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One Level Up: Mobile Gaming on the Cloud

Content

01 Smartphone Era

In today's digital era, it is hard to imagine life without smartphones. Mobile devices are as much integrated into our daily lives as our family members. Smartphones even foster interaction with family and friends irrespective of where we are. Today smartphones are multifunctional at levels beyond mere communication, thanks to the development of mobile applications or "apps".

It is social platforms alongside video, and game applications that dominate the market share of mobile applications. Mobile game downloads, in particular, are exploding and maturing from standalone to Internet-based multiplayer versions. Player-to-player real-time interactions are made possible by high-speed Internet connections. The development of three-dimensional (3D) graphics and improved rendering technologies have also made gaming scenarios more vivid, realistic, and engaging.

This whitepaper provides an overview of the history, development, and challenges of mobile gaming. It also covers how cloud gaming allows developers/enterprises to quickly build, deploy, distribute, and monetize their applications while offering a seamless user experience with minimal response time. Furthermore, it details various kinds of cloud gaming solutions available in the market, as well as recommended solution architectures for mobile cloud MMOG's and card-based mobile gaming, including Alibaba Cloud's impact on a customer's business and user experience. It also provides an insight into the future of cloud gaming and reasons why now is the time to go on the cloud.

1.1 Mobile Gaming

1.1.1 Overview & Evolution

Towards the end of the 20th Century, mobile phones gained immense global popularity following a fall in the cost of these devices and expanding purchase options. At the same time, advances in technology have enabled mobile games to become more sophisticated and engaging.

The very first mobile phone game dates back to the 1976 release of Mattel Electronic Auto Race. Recognized as the first handheld electronic game, it introduced to the world a new form of gaming. Commencing in the '80s, Nintendo, Atari, and Sega entered the race with their own handheld devices. However, it wasn't until 1997 and the release of Snake, which came preinstalled on the Nokia 6110 model, that mobile games burst onto the scene. Similar to pre-installed games of its generation, the relentless serpent maze runner game consisted of nothing more than a few black pixels moving on green pixels. It was arguably the most addictive handheld title since Tetris on Game Boy. Despite its limited scope, Snake introduced a disruptive functionality to mobile phones.

Back then, preloaded (or embedded) mobile games were usually limited to crude monochrome dot matrix graphics (or text) and single channel tones. The storage of the games was limited to the respective device, and commands were

inputted via the device keypad buttons. In the early 2000s, WAP and other old mobile Internet protocols allowed for simple client-server games to be hosted online. These games could be played through a WAP browser on devices that lacked the capability to download and run discrete applications. While WAP was primitive, it opened the door for the more mature and sophisticated Java 2 Micro Edition (J2ME) and Binary Runtime Environment for Wireless (BREW) with the advent of feature phones (contemporarily referred to as the camera phone). More hardware power became available even in bottom range devices. Color screens, multi-channel sound, and most importantly, the ability to download and store new applications paved the way for commercially published mobile games.

This followed by a phone with a desktop-like interface and advanced hardware optimized for complex games, which marked the beginning of the smartphone era in 2007. While some games saw success after the initial launch of iOS and Android app stores, none were more explosive than the 2009 release of Angry Birds. Its success sparked an increase in the number and quality of games, leading to the creation of Temple Run, Draw Something, Clash of Clans and Candy Crush Saga.

These games have shaped the industry to create social, interactive, and engaging games targeted to all demographics. With millions of new games added to smartphones from app stores each day, it only makes sense that developers and publishers focus on smartphones as their primary platform, instead of AAA games (an industry classification for games with premium development and marketing budget).

Mobiles games that were once a mere simple combination of colored pixels have been transformed to deliver PC quality graphics and insane gameplay. While each person does not own a computer or console gaming system, almost everyone owns a mobile phone. This ability to reach more people has had a tremendous impact on the growth of the mobile gaming market.

