Odin Engine Cluster Edition

Optimization Solution based on the 3rd Gen Intel® Xeon® HCI Platform

White Paper

As a global leader in data centers, Intel® released the new 3rd Generation Intel® Xeon® Scalable processors in May 2021. The 3rd Generation Intel® Xeon® Scalable platform delivers industry-leading performance and integrates powerful acceleration features to meet a wide range of end-to-end workload needs.

The benchmarked solution integrates the Odin Engine Cluster Edition with a powerful product portfolio centered on the Intel® Xeon Scalable platform to create a healthcare integration platform that delivers optimal performance to meet various challenging goals in health system integration and services.

Over the past two decades, most hospitals and health systems globally have adopted and embraced digital technologies with varying degrees of success. There are increasing expectations from governments and consumers to raise the bar on the exchange and use of healthcare data to improve the delivery of care.

To scale an effective digital healthcare system to meet these growing demands, solid foundations must be laid for information sharing and integration. As a result many healthcare organizations urgently require high-performance, high-availability, and easily scalable integration products to support their development.

The Odin Engine Cluster Edition is a complete Integration platform designed to address these scenarios. Its product architecture is very different to traditional Integration Engines. They typically have a single node and are usually deployed in secondary and tertiary level hospitals.

The Odin Engine Cluster Edition has many resilient nodes and is suitable for solutions at a major scale, such as large hospitals, and regional or national solutions.

1. Product Overview

The Odin Engine Cluster Edition is a system integration and service orchestration platform that features store-and-forward messaging integration, Enterprise Service Bus (ESB), ETL, and API Management in one integrated solution.

Odin Cluster consists of a control plane application (a.k.a the controller), API gateways, an identity and access management (IAM) application and scalable number of worker applications, all of which can be deployed on Windows or Linux servers and container environments.

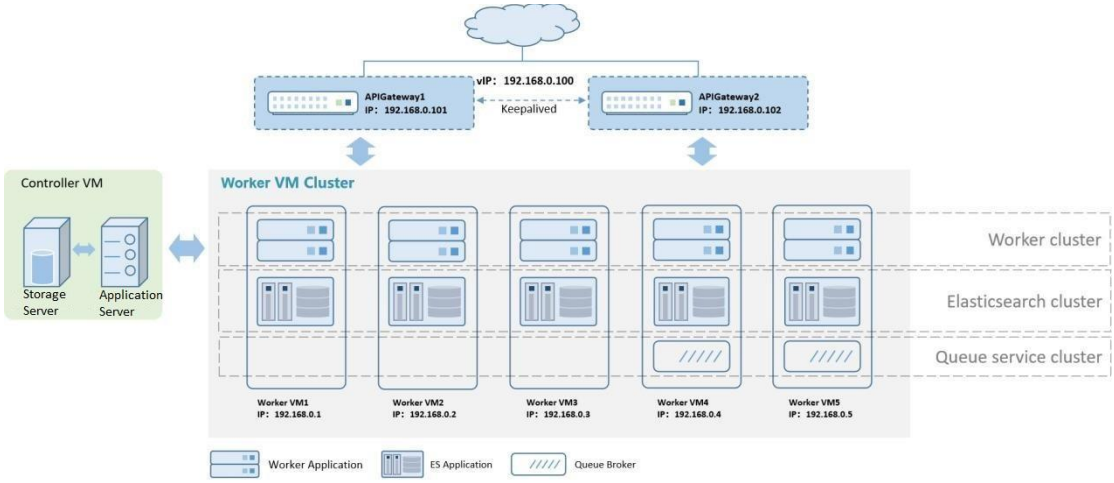
Odin promotes “configuration over coding”, by leveraging Odin’s web based graphical workflow designer and easy-to-use web management console, users are able to develop, test and deploy integration workflows and manage API driven services in one integrated environment.

Odin Cluster also provides a unified experience in managing and monitoring the application cluster with component observability metrics, end-to-end traceability of message flows, and a prebuilt analytics dashboard.

Odin Cluster can greatly reduce complexity of data transformations and protocol conversions for clinical applications using custom data structures as well as international health standards, including HL7 Version 2/Version 3, HL7 FHIR®, and DICOM.

