

# CASE STUDY

Cloud Service Providers  
Online Gaming



## Increasing Game Instance Density Helps Keep Costs Down for Online Gamers

**Nitrado\* is transforming the online gaming world and significantly boosting its data center efficiency by expanding system memory with Intel® Optane™ DC persistent memory**

### Results:

- 112 percent increase in CPU usage<sup>1</sup>
- 175 percent increase in game instance density<sup>1</sup>
- Flexibility for future business expansion, with more games and more customers
- Better data center efficiency results in total cost of ownership (TCO) reduction, helping to keep hosting prices low
- Memory is no longer a limited resource for game developers, allowing them to create even more fantastic worlds

Nitrado\* is one of the leading providers of game servers and application hosting services. In collaboration with Intel, Nitrado now offers its business customers and end customers the benefits of Intel® Optane™ DC persistent memory. This is an important step in revolutionizing storage capacity for game developers and publishing studios, as well as ensuring Nitrado's customers continue to enjoy low and stable prices with good performance.

### Challenge

The complex worlds of today's games place ever-increasing demands on the memory capacity of online gaming servers. At the same time, modern Intel® processors have extraordinary computing capacity. In typical gaming server configurations, the memory capacity is reached long before the processor is under strain. Nitrado wanted to increase CPU utilization and game instance density, but the solution would have to be affordable and be able to maintain the excellent gaming experience Nitrado's customers expect.

### Solution

Intel Optane DC persistent memory provides a flexible, high-performance and cost-effective expansion of system memory. Nitrado added Intel Optane DC persistent memory modules (DCPMMs) to its game hosting servers, making it possible to run more instances of a game on a single server without negatively affecting the game server's performance.

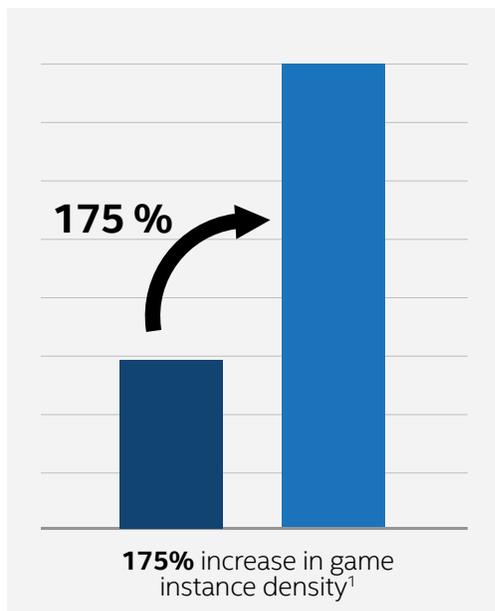
### Results

Adding Intel Optane DC persistent memory increased the number of instances of Minecraft\* that could run on one of Nitrado's servers from 182 to 500 (see Figure 1), and boosted CPU utilization from 40 percent to 85 percent<sup>1</sup>. Server performance remained high. Based on the positive results, Nitrado now offers servers equipped with Intel Optane DC persistent memory to customers.

### Memory-Hungry Games Prevent Efficient CPU Utilization

As online games become more complex, they make increasing demands on both compute and memory resources. But in Nitrado's experience, some games—such as Minecraft—have asymmetric resource consumption. That is, on a dual-socket server with 20 to 24 cores per processor, system memory becomes full well before CPU utilization maxes out. Because user experience is paramount to Nitrado's business model, this limits the number of game instances that can be hosted on a server, and leaves compute resources sitting idle.





**Figure 1.** By increasing game instance density with Intel® Optane™ DC persistent memory, Nitrado keeps hosting prices affordable for its customers.

Inefficient data center resource utilization drives TCO up, which could lead to having to charge customers more for game hosting—something Nitrado did not want to do.

Improving CPU utilization could be achieved by buying less powerful processors, but that could undermine user experience. Another approach would have been to provide more memory by adding more or higher-capacity DRAM modules to game servers. But memory pricing does not generally scale linearly with DRAM and quickly becomes prohibitively expensive. In addition, even the largest capacity DRAM modules are rarely more than 256 GB; at a certain point, the server will run out of free DRAM slots and expanding memory further becomes impossible.

Nitrado sought a solution that affordably and substantially extended system memory without driving up costs or degrading system performance and the user experience during game play.