1.1.2 Gaming Industry Challenges

To cater to the growing needs of mobile game fanatics, gaming companies require a platform that provides a high-level approach to collect, store, and analyze massive amounts of player telemetry data. A scalable, cost effective, and highly available platform is a top priority to meeting game requirements. Minimal latency (or acceleration) is a prerequisite for any online gaming application that is accessible by multiple users spread across the globe. Servers also need to be laid out internationally in an efficient and uninterrupted manner to effectively accelerate online gaming overseas. To provide a stable, highly available, and disaster resistant mobile gaming platform, cloud solutions are now the first choice for enterprises. The integrated scalability of the cloud eliminates overhead costs incurred from over-provisioning resources and performance limitations caused by under-provisioning.

02 Mobile Gaming Cloud Solution

2.1 Overview

"Gaming-on-Demand" is an emerging trend in the gaming industry that leverages cloud computing for its back-end infrastructure. Video games execute via private cloud servers, and gaming video frames transmit via the Internet to desktop PCs or interactive televisions. Conversely, game players' interactions are sent to cloud servers over the same network. When the Gaming-on-Demand model is applied to mobile devices with wireless communication capability, it is known as "Mobile Cloud Video Gaming (MCVG)."

Cloud solutions for mobile gaming enable enterprises to develop advanced and unique games with better user experience and response time, as well as low operational and maintenance costs. Transitioning gaming applications to the cloud drives down hardware and upgrade costs thanks to Pay-As-You-Go or subscription payment models. The growth of the gaming business and the cloud environment also go hand-in-hand. When demand is unpredictable or testing is required for new features, the ability to spin capacity up or down is now instantly available, while the game provider only ever pays for what is used and required.

2.2 Cloud Gaming Solutions Flood the Market

Several cloud gaming solutions are available that allow game developers to build, deploy, distribute and monetize their applications quickly. The built-in elasticity and Pay-As-You-Go model makes for highly cost-effective solutions.

They provide reliable, available and highly scalable infrastructure with robust high-memory server clusters aimed at delivering satisfying gaming experiences for end-users and minimal operational overheads for game developers and providers. With dedicated gaming clusters that support high concurrency and multi-scenario game deployment, developers can cater to a large number of gamers and grow rapidly. They offer superior geographic distribution with the ability to deploy gaming applications from data centers in different locations around the world. They also ensure data security and eliminate a single-point-of-failure (SPOF) by providing automatic failover.

Let's now take a deep dive into the two most popular mobile gaming solutions, massively multiplayer online games (MMOG) and card-based mobile gaming, which occupy a significant segment of the market.

03 MMOG Mobile Cloud Solution

3.1 Overview

Massively multiplayer online games (MMOG) are capable of supporting large numbers of players simultaneously. Access layers of MMOG servers require high connectivity and network throughput built on a robust architecture. These games can be found on most network-capable platforms, including smartphones and other mobile devices. MMOGs enable players to cooperate and compete with each other on a large-scale and interact with other players around the world. They include a variety of gameplays, representing several video game genres.

Monitoring gaming infrastructure 24/7 is a challenge for most game development providers, which is both time-consuming and expensive, and especially for MMOGs. A managed cloud solution allows gaming providers to automate monitoring of their infrastructure and keep data secure. Ever-changing requirements in gaming applications also mean that the infrastructure has to be flexible with quick response time. With cloud infrastructure, new features can rapidly be deployed and go live in a short period, keeping organizations at the forefront of innovation.

A cloud solution also provides faster, secure, and stable connections with minimum latency to provide an optimal gaming experience for users.

3.2 MMOG Developer Challenges

The biggest challenge for mobile game developers is building a robust and powerful back-end architecture to provide mobile MMOG players a seamless experience comparable to traditional PC-based games. Cloud MMOG mobile gaming solutions offer a highly scalable and optimized architecture catering to the needs of mobile game developers.

Challenges

As the mobile game market has become more competitive, there has been massive growth in the number of RPGs (role-playing games). Among RPGs, MMORPG is one of the most popular subcategories. As a result, designers and developers are facing a new challenge to create a mobile background architecture that provides mobile MMOG players with the same smooth experience as enjoyed on traditional PC games.

