

Accelerate 5G Adoption with Cloud Gaming Service

Gamestream gives communications services providers (CoSPs) a cloud gaming service to monetize 5G



Cloud gaming has steadily increased in popularity and is now poised to be the next big use case for cloud computing. Industry analysts expect cloud gaming revenues of between \$1 billion and \$4 billion in 2021 with growth to \$12 billion by 2025.¹ And more and more of cloud gaming is taking place on Android devices. StatCounter reports that as of June 2021, Android has 72.83% of the global mobile market share.² The gaming content catalog is growing, which will provide additional interest and opportunities to cloud service providers (CSPs) and communications services providers (CoSPs) seeking service deployment. The combination of 5G and edge technologies will provide additional benefits to the cloud gaming experience for end users through greater bandwidth and lower latencies over prior mobile technologies.

For cloud gaming to reach its revenue potential, users must have an experience that is seamless with no lag in game play. This requires high bandwidth and low latency, making the high performance of new 5G networks a key enabler. This is important because CoSPs are facing competition from over the top (OTT) providers who have already monetized the streaming delivery of music, television, and movies. Given their current and planned network investments, cloud gaming can help CoSPs to meet business requirements to increase loyalty, reduce churn, and boost average revenue per user.

Total cost of ownership (TCO) is an important consideration for CoSPs. The capital required to build 5G networks is significant and so managing the cloud gaming infrastructure costs will impact both the service's ROI but also the CoSP's ability to get into the market in the first place. To be successful, CoSPs will need to find a balance between delivering a high-density, high-quality of service and demonstrating great value add to customers, while keeping control of infrastructure costs.

Intel® Network Builders ecosystem partner Gamestream has developed a powerful and efficient Android gaming solution, providing a white-label service to allow CoSPs to brand, offer, and monetize OTT-like gaming. Gamestream conducted a performance test to evaluate how to improve the performance of games on Android devices.

For the test, Gamestream developed an Android-optimized server utilizing Intel's Android optimization stack and Intel® Server GPU. Using this solution, Gamestream has validated performance of up to 80 concurrent gaming sessions per server.³ As a point of comparison, Gamestream also ran the Intel Android optimization stack on one of its standard cloud gaming server achieving only 15 concurrent gaming sessions.

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“The Uncertain Light at the End” Postmeta Games Limited. All rights reserved.

Gamestream Offers Cloud Gaming with No Upfront Capital Expense

Gamestream provides CoSPs with a complete cloud gaming service including its streaming technology, servers, games catalog, and web APIs. This turnkey, end-to-end solution is available on a “pay as you go” model that eliminates the need for upfront capital expense from the CoSP.

Gamestream has developed its proprietary game services environment based on the H.265 video encoding and compression standard. This empowers Gamestream to offer CoSPs optimal video gaming quality and a low latency rate, with a throughput of between 4Mbps and 8 Mbps, compared to a conventional platform that requires 15 Mbps of bandwidth.

The service is platform agnostic, adapting to various end-user devices, including smart TVs, laptops, personal computers, smartphones, and tablets. The Gamestream service streams Android games in HD, at 720p and 1080p, utilizing very little bandwidth. The service provides a catalog of games that is frequently updated to offer the most relevant titles.

By selecting Intel's optimal performance GPU and CPUs, Gamestream is optimizing cost per session, and increasing the number of parallel Android gaming sessions as seen in the tests described in this paper.

Utilizing Telco Edge Data Centers for Game Hosting

Gamestream servers are hosted directly within telco edge data centers, thereby providing a fluid, high performance, low latency gaming experience. This gives the CoSP an advantage on its competition, as competitive services are often deployed on external or public cloud services. Working directly inside the telco edge data center allows the CoSP to have direct control and monitoring and provides the best conditions for delivering an exceptional gaming experience.

For even lower latency, [Intel offers a complete edge network solution](#) for applications like streaming games. Intel edge solutions include IoT, hardware security, AI and computer vision technologies all running on high-performance Intel Xeon Scalable-based servers.

