September 2023

Cost savings from running Red Hat OpenShift on IBM Power servers

Modernizing with IBM Power

Increasingly, IBM® Power® customers are modernizing their applications with cloud native capabilities that work in a hybrid cloud environment. AIX® or IBM i applications can be ported to Red Hat® OpenShift® to maximize flexibility to run across multiple clouds. Red Hat OpenShift extends Kubernetes with built-in tools to enhance application lifecycle development, operations, and security. With OpenShift, clients can consistently deploy workloads across multiple public or private clouds with ease.

This paper examines Red Hat OpenShift Container Platform (RHOCP) running on IBM Power servers as an effective platform for application modernization for a hybrid cloud environment. IBM tests show that the same multi-tier online transaction processing (OLTP) workload on Red Hat OpenShift, running IBM® WebSphere® Hybrid Edition on an IBM Power S1022 server, can process 3.6x more transactions per second per core and can reduce the cost per transaction in a three-year TCO model by 69% versus compared x86 servers.[1] In addition to reducing IT costs, IBM Power servers provide other benefits such as resiliency, security and scalability that are requisites for enterprise IT.

Hardware matters in the cloud

In today's rapidly changing IT world, most enterprises avoid vendor lock-in that can limit innovation and increase cost. Red Hat OpenShift offers a container platform to simplify application development and delivery across diverse environments. RHOCP can easily deploy workloads across multiple public and private clouds on a variety of servers. When moving to cloud, IBM Power customers often face the question of what hardware to select. Should they stay on Power servers or move to commodity x86 servers? Power servers are well known for reliability, availability, and serviceability (RAS) features,[2] and are designed to deliver 99.999% availability. RAS continues to be an important consideration for workload placement for most enterprises. For customers basing their decision on cost, we conducted a test to see which platform – Power S1022 or x86 (Ice Lake) servers – can provide a more cost-effective option.[1]

Red Hat OpenShift Container Platform on Power10 versus x86 (Ice Lake)

To examine how OpenShift workloads on IBM Power servers compare to running on x86 servers, we used a two-tier OLTP Day Trader application simulating a real customer workload. Test workload was generated using Apache JMeter running on another server. Testing measured maximum throughput in number of transactions per second (TPS) by driving CPU to highest utilization (over 95%). Tests were run three times on each server in a steady state for 20 minutes each.

DayTrader test application

DayTrader is test application built around the paradigm of an online stock trading system[3]. Originally developed by IBM as the Trade Performance Benchmark Sample, DayTrader was donated to the Apache Geronimo community in 2005.

This application allows users to login, view their portfolio, lookup stock quotes, and buy or sell stock shares. DayTrader is built on a core set of Java EE technologies that includes Java Servlets and JavaServer Pages (JSPs) for the presentation layer and Java database connectivity (JDBC), Java

Message Service (JMS), Enterprise JavaBeans (EJBs) and Message-Driven Beans (MDBs) for the back-end business logic and persistence layer[4]. The following diagram shows a high-level overview of the application architecture.