1. Large Bandwidth and High Package Volume

MMOG's aim to provide the largest field of view possible, and movement and combat are among the core gameplay aspects that require mutual real-time visibility between gamers on the same screen. A large volume of movement and combat packets must be broadcast within a certain field of vision. In this case, MMOG servers produce a massive amount of communication packets when many gamers are playing simultaneously. Therefore, access layers of MMOG servers require network bandwidth and high network packet throughput.

2. Elastic Resource Scalability

Mobile MMOG's are characterized by "light games" and "time fragmentation". As a result, the industry requires maximum conservation and utilization of game server resources to efficiently achieve zone and server combinations for MMOG servers.

3. High Computing Power

For MMOG's played on the Web, providers hope to use the strong interaction between players to attract new gamers. Therefore, the concurrent player base in individual zones must increase as much as possible. The maximum number of gamers in a single zone at a single time is in the thousands, so MMOG's require strong interaction and validation as well as high game server computing power.

4. Nearby Access

MMOG's for the Web generally adopt nearby deployment models based on zones and servers and use multiple centers across regions. This model gives gamers nearby access to the game server to ensure smooth gameplay and enhances the gaming experience.

3.3 MMOG Mobile Cloud Solution - User Case

The following real-life solution illustrates a recommended MMOG mobile cloud solution.

A leading global game studio turned to Alibaba Cloud to scale its gaming platform to handle traffic from millions of users a day, with little or no operational resources.

The Challenge

The global gaming service provider required a multi-layer architecture to develop loosely coupled systems where different application components could be independently deployed, maintained, and updated on various time schedules. It also required securing portions of the application that are behind the firewall and make other components accessible from the Internet. Besides a scalable and cost-effective solution, a stable network accessible from across the globe was required.

In order to give gamers nearby access to games and decrease the possibility of disconnection, high computing power, and stable game access experience were the top priorities.

The Solution

Alibaba Cloud studied the customer's challenges and implemented the following steps:

1. Global Service Primary/Secondary Disaster Recovery

Game server services are classified as regional (e.g. chat services) and global (e.g. gateway services). If a global service encounters a fault, this affects all players in the game. Therefore, the high availability of global services must be ensured. This was accomplished by building primary/secondary dual-activity nodes on the ECS instance.