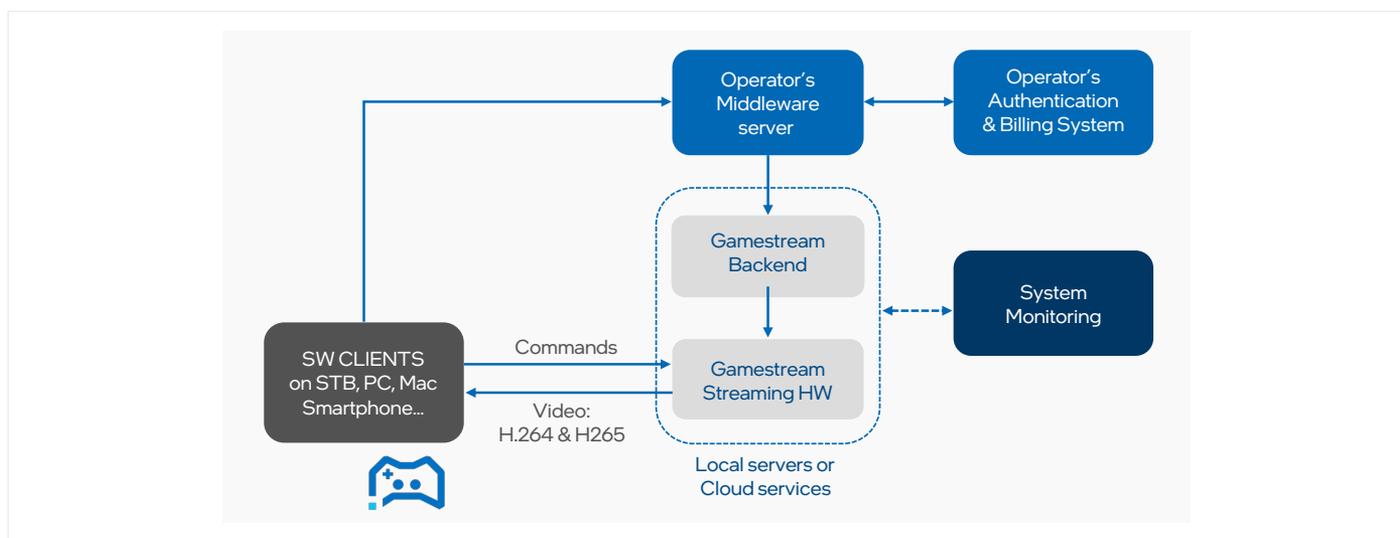


Figure 1. Gamestream solution architecture.

The Gamestream technology backend (see Figure 1) is designed for a seamless integration in CoSP customer relationship management (CRM) and billing systems. Gamestream provides weekly and yearly reports measuring audience, sales, and usage data.

Intel Software Optimizes Android Gaming Performance

A key reason for the increase in number of concurrent sessions for Android games is that the Intel Server GPU is optimized for mobile devices using the Android operating system.

Intel licenses additional software components for its Android cloud gaming solution that work with the game streaming solution to support high server game stream density, game performance, and breadth of gaming title accessibility.⁴

This software, combined with an optimal Intel-based server configuration, provides a strong foundation on which to

deploy an Android gaming service. The Intel Android cloud gaming software stack includes:

- **Android in Container (AIC)** is a proprietary solution that provides a containerized Android environment to run Android games with a Linux host OS on Intel architecture servers.
- **Intel Bridge Technology** is run-time post compiler that can be integrated into AIC to enable certain Android apps – those not written in Java or compiled to run natively on Intel-based devices - to run on those devices.
- **Intel Cloud Rendering (ICR)** is the core cloud rendering technology integrated into AIC.

In addition to this software, gaming servers need optimal **compute, storage, and networking performance**. The compute performance is driven by the Intel Xeon Scalable processors that deliver industry leading, workload optimized performance, with built-in AI acceleration, providing a seamless performance foundation.

