Jio PLATFORMS

SOLUTION BRIEF

5G Cloud Gaming

An unparalleled gaming experience enabled by JPL's cutting-edge 5G technology.

Business Challenges

The gaming market is a rapidly growing industry, generating substantial revenue through game sales, in-game purchases, and subscriptions. With the introduction of cloud gaming, 5G is opening more revenue opportunities than ever. To tap this potential, what the industry needs now is to deliver superior user experience.

Ask any gamer and they'll tell you that response time is everything. Advancing technological capabilities are encouraging game designers to innovate their offerings, but when it comes to practical application, latency issues are still a concern. Limitations within existing networks often cause noticeable delays between player actions and in-game responses, hindering the gaming experience.

For a seamless, advanced, real-time gaming experience, low latency is crucial. This calls for a 5G-powered cloud gaming solution that can leverage the capabilities of next-gen network technology to deliver ultra-low latency, high-bandwidth connections, and a consistent experience across devices.

JPL's Solution

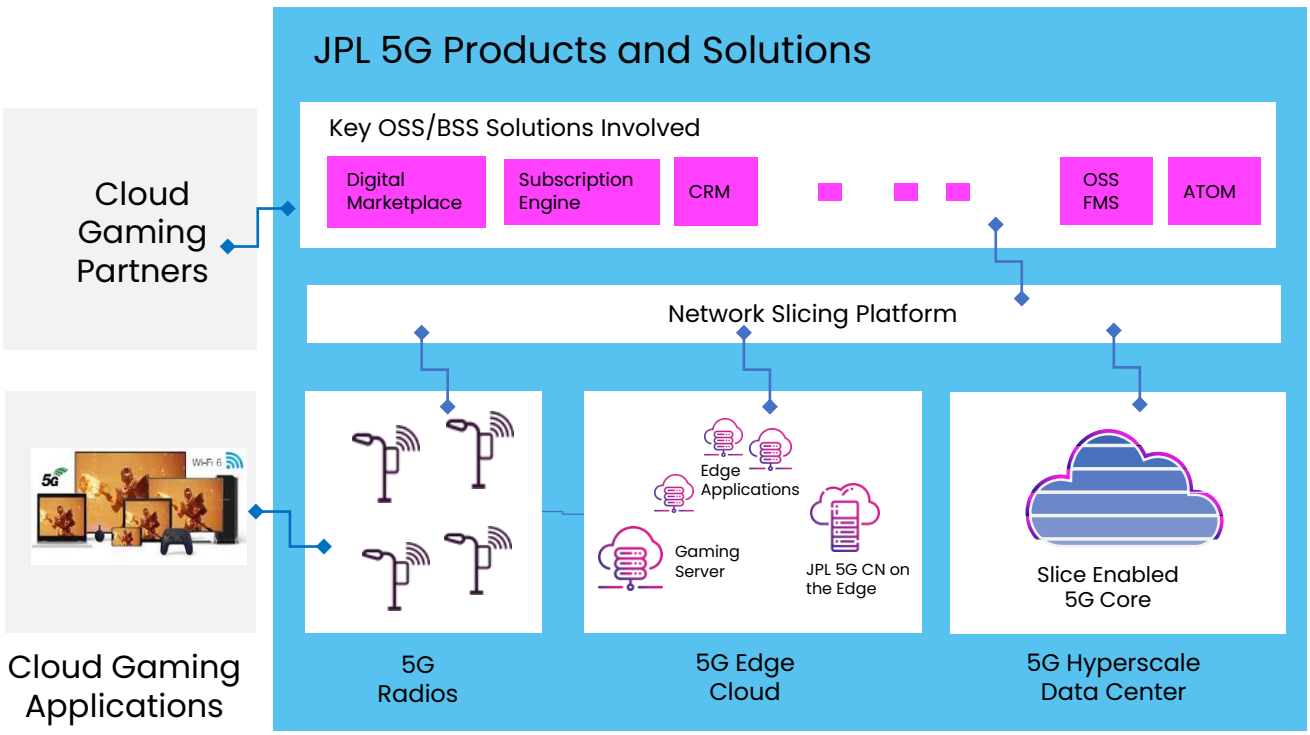
Jio Platforms' 5G Cloud Gaming leverages cloud computing and high-speed internet to transform the way games are accessed and played.