2. Layered Architecture

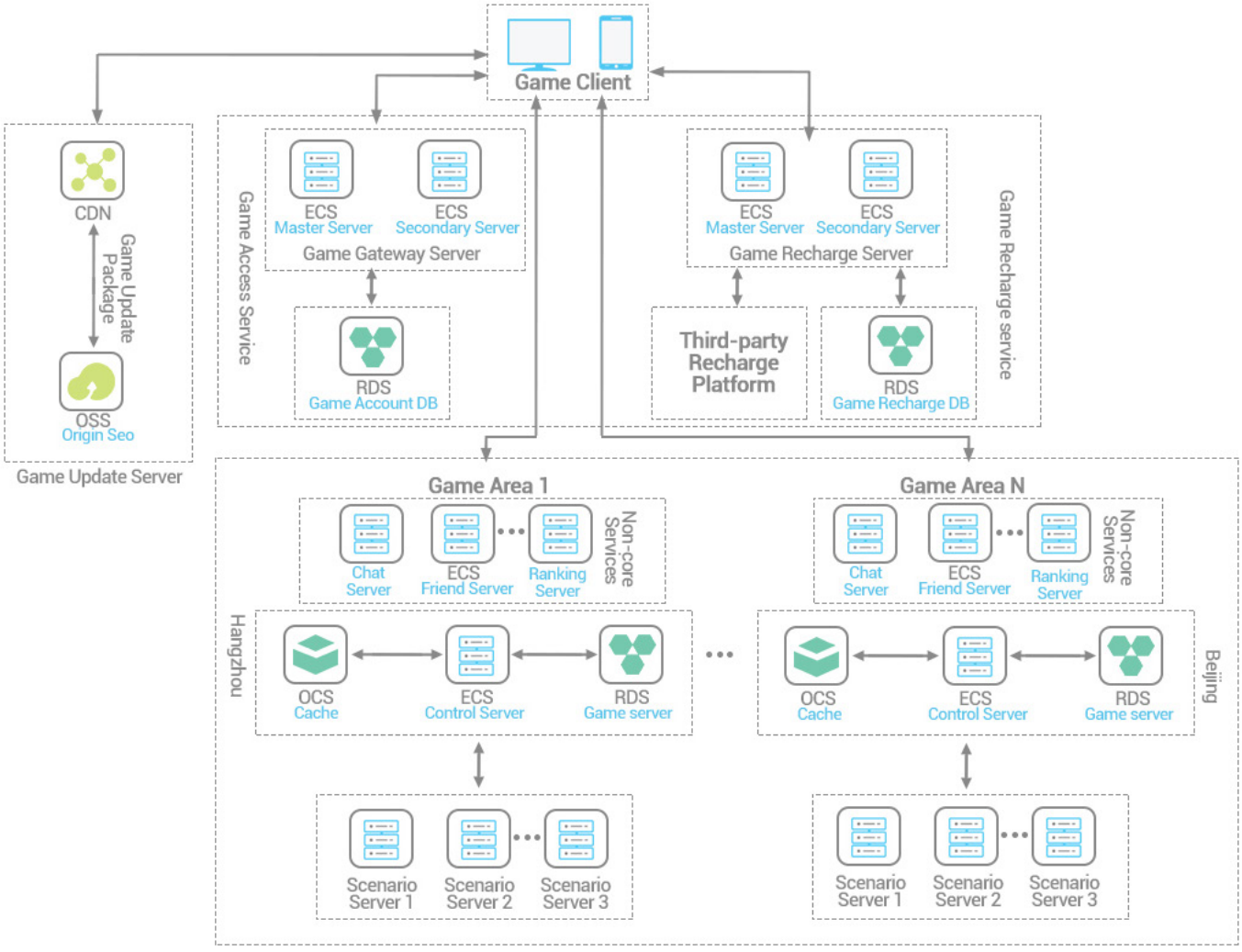
Massive multiplayer online games adopt a three-layer architecture (access, logic, and data). The access layer is majorly responsible for game account login authentication, client connection management and communication packet decryption. The logic layer implements the game's main service logic - regional game services, chatting, and rankings. The data layer provides shared caching and data persistence storage. RDS ensures disaster recovery for primary and secondary databases, including distributed databases and read/write splitting. The logic layer contains core scenario servers that can flexibly extend the service based on the scenario, which in turn helps to increase the maximum number of simultaneous players for a single zone.

3. Cross-Region Elastic Deployment

Customers can deploy different game servers from Alibaba Cloud data centers in various regions including North America, Europe, China, Dubai, Japan, Singapore and Australia. Combined with Alibaba Cloud Auto Scaling, Elastic Scaling Service (ESS) enables developers to conveniently build an automatic server activation system and provides users nearby access, which increased network access quality.

4. Dedicated Data Cache

To serve a high number of simultaneous players in individual zones, massive multiplayer online games can use ApsaraDB for Redis and ApsaraDB for Memcache to construct a cache layer that accelerates the reading/writing of players' game data. It also decreases back-end database read/write pressure. Data in the cache takes regular batches for persistence storage.



5. Game Update Package Downloads

Alibaba Cloud CDN was then integrated, which enables a faster response globally via different edge centers and Object Storage Service (OSS). OSS facilitates the game update package download system efficiently and conveniently delivers frequent MMOG client update packages.

Value-Added Solution

The powerful and highly reliable cloud computing solution provided to this customer addressed MMOG mobile challenges and added additional business value to the customer.

1. High Network Throughput Capacity

Alibaba Cloud Gaming Solution has ample bandwidth resources, and its Server Load Balancer provides access support through clustering. ECS, at its highest realization, can support a PPS of several thousand and provide Gbps-level network throughput capacity to enable a seamless user experience.

2. Elastic Resource Scalability

Alibaba Cloud's multiple services, including ECS and ApsaraDB for RDS, all support vertical configuration upgrade and horizontal extension. Combined with the ESS to enable automatic horizontal scaling based on service load conditions, Alibaba Cloud meets the needs of dynamic resource adjustment at different business stages to allow agility.