### Replace Some DRAM with a New Large-Capacity Memory Technology—And Maintain Performance

Intel Optane DC persistent memory in Memory Mode<sup>2</sup> can add up to 3 TB of memory per socket, which enables Nitrado to increase the number of game instances (each of which runs in a container) on a server—driving up container density and therefore driving down TCO—while maintaining good game server performance. Game performance was measured by observing the effect on a metric called server tick rate. In complex games such as Minecraft, simulations are run in the background—many per second—to prepare for what will happen next in the game (a monster might take a step

or a player’s health and hunger are updated according to the player’s circumstances). The tick rate is the frequency at which a server processes updates and is measured in hertz (Hz). The faster the tick rate, the more “real-time” the game seems to players. Minecraft typically runs at a rate of 20 ticks per second<sup>3</sup>. In Nitrado’s tests, replacing some DRAM with Intel Optane DCPMMs did not negatively affect Minecraft’s tick rate, thereby preserving the player-side experience.

### New Game Possibilities on the Horizon

The cloud gaming market is projected to grow at a compound annual growth rate (CAGR) of 40 percent between 2018 and 2023, reaching a total market size of USD 8 billion by 2025 (up from just over USD 1 billion in 2018)<sup>4</sup>. The benefits of Intel Optane DC persistent memory are going to help Nitrado be part of that growth today. But the ripple effects go beyond Nitrado and its customers.

With the potential for online gaming servers to have as much as 6 TB of Intel Optane DCPMMs installed, game developers and publishing studios can up their game as well. Want more monsters? More tsunamis? More volcanoes? More action and options? With memory no longer the limiting factor on what can happen in “real-time” for online gamers, the gaming industry will transform, creating more fantastic worlds and adventure—creating perhaps an even stronger demand for online gaming services such as Nitrado’s.

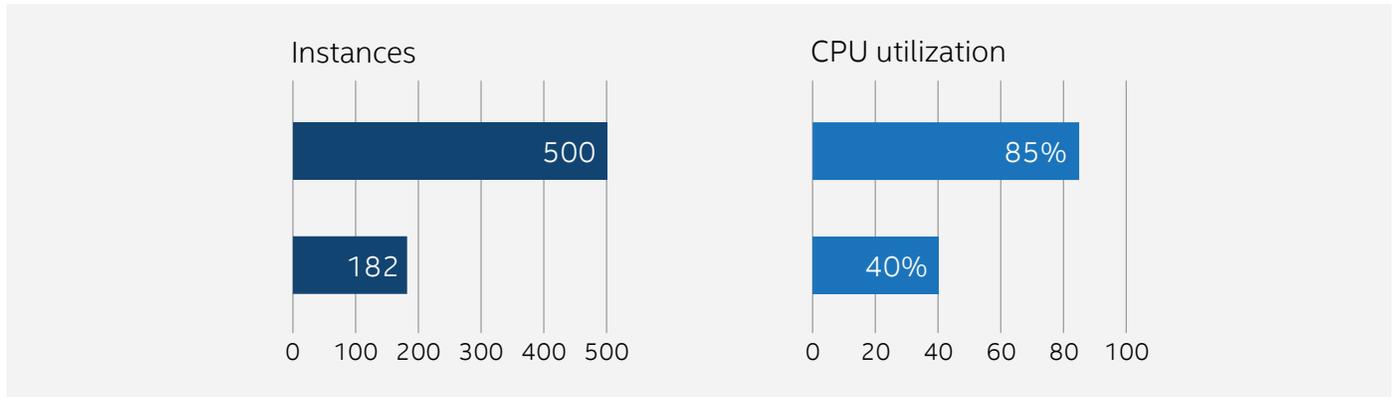
“Our tests showed that we can use Intel® Optane™ DC persistent memory modules (DCPMMs) to extend system memory, letting us more fully utilize our CPUs without losing performance.”

—Marco Balle  
CEO, Nitrado\*

### Collaborating to Drive Innovation in the Data Center

Intel relentlessly innovates, seeking to develop technologies that not only transform the data center, but computing itself. Likewise, Nitrado is a forward-thinking company dedicated to providing top-tier gaming performance and user experience to its customers. When two such companies work together, the results are impressive.

Intel Optane DC persistent memory introduces a flexible new tier to the traditional data center memory hierarchy, architected specifically for data center usage. By deploying systems with Intel Optane DC persistent memory in Memory Mode, Nitrado can optimize its data center efficiency by hosting more game instances per server—thereby increasing CPU utilization—without players noticing any negative effects on game performance.



**Figure 2.** Increased container density and CPU utilization resulting from adding Intel® Optane™ DC persistent memory to gaming servers enables Nitrado\* to keep costs down while maintaining performance levels.