The solution lets gamers play on any device with an internet connection, ensuring a high-quality gaming experience.

It eliminates the need for physical or downloaded copies of games on consoles, PCs, or smartphones. By subscribing to cloud gaming services, enthusiasts can enjoy gaming from any location using their existing devices, without the need for expensive high-end equipment.

Jio Platforms' end-to-end 5G technology helps enable a seamless and immersive gaming experience.

Cloud Gaming
Solution Architecture



The JPL product suite enables any provider to deploy a robust 5G-powered cloud gaming architecture, supported by its slice-enabled 5G core, and an array of BSS/OSS products:

- Marketplace Platform acts as a UI for consumers and businesses to browse, buy, and sell products.
- CRM platform supports end-to-end processes of lead management; order capture and fulfilment; trouble to resolve; customer onboarding using DKYC; as well as document management for regulatory purposes.
- Subscription Engine interacts with content platforms to provision and enable the consumption of content.
- OSS Fulfilment Management System is a next-generation workflow orchestration, provisioning, and activation platform that simplifies operations by replacing a traditional, high-touch management model with a next generation, programmable and virtualized model.
- ATOM leverages machine learning to detect anomalous network patterns and create reports and alerts based on these patterns for proactive root-cause analysis and resolution – before the symptoms start affecting network operations.

Cloud Gaming Service Provider Journey

The Jio Platforms Digital Business Support Systems (BSS) stack enables service providers to deliver a seamless and high-quality gaming experience to customers, while efficiently managing back-end operations and billing processes.

Service Ordering and Provisioning Service Subscription

JPL CRM

JPL Digital MP

The first step involves the customer placing an order for the cloud gaming service through a digital platform such as the Jio Marketplace (website and mobile app). The BSS provisions all required cloud resources such as virtual machines, storage, and network infrastructure to deliver the service. The content and features can be discovered through the Product Catalogue.

Subscriber Billing Management

JPL SE

The Subscription Engine (SE) manages subscribers and their profiles, including their preferences, payment details, subscription tiers, and usage patterns. It ensures a seamless user experience and enables targeted marketing. It generates invoices and manages billing/payments, including recurrent billing for subscription-based services.

Usage Monitoring

JPL SE

The Subscription Engine also tracks and analyzes how players use the platform and the games available on it. It collects metrics including player engagement, retention, and monetization. Usage monitoring can be used to identify popular games, optimize game performance, improve monetization, and enhance player experiences.

Service Quality Management

Jio FMS

To ensure a high-quality gaming experience, the Fulfillment Management System (FMS) monitors key performance indicators such as latency, frame rate, and network bandwidth. It also provides real-time alerts and notifications to enable proactive troubleshooting and issue resolution.