3. High Computing Power

Alibaba Cloud ECS servers are based on a flexible multi-scenario model and use the latest multi-core high clock speed CPUs to provide single-zone computing power through clustering. This generates the computing power required for servers where thousands of players are playing online simultaneously in a single zone.

4. Stable Game Access Experience

By taking full advantage of Alibaba Cloud's multi-regional BGP data centers and high-speed transmission network resources, game developers can achieve geographically distributed deployment for each region. This gives gamers nearby access to games and decreases the possibility of disconnection and other glitches.

04 Card-based Mobile Gaming Solution

4.1 Overview

The mobile gaming industry has prospered in the 4G era. Mobile card games play a dominant role in the international mobile gaming market, accounting for nearly half of mobile gaming revenue in 2013. In 2014, we then saw the rise of intense action-type mobile card games, and mobile card games entered the real-time combat era in 2015.

4.2 Card-based Mobile Gaming

"Card-based gaming" is a generic term that encompasses a variety of permutations and combinations. In its simplest form, it can be no more than a "license to gamble." In other words, a player must insert their player card into the gaming machine to start gaming.

Card-based mobile gaming enables players to set their parameters on the card in the form of a smart card, which incorporates a "gaming purse". Those parameters enable the player to set a range of limits, including the length of play per session, money played per session, hourly/daily/weekly or monthly limits, and predetermination of win results.

A Card-based Gaming System (CBGS) has the hardware and software within the provider's control, which delivers the system to the player and includes components required to issue/validate/report various card-based functions as well as redemption of player funds.

4.3 Card-based MMOG Developer Challenges

Confronted with the surging popularity of RPGs, mobile card games require cloud engines that can power innovative gameplay and powerful back-end service architecture.

Challenges

The following are key challenges faced by gaming companies:

1. High Disk I/O

Mobile card game servers produce and accumulate large volumes of player logs and persistent storage, which is mostly achieved by using NoSQL (non-relational persistence products such as MongoDB and LevelDB). These servers have to provide a high disk I/O capacity.

2. Rapid Deployment and Gray Release

Card games have a shorter development cycle than RPGs and other intense mobile games, which makes cost control easier. Fast server activation, combination, and rolling, as well as value adjustment, have become the norm for card games. Frequent deployment and upgrades on multiple servers present new challenges for the game experience as well as operation and maintenance. The games must support Gray releases and rapid deployment, which poses a challenge for most gaming companies.

3. Bandwidth Billing

Most mobile card games are hosted on a single server for single or multiple zones. It is hard to predict the Internet traffic costs and peak value for a single server. Therefore, operators have to bear the cost of billing the traffic of individual servers on a costly Pay-As-You-Go basis.

4. Risk of Single-Point-of-Failure

This is a typical problem for vertical deployment architectures. In a case where a single server goes down, service may become unavailable in at least one region. The time needed to restore the server has a direct effect on user experience, financial flow, and user retention. Restricted by development conditions, code inheritance, costs, and other factors, the vast majority of games still follow this outdated deployment model.

5. Elastic Scalability

The uncertainty in the number of online gamers makes it difficult to predict resource allocation, especially during online events and peak periods after game releases. Momentary access pressure may easily exceed a system's maximum load capacity. Consistently maintaining a high resource configuration will certainly lead to a massive waste of resources and money. Scalability and elasticity are therefore common challenges for gaming companies.

