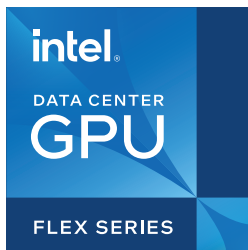**intel**®

Intel® Data Center GPU Flex Series for Cloud Gaming

High density of game streams per server, open cross-platform programmability and a robust software ecosystem make the Intel Data Center GPU Flex Series the choice for cloud gaming providers.

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DATA CENTER
GPU
FLEX SERIES

The fast growth of the global cloud gaming market continues, with a projected CAGR of approximately 43.2% through 2026, when it will have a value of about $3.2 billion.[1] To compete effectively in this segment, game service providers must continually innovate to deliver first-rate playing experiences to their subscribers while operating the most efficient infrastructure possible.

Android cloud gaming providers that meet that challenge will position themselves to establish recurring revenue streams from subscription customers. Cloud distribution models enable them to target game development on their own optimized server infrastructures, streamlining development to deliver a top-tier experience while reducing costs.

Android continues to dominate the mobile OS segment, with more than 2.8 billion users worldwide and a global market share of 75 percent.[2] The content catalog is growing, providing additional opportunities to CSPs and CoSPs. The throughput requirements in this usage area can be expected to grow dramatically as the 5G rollout makes greater bandwidth available to end users over the next several years.

The Intel® Data Center GPU Flex Series provides a standards-based, high-throughput, low-TCO foundation for cloud gaming that helps providers build efficient, effective infrastructure. The platform brings together high gameplay quality with a high density of game instances per server. It supports oneAPI open-standards-based, cross-architecture programming with code portability across processor and accelerator platforms.

Open-Standards GPU Architecture

Code developed for GPUs under proprietary programming models such as CUDA lacks portability to other hardware, creating a siloed development practice that locks organizations into a closed ecosystem. By contrast, the Flex Series GPU supports an open, standards-based software stack together with oneAPI cross-architecture programming for seamless support across CPUs and GPUs.

Open standards code development based on oneAPI benefits from a large open ecosystem that includes open source tools, APIs and drivers. That flexibility helps organizations reduce the complexity, cost and time requirements to bring new services and solutions to market, enabling engineers and programmers to innovate instead of maintaining code and easier adoption of new architectures.

## SUPPORTING STATS

UP TO
68
720p30 on select game streams

Single Intel Flex Series 170 GPU[1]

UP TO
46
720p30 on select game streams

Single Intel Flex Series 140 GPU[3]