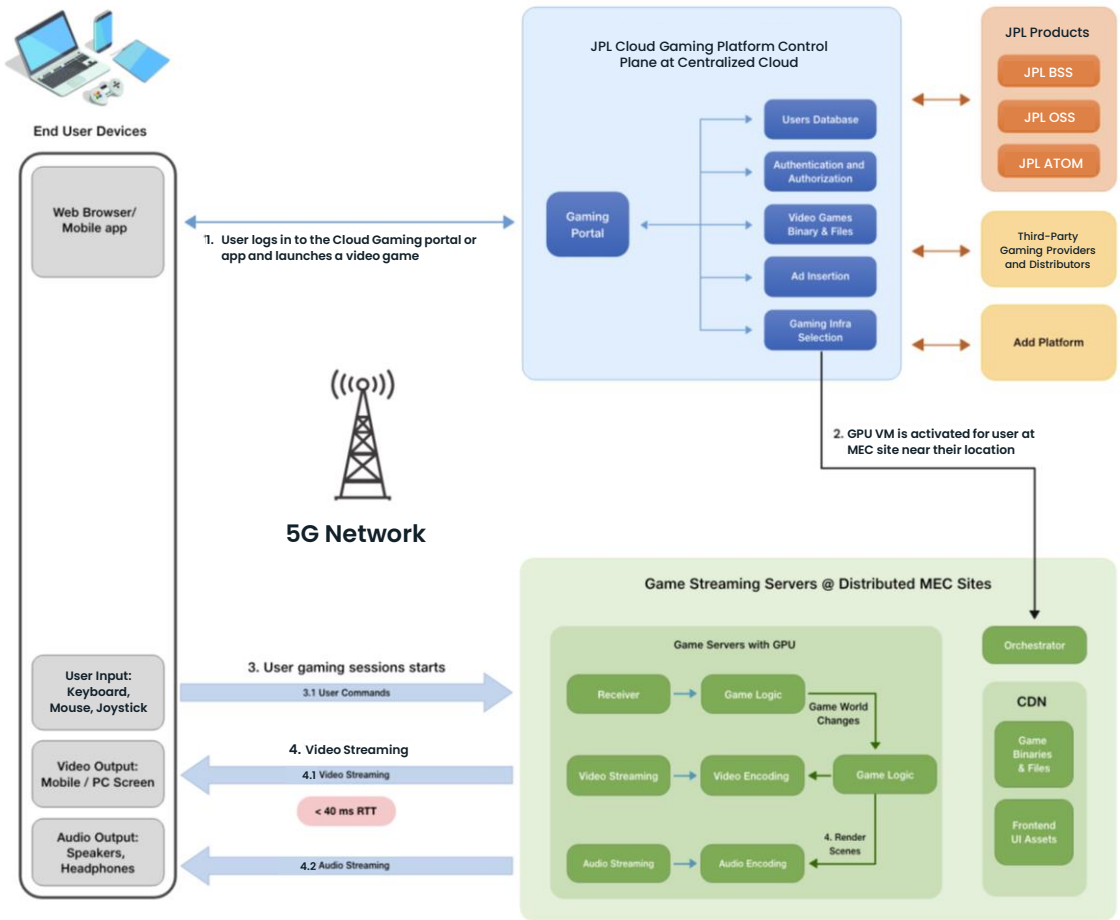
Customer Service and Support

Jio CRM

The CRM provides customer service and support through digital channels such as self-service portals and automated responses. It also enables escalation to human agents for complex issues, as well as providing tools for remote diagnostics and troubleshooting.

Cloud Gaming
Functional Architecture

JPL employs MEC sites to deploy gaming servers with GPU capabilities. Depending on the user's location, gaming virtual machines or desktops are dynamically created at the MEC site to reduce latency during gameplay. These virtual machines are deleted when the user logs out or when the session expires. Additionally, popular game files such as images, videos, and binaries are cached at MEC content delivery networks (CDNs), resulting in faster game loading times on the virtual machines or desktops once the user selects a game.



JioGames Portfolio

JioGames is set to revolutionize gaming by providing a seamless user experience. With lag-free connectivity, users can participate in tournaments, enjoy high-speed uninterrupted streaming, and more – all without the need for any installations or high-end consoles.

The JioGames application provides dozens of fun quality instant games and AAA cloud games with multiple other options – available on all mobiles, laptops and Jio set-top boxes:

JioGames Cloud

Available to play on the Jio set-top box, Android smartphones, and web browsers on PCs and Macs, JioGames Cloud provides full HD quality gaming, with AAA titles, without the need to download or install locally, streamed on the 5G network.

JioGames Esports

JioGames Esports provides a professionally competitive e-sporting experience for gamers to showcase their skills in various online and offline tournaments. Established as well as budding athletes can compete, improve their competency, and even win substantial prize pools.

JioGames Watch

JioGames Watch provides an immersive and interactive game streaming experience across multiple devices, where users can livestream gameplays and share it with friends, family, and the gaming community on the platform. Users can create their own communities, allowing them to follow their favorite gamers and interact with them in a brand-new way.