Intel provided Nitrado with testing servers provisioned with Intel Optane DC persistent memory in Memory Mode, and Intel engineers worked with the Nitrado team to choose an optimal configuration of DRAM and DCPMM that would be most cost effective, efficient and performant. Nitrado's current offering uses 1.5 TB of DCPMM, but in the future could deploy up to 3 TB per CPU socket (in addition to the DRAM in the system).

### Better Data Center Efficiency without Compromising Performance

As shown in Figure 2, adding Intel Optane DCPMM in Memory Mode to the gaming server increased the number of Minecraft instances concurrently running from 182 to at least 500, while CPU utilization climbed from 40 percent to 85 percent. More efficient CPU usage and higher game instance/container density reduces data center costs and presents an opportunity for expansion of services—more games, more customers—without degradation of game performance. Nitrado and Intel are excited about the possibilities, not just for Nitrado and its customers, but also for the game development community. Intel will continue to work with Nitrado to pass on the benefits of Intel innovations to Nitrado's customers. Just think of the magical worlds that can be created, now that memory is no longer a constraint.

Find the solution that is right for your organization.  
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### Spotlight on Nitrado\*

Online gaming is steadily growing in popularity, and Nitrado\* makes it easy and affordable for customers to have their own gaming server. Customers do not need to be a technology expert to rent a server and to create their own world where they can play together with their friends. Having a game server with Nitrado has many advantages, as its data centers are strategically located all around the world for optimal latency. Nitrado's goal is to optimize the gaming experience, which is why it offers cutting-edge servers that are protected against distributed denial of service (DDoS) and have been customized to run more than 130 games dynamically and automatically.

Using an intuitive Web browser interface or smartphone app, Nitrado's customers can rent servers, start games, add and delete players, and even change from game to game while keeping their same files and configurations. Customers can focus on gaming, rather than on server admin tasks. Nitrado also provides services for Xbox\* and PS4\* consoles, rents dedicated servers to game studios and publishers, and offers a managed solution where Nitrado handles the instances that are running on dedicated machines.

The company was founded in 2012, and has data centers in Frankfurt, London, New York, Miami, Los Angeles, Sydney and Singapore. In total, Nitrado's data centers run about 40,000 Intel® CPU cores.

### Learn More

You may find the following resources helpful:

- [Nitrado\\* home page](#)
- [Nitrado Enterprise](#)
- [Intel® Optane™ DC persistent memory](#)
- [2nd generation Intel® Xeon® Scalable processors](#)



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<sup>1</sup> Testing by Nitrado as of February 7, 2019.

**All-DRAM Configuration:** Dual-socket Intel® Xeon® Gold 6148 processor (8x 64 GB DDR4-2666 DRAM), total memory installed = 512 GB. System memory available = 512 GB.

Number of Minecraft\* instances: 182

CPU utilization: 40%

**DRAM + Intel® Optane™ DC Persistent Memory Configuration:** Dual-socket Intel® Xeon® Gold 6252 processor (12x 128 GB (1.5TB) Intel® Optane™ DC Persistent Memory plus 12x 16 GB (192 GB) DDR4-2600 DRAM), total memory installed = 1,692 GB. System memory available = 1,536 GB.

Number of Minecraft instances: 500

CPU utilization: 85%

Final results were extrapolated from Nitrado's testing data.

<sup>2</sup> Note that Intel® Optane™ persistent memory can operate in two modes. In Memory Mode, applications and the OS perceive a single pool of volatile memory, no differently than on DRAM-only systems. In this mode, no specific persistent memory programming is required in the applications, and the data will not be saved in the event of a power loss. This is the operating mode Nitrado\* uses. In App Direct Mode, applications and the OS are aware there are two types of direct load/store memory in the platform, and can direct which type of data read or write is suitable for DRAM or Intel Optane DC persistent memory. Operations that require the lowest latency and don't need permanent data storage can be executed on DRAM, such as database "scratch pads." Data that needs to be made persistent or structures that are very large can be routed to the Intel Optane DC persistent memory.

<sup>3</sup> Source: <https://minecraft.gamepedia.com/Tick>

<sup>4</sup> Source: <https://www.globenewswire.com/news-release/2019/07/01/1876481/0/en/Cloud-Gaming-Market-to-exceed-8bn-by-2025-Global-Market-Insights-Inc.html>

Performance results are based on testing as of the date set forth in the configurations and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure.

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