Android Cloud Gaming Reference Software Stack

Android cloud gaming providers benefit from an ecosystem-enabled, flexible software stack that supports high-density streaming delivery. For Android cloud gaming, Intel licenses additional software components that work with the game streaming solution to support high server game stream density, game performance, and breadth of gaming title accessibility.
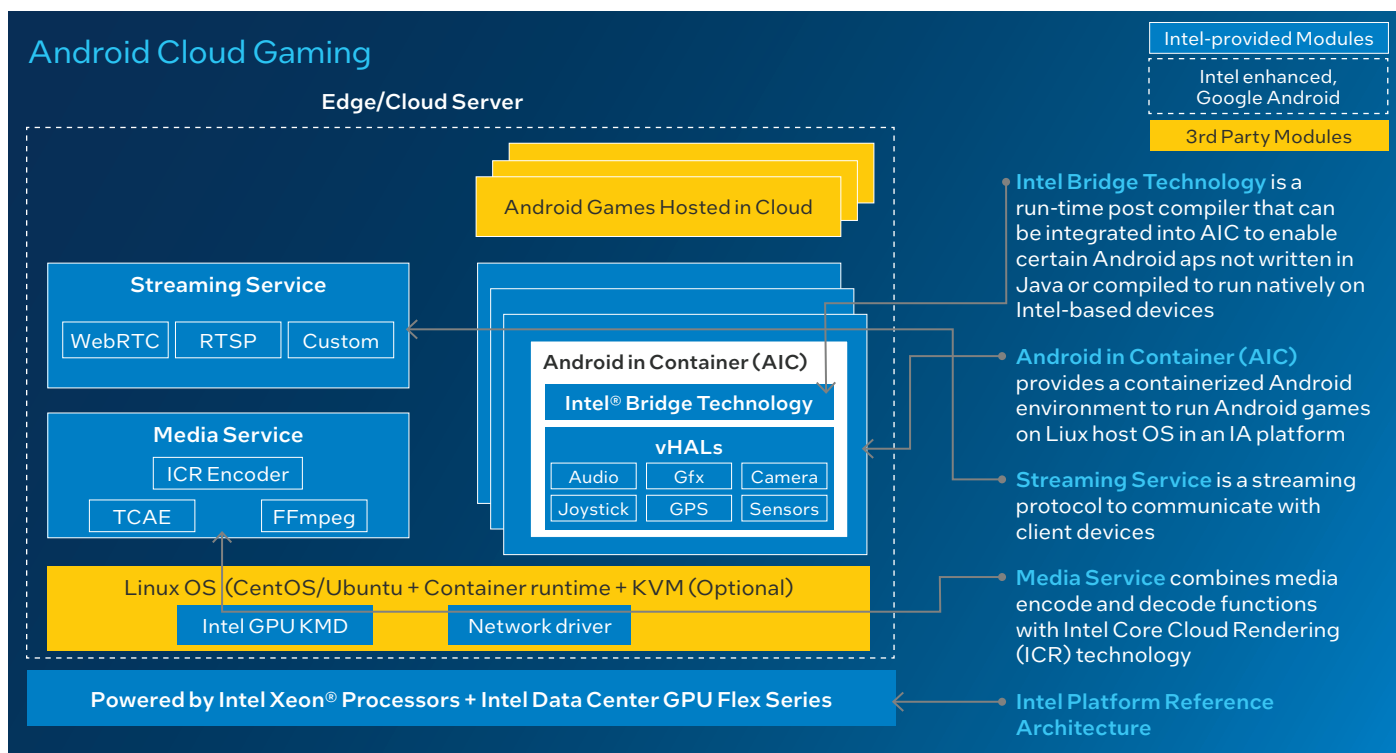
Software is a critical aspect of a successful Android cloud gaming service deployment. For a CSP or CoSP wanting to deploy a gaming service, gaming titles and a streaming service solution are mandatory. For Android cloud gaming, Intel licenses additional software components that work with the game streaming solution to support high server game stream density, game performance, and breadth of gaming title accessibility. These software components include an Android in Container (AIC) solution for games running on Intel-based platforms, helping enable high stream density. Intel Cloud Rendering (ICR) software provides the core cloud rendering technology and leverages the Intel-optimized Mesa 3D graphics library to optimize GPU utilization. Finally, the cloud gaming software stack can take advantage of Intel Bridge Technology, which enables certain Android apps not written in Java or compiled to run natively on Intel-based devices to run on those devices. This software, combined with an optimal Intel-based server configuration, provides a strong foundation on which to deploy an Android gaming service.

SUPPORTING STAT

Flex Series GPU is validated on nearly **90** of the most popular Google Playstore games

Industry Ecosystem

Extending the benefits of its standards-based open architecture and optimized software stack, the GPU draws on a broad ecosystem of service providers, independent software vendors (ISVs), original equipment manufacturers (OEMs) and others to support a wide range of use cases.

These companies are helping advance the case for powering Android cloud gaming with servers based on a combined platform of Intel Xeon Scalable processors and the Flex Series GPU. The openness and transparency of the programming model also encourages uptake by the open source community, creating a virtuous cycle to further enhance the software stack.

Intel is enabling the software ecosystem to take full advantage of the underlying hardware's capabilities to deliver cloud gaming, including work with software standards, frameworks, and vendors.

oneAPI Video Processing Library

The Intel oneAPI Video Processing Library (oneVPL) provides fast media transcode performance across integrated and discrete GPUs. oneVPL provides a video-focused API for video decoding, encoding and processing in applications spanning media processing and delivery, broadcasting, streaming, video on-demand (VoD), cloud gaming and remote desktop solutions.