JioGames Arena

JioGames Arena lets users participate in gaming tournaments of their favorite games every day. Users can invite their friends to pre-scheduled tournaments or set their own tournaments, to maintain their position on leaderboards, where they earn points that can be redeemed for exciting rewards.

JioGames Dev

This platform lets developers from around the world distribute their games across a wide range of consumer devices. It provides robust developer support, a large user base, and partnership opportunities.

Revolutionizing
Cloud Gaming with 5G

The advent of 5G marks a significant transformation for individual gamers and the industry as a whole. The combination of 5G's enhanced speed, reduced latency, and expanded data capacity has the potential to revolutionize the gaming experience for home gamers, presenting a paradigm shift in the way games are played.

- Ultrafast Speeds: Faster download and upload speeds compared to previous network technologies help reduce latency and ensuring smooth, lag-free gameplay in cloud gaming.

- Low Latency: Enables real-time responsiveness in cloud gaming, allowing players to experience instant input-to-action feedback, enhancing the overall gaming experience.

- High Bandwidth: Allows seamless streaming of high-quality, graphics-intensive games, ensuring a visually stunning and immersive gaming experience for players.

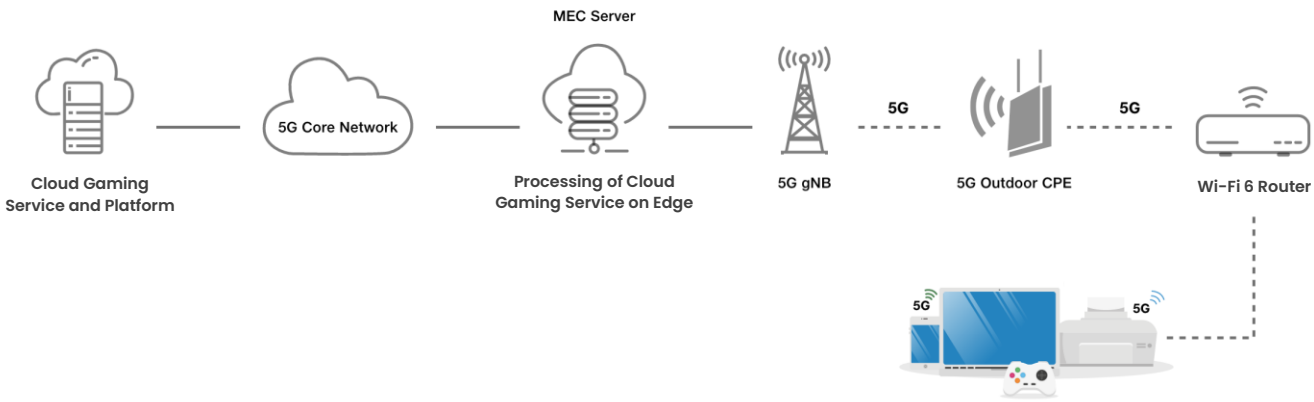
- AAA Content: Cloud gaming enables access to a wide library of titles including AAA and AA games, without requiring individual purchases. It also promotes the development of games by end users.

- Multiplayer Capabilities: 5G's high bandwidth and low latency enable seamless multiplayer gaming, facilitating real-time interaction, and collaboration among players.

The major requirement for cloud gaming is latency in the network. The additional latency capabilities in case of OTT cloud gaming services are introduced due to the network latency while the user communicates with cloud gaming servers.

Network Integration

JPL achieves ultralow latency over a cutting-edge 5G network and further reduces it with edge-level processing using a Multi-access Edge Computing (MEC) server. Backend systems are located in data centers while all the processing is done at the edge using MEC servers, ensuring a seamless and real-time gaming experience.



Integration of Cloud Gaming Services over a 5G Network

Integrating cloud gaming with a 5G telecom network involves:

Infrastructure Development

Building robust 5G network infrastructure with sufficient coverage and capacity to support the high-speed and low-latency requirements of cloud gaming.