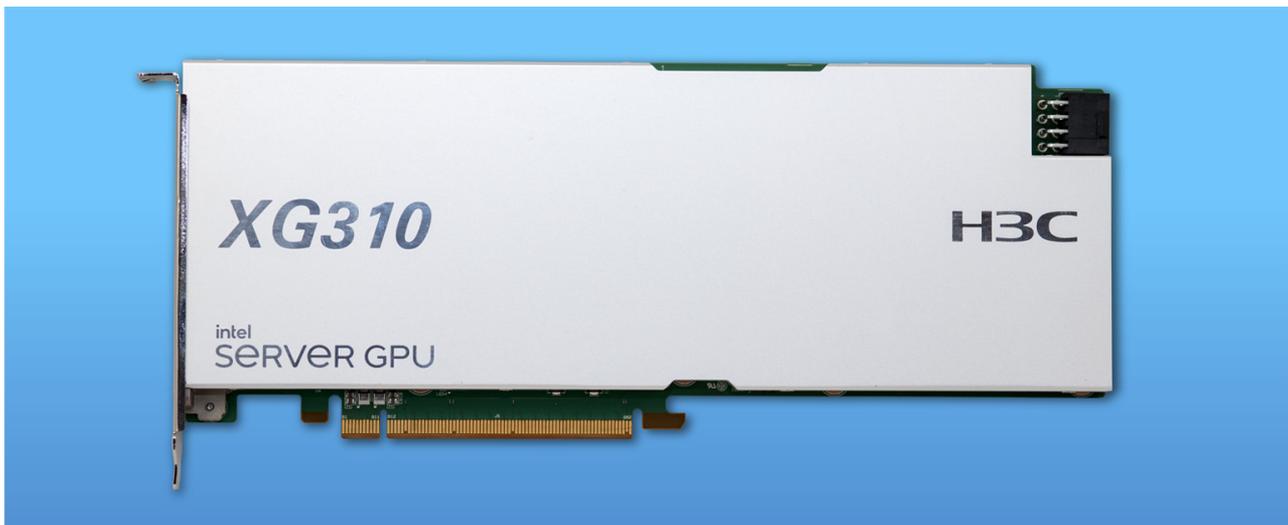


Figure 2. Intel Server GPU H3C XG310 PCIe card with four Intel Server GPUs.

Bouygues Launches Gaming Brand, Community

The flexibility of the Gamestream platform was important in establishing a new gaming service with Bouygues Telecom, one of the leading telecoms operators in France. Bouygues Telecom partnered with Gamestream to launch Pleio, a new consumer cloud gaming brand owned and operated by Gamestream and offered by Bouygues Telecom exclusively to its customers.



Pleio was launched to spearhead Bouygues Telecom's 5G mobile service across France. The Pleio brand itself was established by Gamestream to manage cloud gaming services, including marketing communications and community management.

- Gamestream provides housing, servers, content, technology, and integration into Bouygues Telecom back-end and customer relationship management systems
- Bouygues Telecom provides hosting, billing, and promotion
- Community management of gamers is managed by Gamestream

Together, the two companies have created a successful 5G gaming service with a unique business model that benefits both parties.

Intel 5G Technology

Intel has been a trusted partner for CoSPs in helping to transform the telecom network into a software-defined, agile and scalable infrastructure. Intel has built on this expertise to deliver key 5G technologies including optimized 5G core and 5G radio area networks (RAN) solutions.

Building out the 5G core is a central part of the network transformation. The performance and hardware-enabled security built into the 3rd Generation Intel® Xeon® Scalable processor are foundational to reap the benefits of 5G.

The RAN is undergoing dramatic changes from a closed to an open architecture. In addition to the 3rd Generation Intel® Xeon® Scalable processor, Intel has developed key technologies for very high RAN performance including FlexRAN, Intel® vRAN Dedicated Accelerator ACC100, 3rd Generation Intel Xeon Scalable processor and Enhanced Intel® Select Solutions for network.

Intel offers CoSPs the silicon, software and tools they need to bring the full performance and value of 5G to life.