Low-level encoder and rate controls provided by oneVPL enable developers to fine-tune encoder configurations to maximize video streaming quality while limiting the impact to gaming frame rates. They can also implement their own rate controls to combine customer domain expertise with Intel hardware innovation. oneVPL is backwards-compatible with Intel Media SDK core API.[4]

To optimize delivery of both game content and a customer's internet connection, the Intel Flex Series GPU provides Transport and Content Adaptive Bit Rate Control (TCBRC) and its extension, Transport and Content Adaptive Encode (TCAE). TCBRC provides the best possible quality in an ultra-low latency, adaptive bitrate control. TCAE builds upon TCBRC to adaptively throttle hardware encode frame size by up to an order of magnitude based on the connection speed and content. TCBRC is supported for the GPU by oneVPL, FFmpeg and GStreamer. Cloud gaming customers benefit from TCAE to connect network feedback to the frame size calculation of TCBRC.

oneVPL can be downloaded individually for free. It is also included in the Intel oneAPI Base Toolkit, which is a core set of tools and libraries for developing high-performance, data-centric applications on Intel CPUs and GPUs.

## Analyze Application Performance with Intel VTune™ Profiler

Accelerate application compute-intensive tasks by identifying the most time-consuming parts of GPU code and optimizing GPU offload schema and data transfers for SYCL, OpenCL code, Microsoft DirectX, or OpenMP offload code. Analyze GPU-bound code for performance bottlenecks caused by microarchitectural constraints or inefficient kernel algorithms.

High-Efficiency Codecs

Even as large-scale data storage has become progressively cheaper, bandwidth to access that data remains expensive. Improved compression enables media processing and delivery providers to reduce those bandwidth requirements, for lower operating costs.

The Alliance for Open Media — a cross-industry consortium founded by Amazon, Cisco, Google, Intel, Microsoft, Mozilla and Netflix — introduced the open source AV1 codec in 2018. This next-generation codec built into the Flex Series GPU brings the highest quality real-time video scalable to any modern device at any bandwidth. It enables delivery of commercial or non-commercial user-generated content with low computational footprint, optimized for internet streaming. It does all this at 30% better compression with no degradation in streaming quality, reducing the cost per stream[3].

In addition to AV1, the GPU also supports existing HEVC, AVC and VP9 codecs.
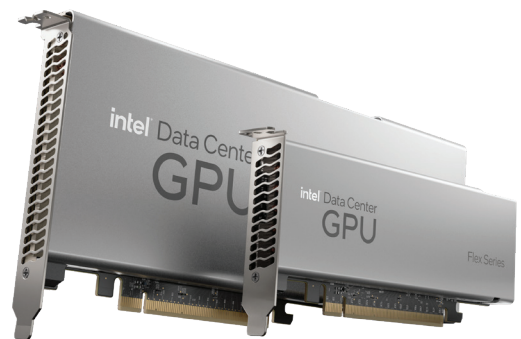
Higher Performance with Lower TCO

Cloud gaming providers have a strategic imperative to optimize TCO while meeting subscriber demands for excellent gameplay experiences. The Flex Series GPU supports that objective by increasing the density of game instances that can be supported per server without compromising quality, so providers can handle a given subscriber base with fewer servers. High performance per watt helps drive TCO down further by reducing operating expense (OpEx).

Built to work in conjunction with the flexible performance of Intel Xeon Scalable processors, the GPU is part of an end-to-end gaming architecture. Platform flexibility enables co-deployment of the Intel Data Center GPU Flex Series 170 with the Intel Data Center GPU Flex Series 140, on a single converged server platform.

By supporting more subscribers per server, the Flex Series GPU enables providers to address growing subscriber bases with smaller data center footprints, helping reduce capital expenditure (CapEx) associated with equipment and facilities costs. Each Intel Data Center GPU Flex Series 140 hosts 40 or more 720p30 Android game streams.[3]

Intel Xe Architecture

Built on the Intel X^e architecture, the GPU has up to 32 Intel X^e cores and ray tracing units, up to four Intel Xe Media Engines, AI acceleration with Intel Xe Matrix Extensions (XMX) and support for hardware-based SR-IOV virtualization.

The Future for Cloud Gaming

The Intel Flex Series GPU offers cloud gaming providers a cost-effective platform for delivering cloud gaming experiences with customer-winning quality. Drawing on the open-standards DNA of Intel architecture, the GPU is code-compatible with Intel CPUs. The open programming environment supports flexible development and removes the inflexible limitations of the proprietary CUDA programming model. With a synergy of hardware and software technologies to drive high-density, high-quality game instances, the Intel Data Center GPU Flex Series will power up gaming providers, leading the industry forward.

Intel® Data Center GPU delivers a high density of gaming instances per server with low power consumption.

Learn more about the Intel® Data Center GPU Flex Series at www.intel.com/FlexSeriesGPU

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