Odin Engine Cluster Edition is designed to help organizations to break through information silos and achieve seamless interoperability between health information systems.

2. Product Architecture



Odin Engine Cluster Edition includes two physically isolated environments out of the box: a development/test environment and a scalable production environment. The web management interface provides a guided process helping users promote tested configurations from the development environment to production, effectively reducing human errors and increasing the reliability of the production system.

The cluster consists of a control plane that centrally manages configurations and coordinates deployments; and horizontally scalable worker applications that support load balancing and workflow sharding to meet various integration and service requirements.

The pluggable framework of endpoints allows Odin Cluster to interface with a variety of external systems such as HTTP REST API, SOAP Web Services, Databases, Websockets, TCP/IP Sockets, File systems, JMS, AMQP, SMTP/POP3, Apache Kafka, Apache Hadoop HDFS, Internet of Things (IoT) applications via MQTT, XMPP, and many more.

In contrast to general purpose ESB products, Odin Cluster inherits the signature features of integration engines to address the varying needs of guaranteed delivery and message ordering for integrating with legacy health messaging systems, and provides a horizontally scalable solution to go beyond the limitation of traditional monolithic application.

Odin Cluster includes API gateways that are fully integrated with the backend worker cluster to offer service load balancing, workflow sharding and customized label-based deployments.

3. Core functions and features

3.1. Overall architecture: the clustering model breaks through the constraints of traditional architecture

Unlike “clusters'' created by traditional monolithic applications, which are formed by deploying multiple copies of the applications onto a number of servers, every component of Odin Engine Cluster Edition was designed to support clustering in its native form and to eliminate single points of failure of the system. Faulty components can be failed over to backups in seconds to ensure very high availability of the service.

3.2. Integration capabilities: focused on complex integration scenarios in the health domain

Odin Engine Cluster Edition includes all the capabilities of scenario-based integration, with a dual-mode workflow runtime that is designed and optimized for various integration scenarios such as messaging system integration, enterprise service bus (ESB), and ETL. The engine cluster not only bridges legacy systems and modern healthcare systems with greatly reduced complexity but also opens the possibilities to redefine modern healthcare interoperability with an API-driven service architecture that meets the needs of every health domain.

3.3. Operations and Management: helping healthcare organizations to improve service quality and efficiency

Odin Engine Cluster Edition is designed to meet the specific requirements of IT infrastructures for today’s hospitals and health organizations. The Odin cluster brings the management of complex multi-node applications under one platform, by offering centralized resource surveillance, situational awareness monitoring, end-to-end message tracing, error notifications, built-in circuit breaker and performance metrics analysis, helping users stay on top of their service level agreements.