The solution also utilizes the H3C XG310, a PCIe GPU card manufactured by H3C that integrates four Intel Server GPU SoCs (see Figure 2). The H3C XG310, when used along with Intel Xeon Scalable processors, provides independently scalable graphics performance⁵ that allows CoSPs to differentiate visual cloud services that can rapidly scale to meet new and escalating customer demands. The Intel Server GPU is a low power system on chip (SoC) design, with 128-bit wide pipeline and 8 GB of dedicated onboard low power DDR4 memory.

Test Compares Options for Best Android Performance

Gamestream set up a test of two servers to demonstrate the impact of Intel Android optimization software stack on the number of concurrent Android game sessions that can be served from a single server. The game chosen was Arena of

Valor, a multiplayer action role playing game with a streaming quality of 720 pixels at 30 frames per second (fps).

Two servers were configured:

- **Standard Cloud Server:** This dual-socket server is based on a design that is currently deployed by Gamestream. It features two Intel Xeon Gold 6226R CPUs, each with 16 cores, and four Nvidia Quadro RTX4000 GPUs.
- **Android-Optimized Server:** This dual-socket server supports Intel Android software . It features two Intel Xeon Platinum 8260M CPUs, each with 24 cores, and one H3C XG310 GPU card that includes four Intel Server GPU nodes.

The Standard Cloud Server is Gamestream's standard cloud gaming configuration running on a Windows 10 server and is designed for cloud-based games played on a standard PC platform. In the test, an emulator was used to enable the Intel Android optimization stack to be used.

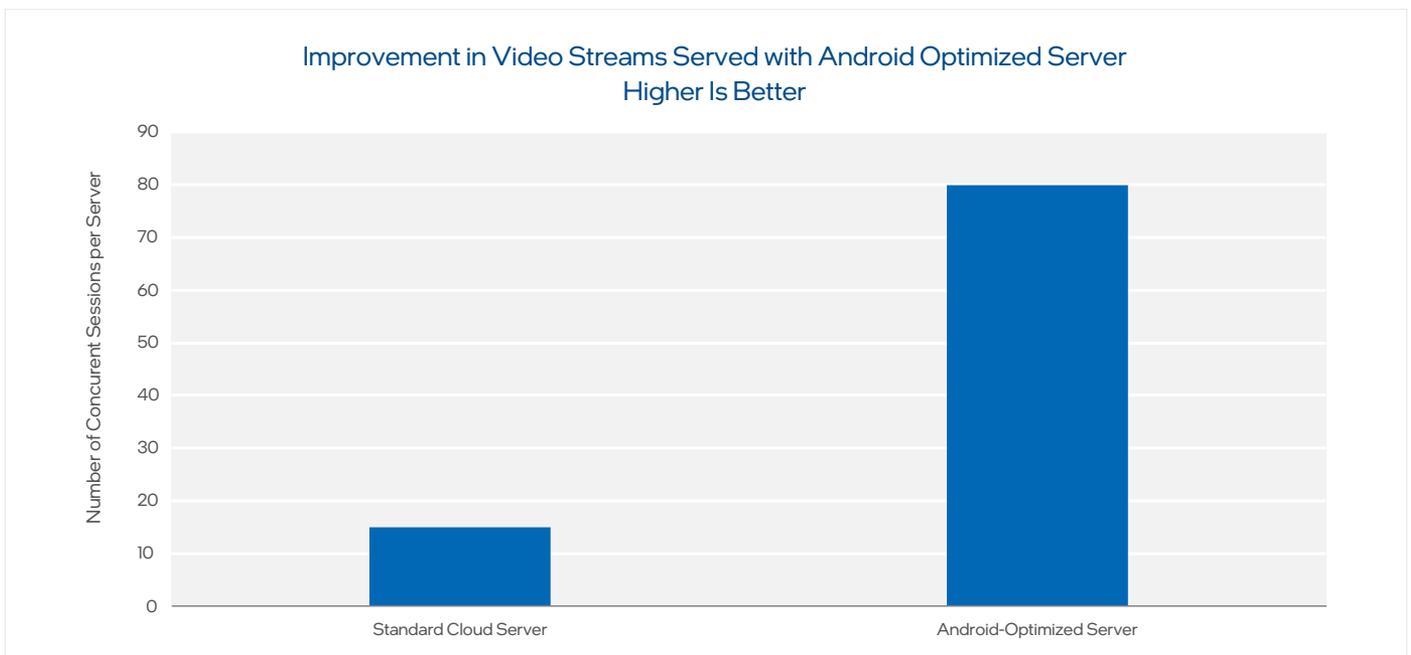


Figure 3. Comparison of number of concurrent video streams served from the Standard Cloud Server and from Android-Optimized Server.³

