to significant revenue lifts and requires game developers to deliver well-timed content drops to continue monetization. This is called the meta-game – where a player spends time on actions that are not gameplay but make up a core part of the game loop.

4. Developing Services for Live Service Games

There are many challenges in developing and maintaining live service games. Such games deal with massive scale, are always online and need to build the technology to engage and retain players.

The principles for developing well-architected live service games are:

4.1. Mental Model Shift

Most traditional game developers still think of games in terms of "shit it and forget it". In such a world, updates are rare, and the technology systems that power the game do not need to stand the test of time.

Moving to an "iterate and update" model requires a change in mindset and process, with teams needing to adopt agile methodologies, tooling and systems that push updates into the game and robust testing frameworks.

4.2. Server-Authoritative Services

Online games can manage player state -- information about the player level, challenge progress, etc., can be stored on the gaming console (client) or the services maintained by the game developer on the cloud (server). Traditional games could be client-authoritative, but live service games must be server-authoritative and hold the "truth" of the game state. This is crucial for preventing cheating, ensuring fairness, and enabling smooth updates. This architecture also allows for more effortless patching and testing. However, server-authoritative games require more sophisticated backend design, including game state management, load balancing, and content management.

4.3. Content Pipeline and Updates

The power of a live-service game lies in its ability to keep the game fresh with updates on a regular cadence and keep players engaged. In order to achieve this, there are two main areas game developers need to focus on Examine published marketing and sales materials (latest and older iterations) to understand current and promised value. Management stages

(individual contributor, frontline manager, group manager, executive) Building a robust content pipeline allows for the seamless introduction of new content (maps, skins, features) while minimizing downtime or disruptions.

- The content pipeline must handle significant and minor incremental updates with proper testing to avoid misconfigurations that disrupt the player experience or revenue[7] or break the game.

4.4. Personalization and Engagement

With stiff competition in the gaming marketplace, engaging players with content that is meaningful to them is key to retention. Games must be data-first - collecting relevant data about behaviour and preferences to deliver customized in-game experiences and developing systems to make real-time decisions on personalized experiences to serve the player.

4.5. Scaling for Launch Surges

Launches are make-or-break game moments - often attracting millions of players and setting new records for concurrent users. For example, the popular game Fortnite[8] saw a million players log on in the first 20 minutes of the launch of Fortnite OG. Games need to be supported by well-architected services employing techniques like Autoscaling, rate limiting and login queues to support such spikes in traffic. A robust load test infrastructure is also key to stress-testing these services.

5. A Primer on Architecture

To address the complexities discussed and to understand how best to select the right technology, it is crucial to understand how the backend architecture of live service games is designed to meet these challenges. This section will explain how the architecture is structured to support seamless gameplay and scalability. Live service games are architected to provide the player with a seamless playing experience while keeping the game safe and fair. The player interacts with the game client, which works with the game backend system hosted and maintained in the developer's infrastructure. Most online games store information about gameplay and the player in the game device the player can access; it could be a PC, gaming console or mobile device. The client is responsible for providing the player with the interactive experience of gameplay - rendering the visuals, capturing and sending that input to the server and advancing gameplay based on data received from the server and the player inputs. The client also performs some computations and predicts behavior for efficiency. For example, when a weapon is fired, the client might calculate and display the trajectory of the bullet before confirming it with the server. This provides the player with smooth visuals and reduces latencies. The game backend system is where the majority of the game logic exists. Backend refers to all services the game developer maintains on the cloud or self-hosted in their data centres. The game backend

system contains game servers that own game logic and data management and hold the 'truth' of the game world. Game servers track player movement and ensure accuracy and consistency across all game clients. Additionally, the backend system will also host different services to provide supporting functionality for the gameplay, this could include:

- Authentication services to manage player identity and profiles
- Matchmaking services are provided to group players by skill, latency, or other criteria for optimal 'fun.'

- Services that support progression and in-game economies, including the ability to purchase content for monetization, etc
- Social services like in-game chat, friends list and presence. This also includes services to filter out profanity and inappropriate content to maintain a safe environment for all players.
- Personalization and recommendation services for players to discover content and other players
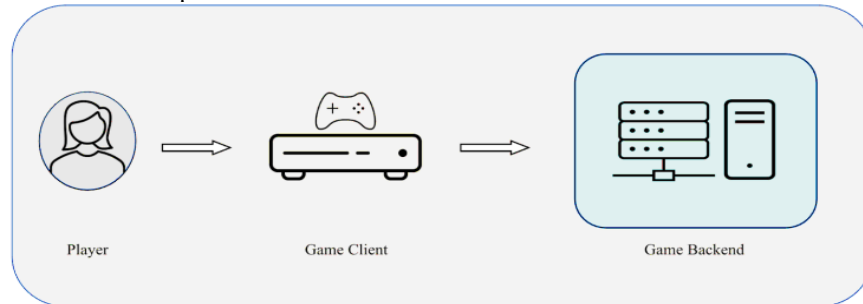