3.4 Usability: a platform that puts the control back to the hospital

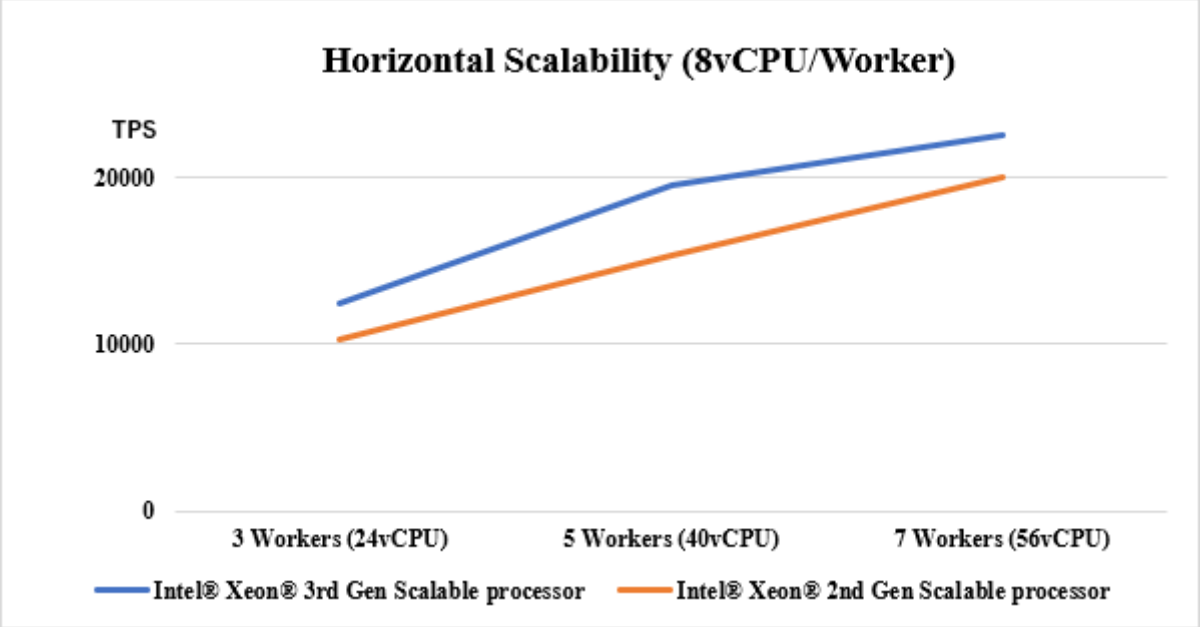
Odin has localized the engine with customizations designed to bridge the usability gap for local markets and to provide integrated development, testing, deployment, resource management, and monitoring under a single pane of glass. Odin’s intuitive web-based user interface, graphical workflow designer, ready-to-use functional processors and powerful visualization capabilities enable users with limited technical knowledge to become productive with a shallow learning curve.

4. Scalability of Odin Engine Cluster Edition under different Intel® Xeon® CPU generations

4.1. Scalability of Odin Engine Cluster Edition under different generations of Intel® Xeon® CPUs

Engineering teams from Odin and Intel® have worked closely together to optimize Odin Engine Cluster Edition on the multi-core/multi-node virtual environment by leveraging Intel® technologies. The Odin Cluster showed a linear growth in overall performance under both horizontal and vertical scaling models. The messaging performance of Odin Cluster improved 20% to 30% on Intel® Xeon® 3rd generation scalable processor compared to the previous Intel® Xeon® 2nd generation processor.