Test Results

The test results show that the Standard Cloud Server sustained up to 10 concurrent sessions per server and the Android-Optimized Server sustained up to 80 concurrent sessions, per GPU card (see Figure 3). Each 2nd generation Intel Xeon Scalable processor in the Android-Optimized Server is capable of driving the 80 Android game instances to run on each XG310 GPU card. Thus, when a second H3C XG310 GPU card is added into this server the two CPU sockets can support up to 160 instances.⁶

The lack of native support for Android applications in the Standard Cloud Server required the CPU to run an emulator to run the Intel Android optimization stack. This is the main performance bottleneck because CPU cores must be dedicated to the emulator which consumed up to three CPU cores per session. The slow performance of the emulator made the CPU a bottleneck reducing the performance of the Nvidia GPU card.

The Android-Optimized Server, however, runs the Intel Android optimization stack natively on the H3C XG310 GPU freeing up the CPU for other processing tasks.

Conclusion

The test results in this paper show that the Intel Android optimization stack running on an Intel-architecture server with Intel Server GPUs allows the Gamestream solution to deliver a high number of streams per session. That performance, combined with Gamestream's on-demand business model, means CoSPs can provide high density, low latency Android cloud gaming at low total cost of ownership (TCO). CoSPs can serve a greater number of gamers without sacrificing game quality or latency.

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¹ <https://www.rcrwireless.com/20210128/5g/cloud-gaming-to-surpass-1-billion-in-revenue-for-first-time-according-to-some-estimates>

² <https://gs.statcounter.com/os-market-share/mobile/worldwide>

³ Testing done by Gamestream in Jan. 2021. Standard Cloud Gaming Server featured dual Intel Xeon Gold 6226R processors (microcode: 5002F01) each with 16 cores operating at 2.9GHz. The server featured 192 GB of RAM with 2TB of storage. Intel Hyper-Threading was enabled, but Intel Turbo Boost 2.0 was turned off. BIOS version was Intel Corporation SE5C620.8 6B.02.01.0012.070720200218. Intel Ethernet Network Adapter X722 provided network access. Hardware acceleration was provided by four Quadro RTX4000 Graphics cards. The operating system was Windows 10 Pro x64 v2004; Kernel version 19041.540.

Android-Optimized Server featured dual Intel Xeon Platinum 8260M processors (microcode: 0x5002f01) each with 24 cores operating at 2.4GHz. The server featured 192 GB of RAM with 2.48TB of storage. Intel Hyper-Threading was enabled, but Intel Turbo Boost 2.0 was turned off. BIOS version was Intel Corporation SE5C620.86B.02.01.0012.070720200218. Intel Ethernet Network Adapter X722 provided network access. Hardware acceleration was provided by one H3C XG310 GPU card each containing four Intel Server GPU nodes. The operating system was Linux.

⁴ <https://www.intel.com/content/dam/www/public/us/en/documents/solution-briefs/server-gpu-solution-brief.pdf>

⁵ Intel® Server GPUs for Cloud Gaming and Media Delivery <https://www.intel.com/content/www/us/en/products/docs/discrete-gpus/server-graphics-solution-brief.html>

⁶ Performance may vary based on the specific game title and server configuration. To reference the full list of Intel Server GPU platform measurements, please refer to [this link](#) on [intel.com](https://www.intel.com).

Performance varies by use, configuration and other factors. Learn more at [www.Intel.com/PerformanceIndex](https://www.intel.com/PerformanceIndex).

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