Fig. 1 Typical live service game architecture

6. Evaluating Game-Backend-as-a-Service Platforms

Given the specific needs of live service games, selecting the right backend technology is vital to the game's success. While game developers could develop all the technology in-house, many Game-Backend-as-a-Service platforms are available, each with different feature sets to cater to games with differing use cases and scaling needs. This study evaluates game backend services along the following vectors:

6.1. Feature Depth and Flexibility

In order to monetize and engage players, live service games require systems to support:
- Cross Platform Play: players from multiple gaming consoles can play online together.
- Game economy system to manage player currencies, item ownership, and manage in-game storefronts
- Player Progression services like Stats, Leaderboards
- Social Features like creating friends with other players, in-game chat and presence.
- Matchmaking and player session management
- Ability to customize features and workflows based on the unique needs of the game

6.2. Tooling

Rich features alone are not enough to make a live service game successful. Content updates are the lifeblood of live service games, and any game backend must support easy-to-use systems to understand player behavior and allow game developers to react to it:
- Tooling to publish and manage content easily is paramount.

- Real-time Analytics and Player Engagement tools like usage tracking, player counts, etc., to track player behavior and overall game performance.
- Player Lifecycle Management tools to avoid churn include in-game messaging, personalized content delivery and the ability to segment players.

6.3. Operational Complexity
- Hosting model: is the technology hosted in the cloud, or does it require developers to host, maintain and scale it?
- Scaling is a key consideration in evaluating technologies. This includes understanding if the platform autoscale has limits on how much it scales and if there are rate limits on usage.
- Security and compliance: Does the platform follow standard security practices to protect against DDoS attacks and TLS certificate standards, and does the platform enable compliance with regulations around player safety?

6.4. Cost

Analyze the pricing model to understand the types of games and usage patterns for which the platforms are optimal.

7. Comparative Study

This study compares the six game backend technologies - Acclebyte[9], Epic Online Services (EOS)[10], LootLocker[11], PlayFab[12], Pragma[13] and Unity Gaming Services (UGS)[14]. The analysis is based on reviewing documentation, analyzing pricing structure, reading testimonials and prototyping features where applicable.

7.1. Feature Depth and Flexibility

7.1.1. Cross Platform Play

Table 1. Comparing cross-platform play capabilities

AccleByte Premium	Tools to configure cross-play preferences, enabling players to opt in or out of cross-platform matchmaking.
Epic Online Services	Designed to facilitate cross-platform play, allowing players from various platforms to interact seamlessly.
LootLocker	Backend services supporting cross-platform play ensure players can engage across different devices.
PlayFab	Supports cross-platform multiplayer features, facilitating player interactions across different platforms.
Pragma	Pragma's platform is optimized for cross-platform multiplayer experiences, supporting various gaming consoles and devices.
Unity Gaming Services	Supports cross-platform multiplayer gaming, enabling players across different platforms to connect and play together.

7.1.2. Game Economy

Table 2. Comparing game economy capabilities

AccleByte Premium	Offers robust game economy management tools, including virtual goods and currency management.
Epic Online Services	It provides features like achievements and leaderboards but does not offer a comprehensive game economy system.
LootLocker	Player currency management, item ownership, and in-game storefronts.
PlayFab	Comprehensive game economy services, including virtual goods, currency management, and in-game purchasing.
Pragma	Pragma: Pragma offers integrated game economy systems that support virtual currencies and item management.
Unity Gaming Services	Allows for in-game currencies, virtual goods, and economy configurations.

7.1.3. Progression

Table 3. Comparing progression capabilities

AccleByte Premium	Includes player progression services such as leaderboards, stats tracking, and customizable progression systems.
Epic Online Services	Robust player progression features, including achievements, leaderboards, and stats tracking.
LootLocker	Leaderboards and stats tracking, with customization options.
PlayFab	Extensive player progression services, including customizable leaderboards, stats tracking, and progression systems.
Pragma	Provides player progression services tailored to game-specific requirements, including stats tracking and leaderboards.
Unity Gaming Services	Offers player progression services, including leaderboards and player stats tracking.