Edge Computing and Data Centers

To reduce latency and enhance the gaming experience, edge computing and data centers can be strategically placed closer to the network edge. This enables game processing and data storage in close proximity to users, minimizing the distance and time required for data transmission.

Network Slicing

Network slicing allows operators to create dedicated virtual networks or slices specifically tailored for cloud gaming. This ensures that gaming traffic receives prioritized and optimized connectivity, delivering low latency and high bandwidth to support smooth gameplay.

Quality of Service (QoS) Prioritization

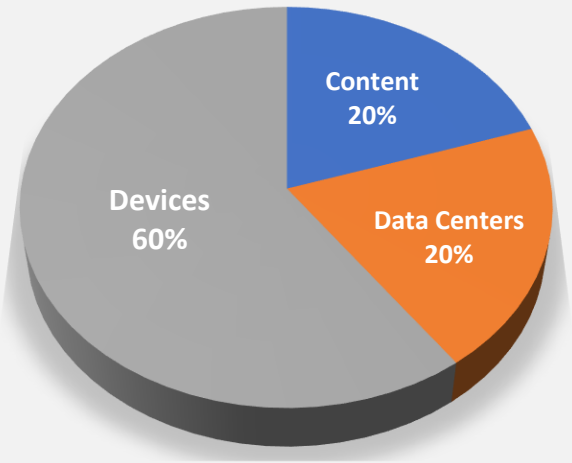
Operators can prioritize cloud gaming traffic over other types of network traffic to ensure a consistent and reliable gaming experience. By assigning higher QoS levels to gaming data packets, they can minimize delays, packet loss, and jitter during gameplay.

Partnerships and Integration

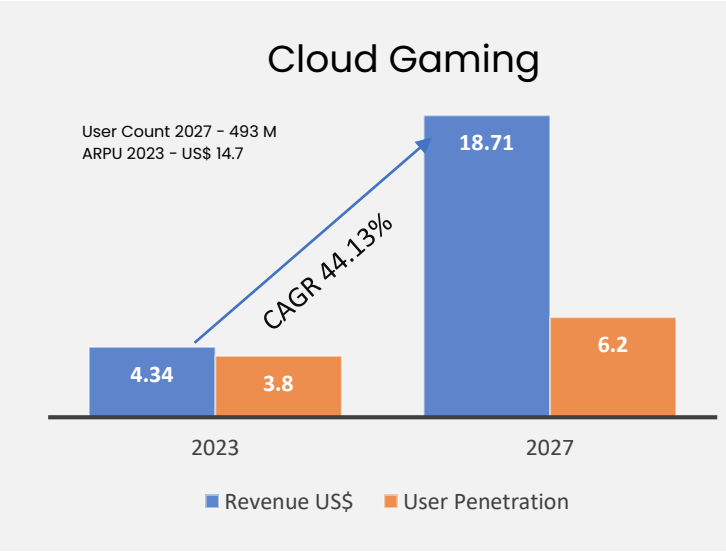
Collaboration between telecom operators, cloud gaming providers, and game developers helps ensure seamless integration.

An MEC-Ready Platform

Globally, the costs in deploying a cloud gaming platform primarily revolve around server infrastructure, both in terms of capital expenditure (CAPEX) and operational expenditure (OPEX). The need for low latency necessitates regional data centers with specialized hardware like GPU-enabled CPUs, resulting in higher CAPEX.