4.4 Solution for Card-based Mobile Games - User Case

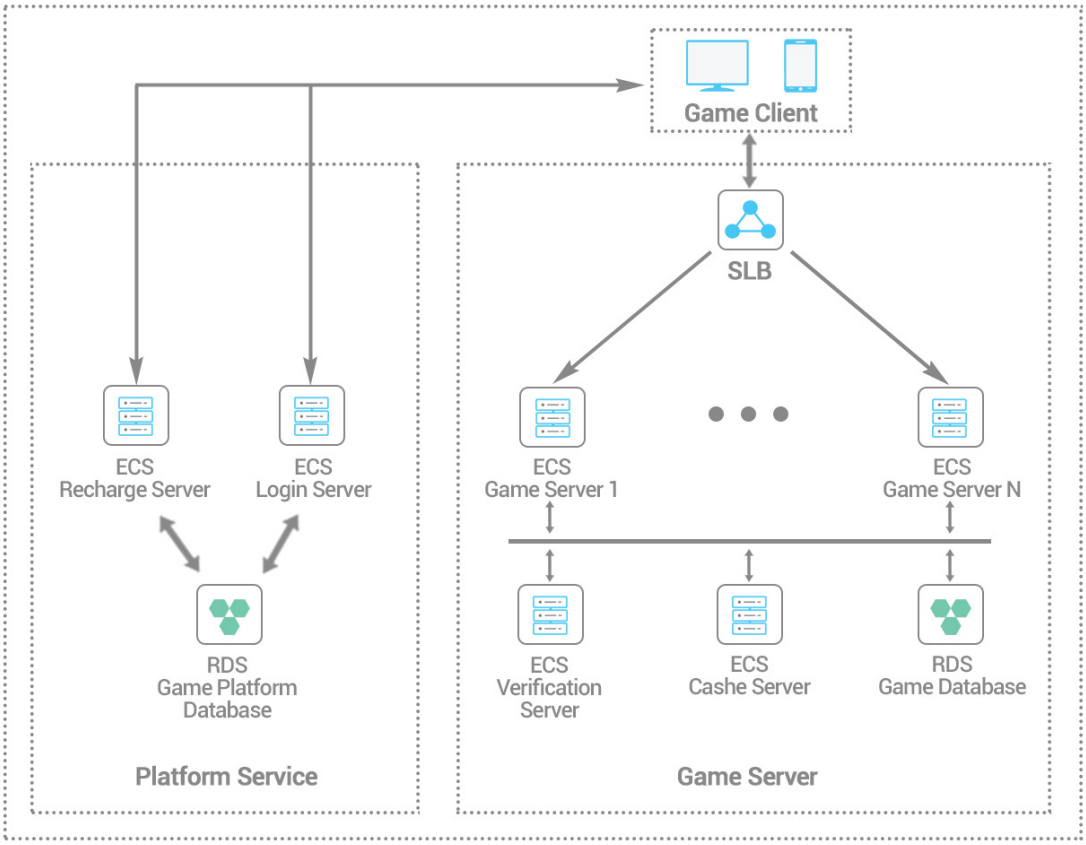
The card-based mobile game solution is similar to the mobile cloud MMOG solution. Alibaba Cloud Gaming Solutions addresses these common challenges to eliminate the risk of single-point-of-failure and provide robust infrastructure.

The Challenge

A gaming company needed a solution to eliminate the risk of SPOF, as well as provide vertical configuration upgrades and flexible scaling capabilities in gaming applications. The organization wanted to ensure the stable and reliable operation of customers' game data, where users would experience no interruptions from the new release of game features.

The Solution

Alibaba Cloud provided a cloud computing platform that addressed the unique needs and challenges faced by this card-based gaming company. Alibaba Cloud Gaming Solutions enabled high-quality Border Gateway Protocol (BGP) routes, exclusive game cluster resources, global network layouts, and advanced mobile application security.



Key Steps

1. Scale Out

Game server portals utilized Alibaba Cloud Server Load Balancer. As game traffic volume increased, the carrying capacity of a single server would be reached, and the number of game servers would be automatically increased as necessary. Server Load Balancer supports Layer 4 TCP/UDP and Layer 7 http/https load balancing. Alibaba Cloud ECS supports vertical configuration upgrades and Auto Scaling. Combined with Server Load Balancer, this allows users to construct an ECS-based architecture for automatic horizontal scaling. This gives the service a variety of flexible scaling capabilities.