7.1.4. Social

Table 4. Comparing social capabilities

AccleByte Premium	Supports friends systems, in-game chat, and player presence management.
Epic Online Services	Offers comprehensive social features, including friends lists, in-game chat, and presence functionality.
LootLocker	It offers basic social features, including player profiles and limited chat functionalities.
PlayFab	Social features include friends systems, in-game chat, and player presence tracking.
Pragma	It includes social features like friend lists, in-game chat, and player presence indicators.
Unity Gaming Services	Includes social features such as a friends system, in-game chat, and player presence indicators.

7.1.5. Matchmaking and Session Management

Table 5. Comparing matchmaking & session management capabilities

AccleByte Premium	Matchmaking services and player session management with support for cross-platform play and customizable rulesets.
Epic Online Services	Provides advanced matchmaking and player session management, supporting cross-platform play and custom configurations.
LootLocker	Matchmaking and session management features are suitable for various game types.
PlayFab	Comprehensive matchmaking and session management services, supporting various game modes and player configurations.
Pragma	Matchmaking and player session management services are optimized for performance and scalability.
Unity Gaming Services	Offers matchmaking services and player session management, supporting various game modes and configurations.

7.1.6. Custom Logic and Workflow Customizations

Table 6. Comparing customization capabilities

	Flexibility	Scripting Support
AccleByte Premium	provides high flexibility with support for custom logic and workflows	Yes
Epic Online Services	limited flexibility, focusing on ease of use and quick integration	No
LootLocker	moderate flexibility, suitable for many use cases but with some limitations	Yes
PlayFab	limited flexibility, focusing on ease of use and quick integration	Yes
Pragma	extensive flexibility, allowing for custom logic, scripting, and workflow customization.	Yes
Unity Gaming Services	limited flexibility, focusing on ease of use and quick integration	No

7.2. Tooling

7.2.1. Content Management

Table 7. Comparing content management capabilities

AccleByte Premium	Offers comprehensive content management tools, including asset management, content delivery, and version control.
Epic Online Services	It provides tools for managing game content and publishing updates and integrates with the Epic Games Store for streamlined publishing.
LootLocker	Centralized content management for virtual goods, currencies, and player-created content includes content moderation tools.
PlayFab	It provides content management capabilities, including in-game content updates and asset management, and integrates with Azure for content delivery.
Pragma	offers solid tooling for real-time multiplayer games, especially around server management, matchmaking, and session management, but does not provide as extensive content publishing tools as Unity Gaming Services or AccelByte Premium. Custom integration would be necessary to handle game assets and content updates.
Unity Gaming Services	Centralized dashboard for managing and publishing game resources; supports cloud content delivery, asset management, and game overrides

7.2.2. Analytics and Player Engagement

Table 8. Comparing analytics capabilities

AccleByte Premium	Solid analytics support with real-time analytics, performance metrics, and player engagement tracking.
Epic Online Services	Basic game analytics through the developer portal; tracks game activity, player retention, and online player counts
LootLocker	Basic analytics tools for monitoring player behavior and game performance include player engagement metrics.
PlayFab	Compelling offering with real-time analytics, event tracking, and segmentation; integrates with Azure for advanced data processing.
Pragma	Basic player behavior tracking and performance monitoring features, particularly focused on real-time multiplayer game performance. The offering is not as robust as that offered by PlayFab or Unity.
Unity Gaming Services	Excel has real-time analytics capabilities with prebuilt dashboards and visualizations that support A/B testing and custom event tracking.

7.2.3. Player Lifecycle Management

Table 9. Comparing player lifecycle management capabilities

AccleByte Premium	Compelling lifecycle management tools, including player profiles, messaging, and personalized content delivery.
Epic Online Services	It provides basic player lifecycle management tools and integrates with the Epic Games Store for account management and messaging.
LootLocker	Provides player profile management, messaging, segmentation and personalized content delivery; may require custom workflows for advanced use cases.
PlayFab	Advanced tools for player lifecycle management, including messaging, player segmentation, and personalized experiences; integrates with Azure for advanced analytics.
Pragma	It does not have a full suite of lifecycle management tools for messaging and personalized content delivery like PlayFab, Unity Gaming Services, or AccelByte Premium.
Unity Gaming Services	Comprehensive support with remote configuration, player segmentation, and personalized content delivery; integrates with Unity's analytics for targeted messaging.