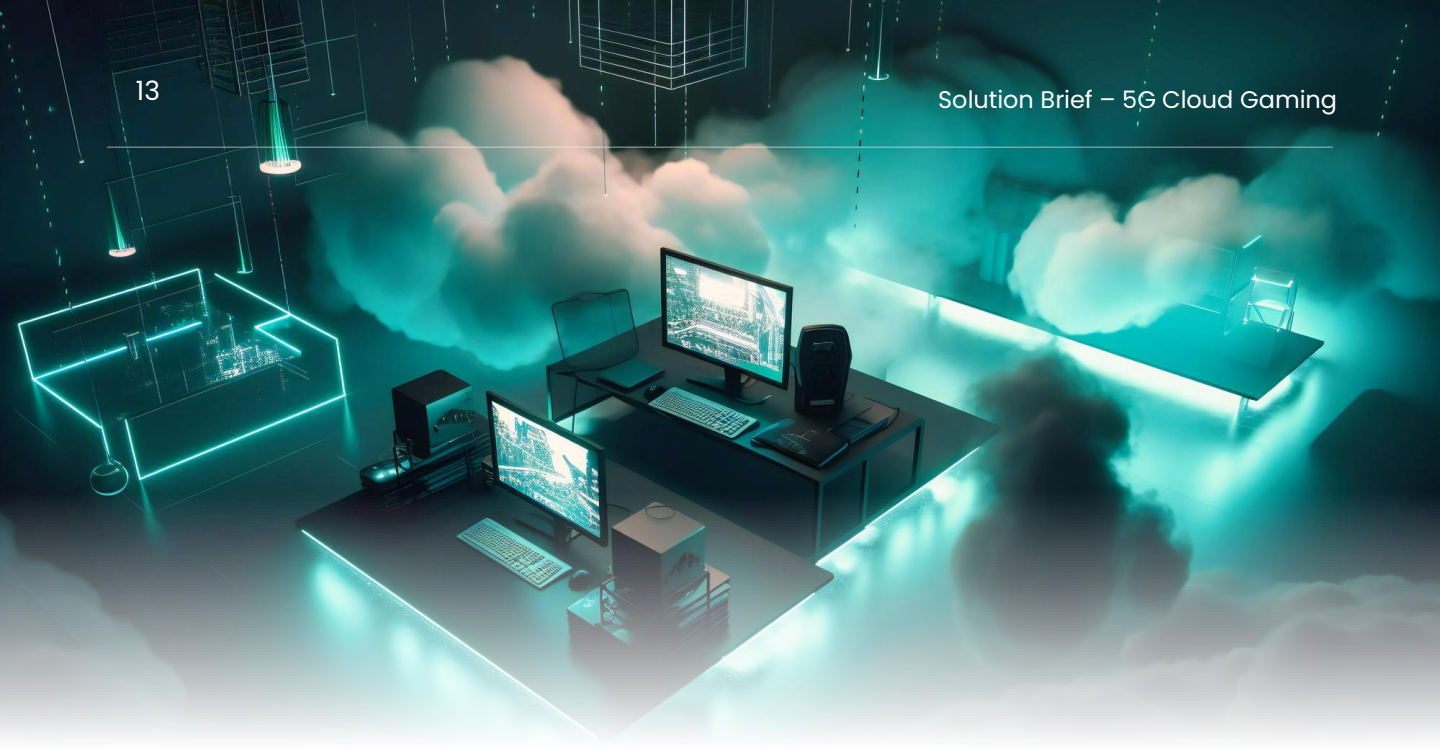
Cloud Gaming Revenue Breakup



Source: Statista

The cloud gaming revenue pie consists of data center revenue, devices revenue, content revenue, and so on. The data center is the highest revenue contributor.

JPL's Standalone 5G Core substantially reduces OPEX. It integrates with operator's MEC architecture to provide a robust, lag-free experience to its users.



Impact
of 5G Cloud Gaming

- **Gaming Industry:** 5G cloud gaming has the potential to reshape the industry by enabling new business models, expanding game accessibility, and delivering immersive experiences. It opens opportunities for game developers and publishers to reach a wider audience and deliver high-quality games without the need for expensive hardware.

- **Network Infrastructure:** 5G cloud gaming requires high-speed, low-latency connections. This demands robust network infrastructure and connectivity technologies, emphasizing on the need for an advanced 5G stack like JPL's.

- **Mobile Devices and Edge Computing**: With 5G cloud gaming, gamers can enjoy console-like experiences on their mobile devices. This drives the development of more powerful smartphones and tablets with enhanced processing capabilities. Additionally, edge computing plays a crucial role in reducing latency by bringing game processing closer to the user, enabling faster response times.