2. ApsaraDB for RDS

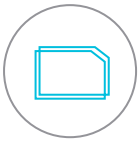
Game data and platform data both use ApsaraDB for RDS. The primary/secondary ApsaraDB for RDS architecture allows games to protect core data from the risk of SPOF. Additionally, as a game's traffic increases, database admins can hot upgrade their databases when necessary. ApsaraDB for RDS provides professional advice on database optimization, including intuitive slow SQL diagnostics and complete SQL operation reports, as well as primary key checks, index checks, and other types of optimization advice. This ensures the stable operation of customers' gaming data and core platform systems (such as their recharge payment and login systems) continually.

3. Deploy and Publish

A single ECS game server supports the parallel deployment of two runtime containers, A and B (for JAVA development platforms, the container is Tomcat). A reverse proxy (such as Nginx) is deployed in the game server, which is directed to container A. Gray releases are coded to B (a WAR package for JAVA development platforms), and the reverse proxy is directed to B. This allows for a successful Gray release where users will experience no interruptions. If the new release fails, the reverse proxy is directed to container A. This allows for a successful rollback, where game users won't even be aware of the event. This ensures game continuity and allows almost zero interruption time for gamers.

4. High-IO SSD ECS

Users can load self-built MongoDB and other database services on Alibaba Cloud ECS with high-I/O SSD Cloud Disk. With a fast and stable random read/write capacity and storage throughput of more than 100 Mbps, the ECS SSD provides the I/O capacity required for NoSQL databases. Moreover, the distributed triplicate mechanism delivers robust data reliability, which was a primary concern for this organization.



5. Images and Snapshots

For ECS with installed application software packages, users can quickly activate servers by using user-defined images and data disk snapshots to create new servers in batches.

Value-Added Solution

Value-added features offer by Alibaba Cloud Gaming Solutions:

1. SSD High-Speed Cloud Disk

With Alibaba Cloud ECS, users can configure a high I/O SSD cloud disk with high speed and stable random read/write capacity to fully match game developers' requirements, such as the write performance needs of storing a massive volume of player logs. Using a distributed triplicate mechanism, this solution delivers ongoing robust data reliability to enable a seamless user experience for gamers.

2. Rapid Deployment and Gray Release

Alibaba Cloud servers provide completely automated activation and release, convenient image copying, and batch operation functions. This allows users to set up the environment in a short period and release excess resources after switching. The API operation method being aptly suitable for a fully automated operation and maintenance deployment.

3. Servers with No SPOF Risk

The cloud platform is built on a distributed file system that operates under a highly reliable triplicate data redundancy storage mechanism. This ensures data security at all times. Moreover, the ECS servers support automatic downtime migration. Therefore, when a fault occurs, service is rapidly restored through migration, protecting gaming servers from the risk of single-point-of-failure to ensure minimum downtime and maximum data security at all times.

4. Elastic Resource Scalability

Alibaba Cloud's multiple services, including ECS and ApsaraDB for RDS, all support vertical configuration upgrade and horizontal extension. Combined with the ESS to enable automatic horizontal scaling based on service load conditions, Alibaba Cloud Gaming Solutions was able to provide dynamic resource adjustment at different business stages of the company's business development.

05 Future of Gaming

In order to appeal to new trends, console and computer games often release companion apps to continue the gamer experience. In some of these games, gamers can build a team from their phones and then jump onto the console game, picking up from where they left off on a separate device.

Companies will continue to evolve mobile gaming, and the industry will continue to make money off of freemium games.

Mobile gaming always provides indicators and insight on the direction of the gaming industry. However, the mobile gaming industry is still navigating through a maturation stage, despite its explosive success. Nonetheless, one thing is for sure, and that is the improved user experience and reduced operational and maintenance costs enabled by the cloud will continue to drive the industry forward. This will, in turn, continue to impress and surprise gamers, as well as fast-track game commercialization for game providers.

06 Conclusion

Cloud computing helps gaming companies gain fast access to computing resources to achieve faster and high-quality results at a reduced cost (relative to traditional infrastructure) and irrespective of location.

Alibaba Cloud Gaming Solutions transform previously complex and static gaming infrastructures into highly flexible and adaptable resources for on-demand and long-term use. There are alternative game development engines available, but Alibaba Cloud offers a robust, globally scalable, and integrated one-stop shop to service game developers.

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