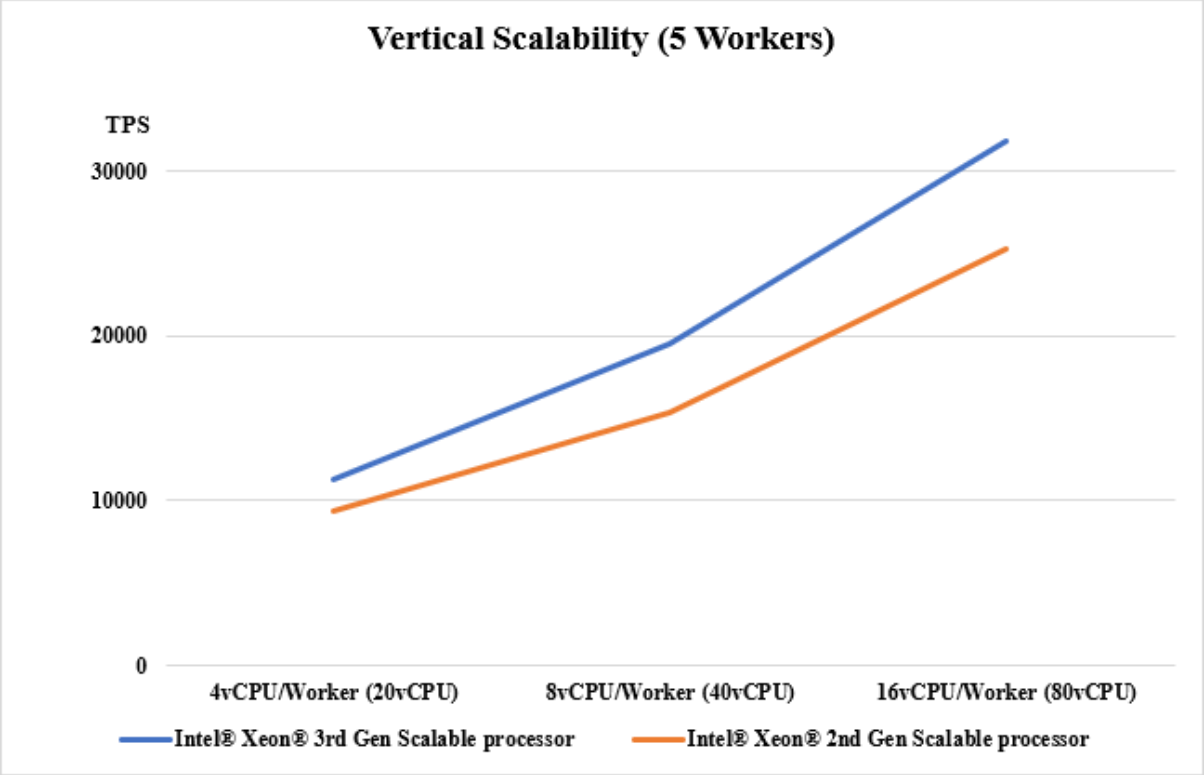
1) Horizontal Scalability Tests



Higher is Better for TPS.

- The overall performance of Odin Cluster (measured in transaction per second, TPS) maintained a linear growth with an increased number of worker nodes
- The performance of Odin Cluster improved by 20% to 30% on Intel® Xeon® 3rd generation scalable processor over its predecessor -- Intel® Xeon® 2nd generation processor

2) Vertical Scalability Tests

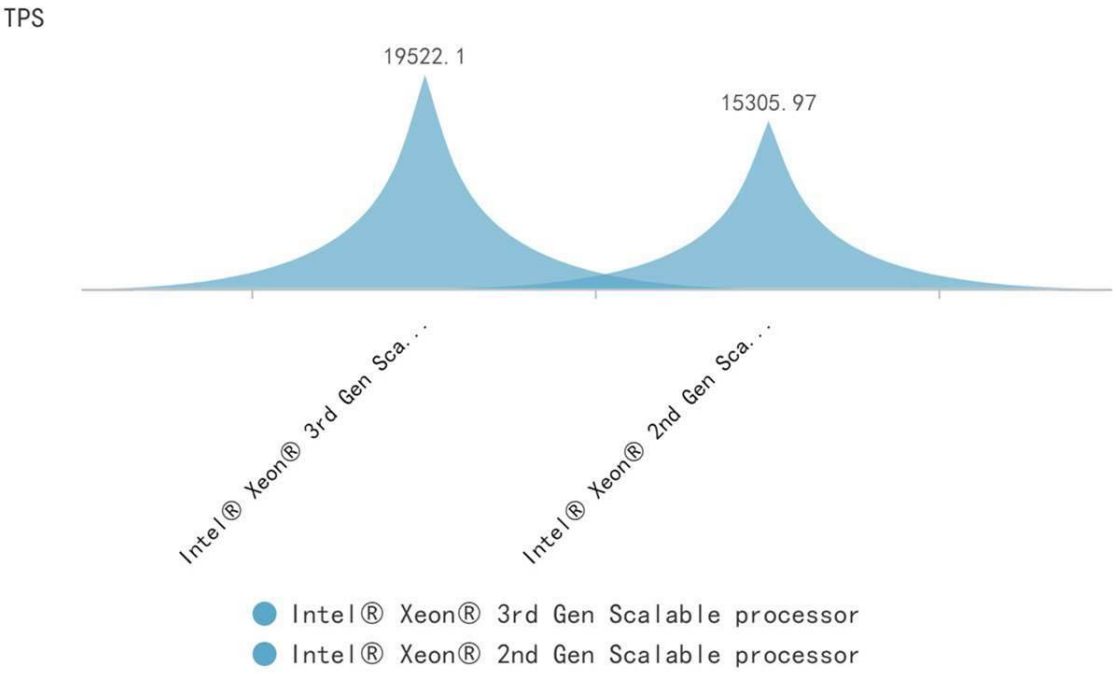


Higher is Better for TPS.