7.3. Operational Complexity

7.3.1. Hosting Model

Table 10. Comparing hosting models

AccleByte Premium	Managed SaaS
Epic Online Services	Managed SaaS
LootLocker	Managed SaaS and Self-hosted
PlayFab	Managed SaaS
Pragma	Self-hosted
Unity Gaming Services	Managed SaaS

7.3.2. Scalability

Table 11. Comparing scaling capabilities

AccleByte Premium	Supports Autoscaling, no data on max scale
Epic Online Services	Autoscales have been proven to scale to 14 million concurrent users within 60 minutes.
LootLocker	Supports Autoscaling, no data on max scale
PlayFab	Supports Autoscaling, no data on max scale
Pragma	Autoscales: load-tested to handle 1 million concurrent users on AWS
Unity Gaming Services	Supports Autoscaling, no data on max scale

7.3.3. Usage Limits

Table 12. Comparing usage limits

AccleByte Premium	Rate limits apply at higher traffic; specific limits not detailed
Epic Online Services	No official rate limits were published.
LootLocker	Focuses on file upload limits rather than API call rates.
PlayFab	Varies by API; for Economy API, 150 requests/min per player
Pragma	No specific rate limits have been published; it relies on self-hosted infrastructure.
Unity Gaming Services	12,000 requests/min (per player) for Cloud Code Client API; 120 requests/min for Admin API

7.3.4. Compliance

Table 13. Comparing compliance capabilities

AccleByte Premium	Implements features for data portability and erasure; supports GDPR and CCPA processes.
Epic Online Services	Offers tools for data management and user consent; specific details may require direct inquiry.
LootLocker	Provides endpoints for data deletion and user data management.
PlayFab	Offers tools for data export and deletion; assists developers in fulfilling GDPR obligations
Pragma	As a self-hosted solution, compliance depends on the developer's implementation and adherence to regulations.
Unity Gaming Services	It provides tools for data management and user consent and allows for data retention customization.

7.4. Cost

Table 14. Cost Comparison

	Pricing Model	Cost Effectiveness
AccleByte Premium	Pay-as-you-go. Free for up to 25,000 play hours or 90 days; then from $100/month for a shared cloud offering.	It suits mid-sized to large games and may be costly for smaller projects.
Epic Online Services	Free to use	Highly cost-effective, especially for indie developers and small studios
LootLocker	Free to use during development. After launch, it is free for up to 1,000 MAU; $0.015 per additional user.	Affordable for small games; costs increase proportionally to the user base.
PlayFab	Free for up to 100,000 users in Development Mode; then pay-as-you-go.	It scales well for small and large games; costs increase with the user base.
Pragma	Free-to-start, self-serve solutions; pricing based on contract terms.	Cost-effective for large-scale games; pricing varies based on contract.
Unity Gaming Services	Pay-as-you-go. Free for up to 5,000 monthly active users (MAU); $0.05 per additional user	Ideal for small to mid-sized games. It scales well for larger games but may become costly as the user base grows.

8. Overall Comparison

Having evaluated the different platforms across key criteria such as feature depth, tooling, and scalability, the next step is to reflect on how these platforms align with a specific game's goals and long-term vision for success.

Each of these products has unique offerings suited to different types and scales of games. Below is an overview of the scenarios these products are best suited for:

Table 15. Overall Comparison

	Summary
AccleByte Premium	AccelByte is highly regarded for its affordability, flexibility, and ability to scale games from indie to large-scale live-service operations, with features built specifically for mid to large multiplayer games. It might be more complex than EOS or PlayFab for smaller games.
Epic Online Services	A popular choice for games of all sizes looking to get started with a free product with basic

	features, especially when paired with other platforms for complex use cases. There is robust support for matchmaking and player stats but not as much depth in player progression and in-game economy features.
LootLocker	It is excellent for developers looking for a comprehensive yet simple game economy system, especially if you need inventory and currency management. It is a good choice for smaller to mid-sized games but might lack the extensive features and customizability of platforms like PlayFab or AccelByte.
PlayFab	It is Popular for its feature-rich, easy-to-use backend services, especially in-game economy, player progression and matchmaking. PlayFab scales well for games of all sizes and is relatively cost-effective.
Pragma	Best for real-time, high-performance games focusing on low-latency multiplayer and strong matchmaking. However, it may lack some broader features (economy, social elements, personalization) offered by other platforms and requires developers to self-host the platform.
Unity Gaming Services	It is the top choice for games built on the Unity game engine due to the seamless integration and support for most cross-platform play, analytics, and game economy needs. However, it may not be as strong in matchmaking and advanced multiplayer networking as other platforms.

9. Conclusion

Developing services that scale to support the needs of today's games requires effort and consideration. While many game developers will prefer building the technology in-house, many compelling offerings are available in the marketplace that support a variety of games. Armed with the information in this analysis, game developers have many options when building live service games.

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