- **Esports and Online Gaming Communities:** 5G cloud gaming can have a transformative impact on the way esports and online gaming communities operate. It enables real-time multiplayer gaming experiences with minimal lag, fostering competitive gaming and interactive gameplay among players around the world. This capability opens a host of opportunities for the industry, such as hosting esports tournaments, support for streaming platforms, and enabling social interactions within gaming communities.

- **Streaming and Content Delivery:** With the rise of 5G cloud gaming, streaming and content delivery platforms are experiencing increased demand for high-quality and lag-free game streaming services like never before. This is leading to advancements in video streaming technologies, content delivery networks (CDNs), and adaptive streaming algorithms that can support smooth and uninterrupted gameplay.

- **Digital Transformation and Technology Innovation:** 5G cloud gaming is driving innovation in cloud computing, edge computing, and network technologies. These innovations are enabling advancements in areas such as virtual reality (VR), augmented reality (AR), Metaverse, artificial intelligence (AI), and immersive gaming experiences.

Features
of Cloud Gaming

- Eliminates the need for game installation and upgrades
- Instant access to gaming library
- Up-to-date with the latest gaming experiences
- Device-agnostic and cross-platform support
- Lower hardware requirements
- Flexibility to game from anywhere at anytime

Highlights of JPL's 5G Cloud Gaming Platform

- Serves as a gateway for end users to access 5G gaming services, including gaming applications and web browsers.
- Handles user authentication and authorization, either through user credentials or integration with third-party authentication services.
- Provides integration with JPL's BSS, enabling subscription management and subscriber provisioning for seamless service delivery.
- Facilitates the selection and allocation of gaming infrastructure, ensuring that gaming servers are located at the nearest MEC site to minimize end-to-end round trip time (RTT).
- Manages game files such as game binaries, demo videos, and still images, forming a comprehensive game library.
- Seamlessly integrates with third-party digital game stores and distributors, enabling users to access a wide range of games.
- Supports onboarding services for third-party game developers to bring their games onto the network.
- Integrated with the ATOM platform, which leverages AI/ML to enable advanced analytics and reporting, benefiting publishers and gamers.
- Integrates with an ad platform, allowing subscribers to receive targeted promotions based on their interests.

Cloud Gaming
Analytics and KPIs

Analytics, in case of cloud gaming, play a crucial role in understanding player behavior, optimizing gaming experiences, and driving business decisions. Through data analysis, operators can gain insights into player preferences, usage patterns, and engagement metrics to personalize gaming recommendations and improve content offerings.

Advanced analytics capabilities also help identify network performance bottlenecks, monitor quality of service, and optimize resource allocation for seamless and reliable gameplay. Operators can enhance the overall gaming experience, increase player satisfaction, and drive revenue growth in the 5G cloud gaming ecosystem.

JPL's Adaptive Troubleshooting, Operations, and Management (**ATOM**) platform helps leverage untapped data into actionable insights and real-time decisions, ensuring superior customer experience. The cloud-native data lake solution is designed to enhance operational efficiency using Machine Learning as a Service (MLaaS). By harnessing AI/ML capabilities, it identifies unusual network patterns, generates reports, and issues alerts for proactive root cause analysis and resolution, preventing network issues from impacting operations. It empowers operators to make smarter operational decisions and optimize performance through advanced analytics and automated troubleshooting.

Consumption/Usage KPIs are metrics used to monitor data usage and revenue. Some of the main KPIs for cloud gaming include:

S. No.	KPI	Definition	UoM	Target Value
1	DAU/MAU	Percentage of DAU/MAU	Percentage	> 20%
2	Daily Sessions	Total number of unique sessions created	Count	As High As Possible
3	Total Streams	Total number of streams by users	Count	As High As Possible
4	Total Play Time	Total play time in hours	Hours	As High As Possible
5	Avg. No. of Streams/Active User	Average streams listened to by an active user	Count	As High As Possible
6	Avg. Data Consumed/Active User	Average data consumed by an active user in TB	Count	As High As Possible
7	Search Events	Fired when the customer searches for content	Count	As High As Possible
8	Active Subscriptions	Number of active subscriptions	Number	As High As Possible