- The overall performance of Odin Cluster (measured in transaction per second, TPS) maintained a linear growth with an increased number of vCPUs (on a fixed number of workers)
- The performance of Odin Cluster improved by 20% to 30% on Intel® Xeon® 3rd generation processor over its predecessor Intel® Xeon® 2nd generation processor

4.2. Performance Differences Between Intel® Xeon® CPU Generations

Intel® Xeon® 3rd Generation Scalable processors demonstrated a significant performance improvement over its previous generation processors (Intel® Xeon® 2nd generation). The average messaging performance has improved by 27% in both horizontal and vertical scaling tests on an Odin cluster with 5 worker nodes.



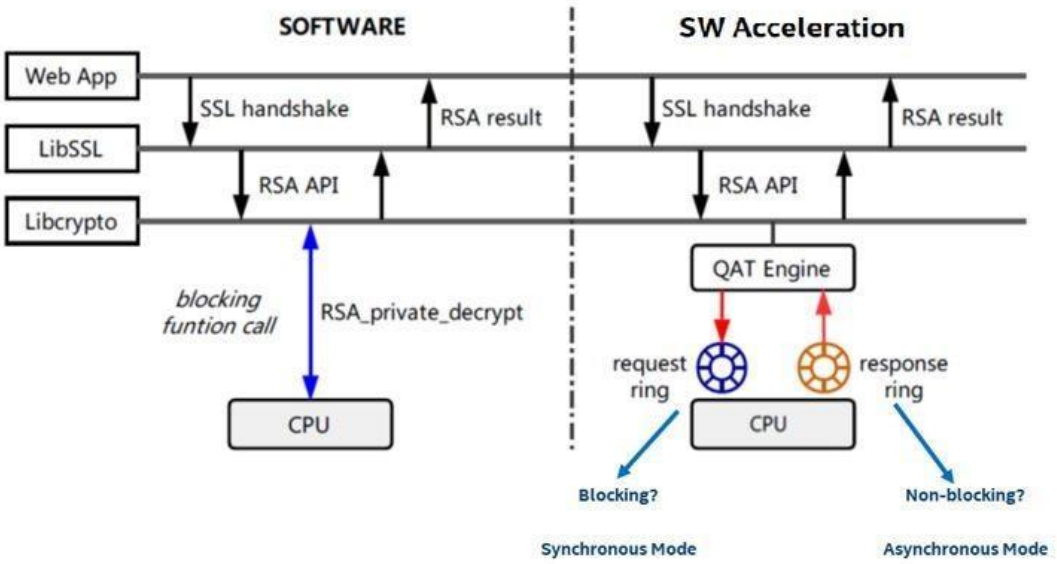
Higher is Better for TPS.

5. Optimization of Intel® and Odin Engine

5.1 The encryption acceleration scheme (CryptoNI) of the 3rd generation Intel® Xeon® Scalable processor greatly improves the performance of Odin KONG/API gateway

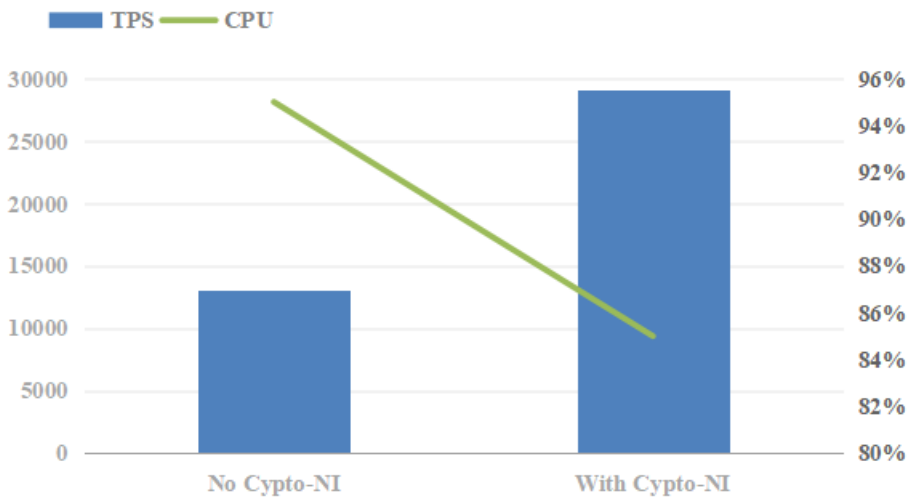
Odin's API gateway incorporates the Kong Gateway OSS and Nginx OSS solutions. Nginx is a high-performance HTTP and reverse proxy web server based on a BSD-like license. Nginx uses SSL/TLS to enhance web access security. Intel has introduced the Crypto-NI software solution, which is based on 3rd generation Intel® Xeon® Scalable Processors (Codename Ice Lake/Whitley). It can effectively improve the security of web access.

Crypto-NI (NI stands for New Instructions) is a new instruction set that supports encryption and decryption in 3rd Generation Intel® Xeon® Scalable processors. The new architecture has six instructions: four instructions (AESENC, AESENCLAST, AESDEC, and AESDELAST) facilitate high-performance AES encryption and decryption, and the other two (AESIMC and AESKEYGENASSIST) support the AES key expansion. The main software used in this solution is the IPP Cryptographic Library, Intel® Multi-Buffer Crypto for IPsec Library (intel-ipsec-mb), and Intel® Communication Acceleration Technology (Intel® QAT). The AES instructions provide a substantial performance speedup to bulk data encryption and decryption. When using parallelizable modes of operation, such as CBC decryption, CTR, and CTR-derived modes (GCM), XTS. The performance speedup could exceed an order of magnitude over software-only, lookup tables based AES implementations.



Crypto-NI can also be utilized in a cloud environment.

Compared to a conventional software-based solution, the performance of SSL/TLS termination on an Odin cluster using Crypto-Ni with 5 worker nodes (32 vCPU cores, 32GB RAM) and an API gateway node (Nginx basic configuration 16 vCPU, 16GB RAM) improved significantly. The overall throughput is increased by 123%, while the CPU utilization is decreased by 10%.



Higher is Better for TPS.

5.2. Intel® Optane™ Persistent Memory (PMEM) increases virtual machine density in HCI environment and improves platform cost-effectiveness

In today's rapid evolution of data center infrastructure, to meet memory requirements in a cost-effective manner, the latest technical solutions begin to adopt a new approach of "memory tiering" architecture. Using a tiered memory approach, DRAM capacity is reserved for hot data that requires high performance and the capacity tier for less performance intensive tasks that still require large scale capacity to accommodate different data formats, use cases, technical needs and budget constraints.

- Provide more memory capacity at a lower cost
- Deliver high performance and meet workload service level agreements
- Lower total cost of ownership by increasing memory per server and workload density to reduce footprint

In the PMEM test scenario, Odin Cluster was deployed to two virtual environments for comparison:

- 2 x physical servers hosting virtual machines with conventional memory settings;
- 1 x physical server with 16 x 128 GB PMEM installed (in PMEM memory mode), allowing a total of 2TB available memory on a single server.

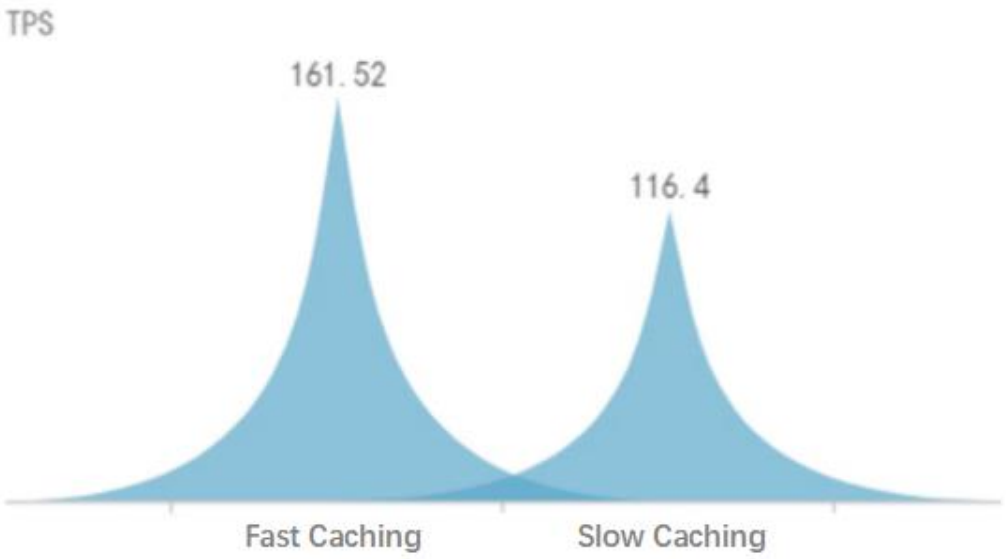
The virtual machines required to host a Odin Cluster platform running on two physical servers are able to be accommodated on a single server with PMEM. The test results showed that with increased workload density, the total cost of ownership with the server on PMEM is reduced without compromising performance.