Performance/Operational KPIs are the metrics used to monitor performance and usability. These include:

S. No.	KPI	Definition	UoM	Target Value
1	Incoming Frame Rate from Network	Average estimated number of frames that are received.	Number	Maximum as configured (30 or 60 FPS)
2	Decoding Frame Rate	Average number of decoded frames in the client.	Number	Maximum as configured (30 or 60 FPS)
3	Rendering Frame Rate	Average number of rendered frames in the client.	Number	Maximum as configured (30 or 60 FPS)
4	Frames Dropped by Network	Average percentage of frames lost in the transport process due to network errors or hardware limitations.	Percentage	<1%
5	Frames Dropped due to Jitter	Average percentage of lost frames due to jitter.	Percentage	<1%
6	Average Receive Time	Average time that an encoded frame needs to be completed since the first packet was sent from the server.	Milliseconds	<33.33 ms
7	Average Decoding Time	Average time that a reassembled frame needs to be decoded in the client.	Milliseconds	<33.33 ms
8	Average Rendering Time	Average time that a decoded frame needs to be rendered and represented in client's screen. This KQI considers V-SYNC latency.	Milliseconds	<16.67 ms
9	Average Frame Queue Delay	Average time that a decoded frame waits in the queue before the rendering process.	Milliseconds	<16.67 ms

S. No.	KPI	Definition	UoM	Target Value
10	App Start Time	Time taken to launch the app and show home screen	Seconds	< 5 seconds
11	No. of Crashes	Count of users who are experiencing app crash at app launch	Percentage	< 0.1%
12	Login Failures	No. of times with login failed	Percentage	< 1%
13	API Failure	No. of times where API is getting failed	Percentage	< 1%
14	Playback Error	No. of times media could not be played	Percentage	< 2%
15	Screen Load Time	Average time taken to load the screen	Seconds	< 3 seconds
16	Total Errors	Total count of errors	Percentage	< 1%
17	Buffer Ratio	No. of times content has buffered	Percentage	< 0.01%
18	ANR	Count of users who are experiencing ANR in the application	Percentage	< 0.1%

Conclusion

By leveraging the power of 5G networks and cloud computing, operators can revolutionize the way games are accessed, played, and monetized. In cloud gaming, latency is the most important factor in driving success. Jio Platforms' end-to-end 5G stack leverages network slicing capabilities to meet its low latency and high bandwidth demands.

JPL's 5G Cloud Gaming solution overcomes the challenges of traditional gaming methods, enabling users to stream games directly from the internet, rather than downloading and running them on individual devices. It turns any mobile device into a gaming console.

Jio Platforms is helping democratize high-end gaming, supporting it on any device from anywhere without having to buy expensive consoles and devices. It lets gamers experience even the most graphics-intensive gaming on the device of their choice.

As 5G networks continue to expand globally and advancements in cloud technology accelerate, the future of gaming is promising. Early-movers who adapt their strategies to harness its potential will be well-positioned to thrive in this evolving landscape.

5G cloud gaming represents a paradigm shift towards a more accessible, immersive, and financially rewarding gaming ecosystem for companies and gamers alike. It serves as a catalyst for monetization for the gaming industry as well as service providers. Jio Platforms is at the forefront of this revolution.

Common Abbreviations

AAA	Recognized as the highest rating for cloud gaming.
ANR	Application Not Responding
ARPU	Average Revenue Per User
ATOM	Adaptive Troubleshooting and Operations Management Platform
BSS	Business Support Systems
CAPEX	Capital Expenditure
CRM	Customer Relationship Management Platform
Digital MP	Digital Marketplace
FMS	Fulfilment Management System
MEC	Multi-access Edge Computing
OPEX	Operational Expenditure
OSS	Operations Support Systems
RTT	Round Trip Time
SE	Subscription Engine

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