5.3. Intel® Optane™ Performance Optimization for ElasticSearch in Odin engine

Intel® Optane™ technology is not based on NAND; it's a whole new technology built on a unique architecture that allows memory cells to be individually addressed in a dense, transistor-less, stackable design. In particular, Intel Optane SSDs provide consistent, high performance under load, reaching peak performance at lower queue depths, where nearly all real-world applications operate. In comparison, traditional NAND storage drives often reach optimum performance levels only at higher queue depths—beyond the usable range of most applications. Peak performance at higher queue depths does not accurately reflect real-world drive performance. As a result, Intel Optane SSDs offer enhanced performance for applications, up to 6x higher throughput versus NAND-based SSDs. The Intel® Optane™ SSD P5800X can reach up to 1.6M IOPS of random read or random write performance at low queue depths.

The integration workflows on Odin Engine Cluster Edition persist a large number of message logs to Elasticsearch for indexing and searching. An underlying storage device with lower latency for random access and a higher level of concurrent IO is the key to achieve the best performance outcome for such IO-intensive applications.

The overall performance of Odin Engine Cluster Edition improved by 38% in IO intensive test scenarios on Intel® Optane™ SSD P5800X with accelerated caching tier on vSAN, compared to Intel® SSD DC P4510 Series.



6. Conclusion

Thanks to the joint efforts of the engineering teams from Odin and Intel®, the performance of Odin Engine Cluster Edition has been greatly optimized using the latest Intel® Xeon® processors and other Intel-related products and technologies.

The optimized Odin cluster on the 3rd Generation Intel® Xeon® Scalable Platform HCI Platform has achieved an average of 30,000 TPS (transaction per second) on a 5-worker cluster, each worker node with 16 vCPU cores.

Intel® acceleration technology is highly recommended to optimize the end-to-end experience in the following scenarios

1. In the HTTP (TLS v1.2) use case, overall throughput increased 123% by leveraging the Crypto-NI technology built into the Intel® Xeon® platform
2. The total cost of ownership is reduced by up to 40% through increasing memory and workload density by leveraging the Intel® Optane™ technology
3. The overall performance is improved by 38% in the high IOPS use case with the Intel® Optane™ SSD P5800X

Notices & Disclaimers

Performance varies by use, configuration and other factors. Learn more on the Performance Index site.

Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No product or component can be absolutely secure.

Your costs and results may vary.

Intel technologies may require enabled hardware, software or service activation.

Performance results are based on testings performed by Intel and Odin in July 2022

Configuration of 3rd Generation Intel® Xeon® Platform: 2x Intel® Xeon® Gold 6348 CPU @2.60GHz, 256GB RAM (16GB DDR4 x16), Intel® Optane™ PMEM 2T (128G x16), P4510 1T x4, P5800X 1.6T x2, CentOS 8.4 BIOS: SE5C6200.86B.0020.P08.2012230523

Configuration of 2nd Generation Intel® Xeon® Platform: 2x Intel® Xeon® Gold 6240 CPU @2.60GHz, 192GB RAM (16GB DDR4 x12), Intel® Optane™ PMEM 1.5T (128G x12), P4510 1T x4, P5800X 1.6T x2, CentOS 8.4 BIOS: SE5C620.86B.0D.01.0286.011120190816