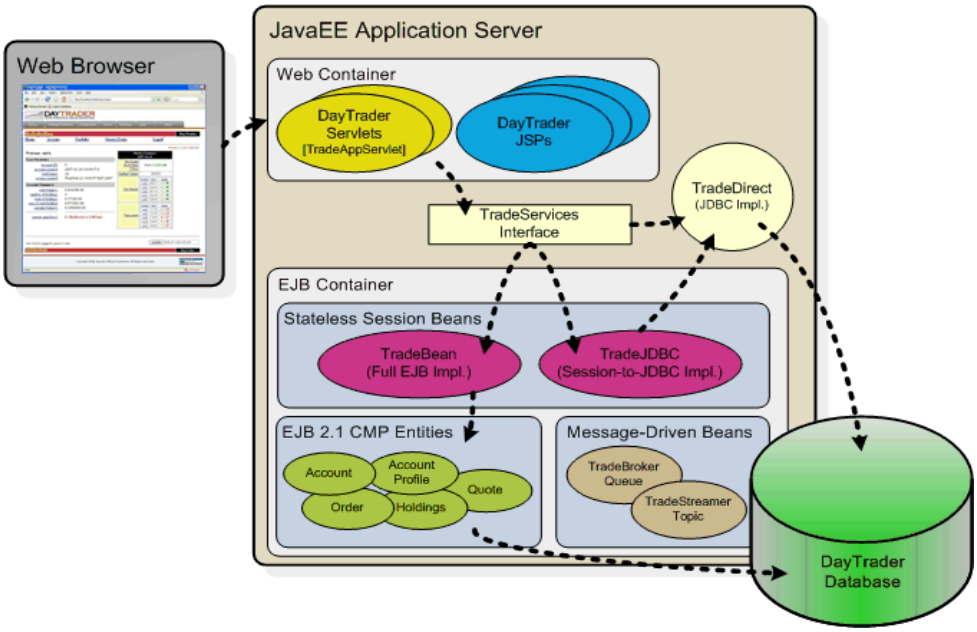

Figure 1: High level architecture of DayTrader test application

Test hardware environment

For this test, we used a 2-socket 40-core Power S1022 server for the IBM Power environment and a 2-socket 80-core x86 Ice Lake server for the x86 environment. Both environments ran WebSphere Liberty on Red Hat OpenShift version 4.9.18. Apache Jmeter, running on a separate server, was used to simulate transactions from 1600 users. Both the Power and x86 configurations connected to the same database (DB) on another server. The DB server was configured with enough resources to make sure it was not the bottleneck. CPU utilization of DB server was less than 50%.

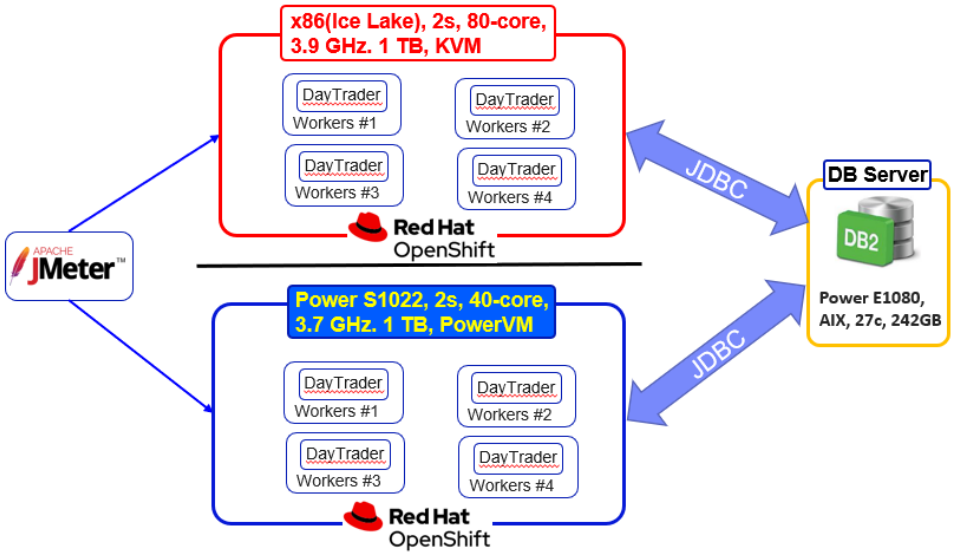

Figure 2: Test hardware configuration

Test findings

Through repeated tests we found that the DayTrader application deployed on Red Hat OpenShift running on the 40-core Power10 server achieved on average 76,763 TPS compared to 42,565 TPS in the 80-core x86 Ice Lake environment, which is 1.8 times more TPS on the Power server over x86 server. So, on a per-core basis, the Power10 server delivered 3.6x more TPS per core vs the x86 server.[1] We also measured the "error rate" i.e., number of transactions where test result did not match the expected result. In both environments, the error rate was under 1%.

Lower total cost of ownership

In addition to measuring peak performance, a three-year total cost of ownership (TCO) model was developed to examine costs for each platform. The TCO model included hardware, system software, application software, people, networking, floor space, and energy and cooling based on U.S. costs. The Power S1022 configuration resulted in a 45% lower total cost of ownership than the x86 configuration primarily due to the difference in software costs. In the tested configuration, the x86 environment had twice the number of cores than Power10 (80 versus 40 cores), hence doubling the software costs on x86 since both Red Hat OpenShift and WebSphere Hybrid Edition are priced per core.

In addition, x86 virtualization is charged per socket while IBM® PowerVM® virtualization is included in the purchase cost of Power S1022 servers, creating another cost consideration. In this model, higher x86 software cost more than offsets the higher cost of Power hardware, resulting in an overall lower TCO for Power10.

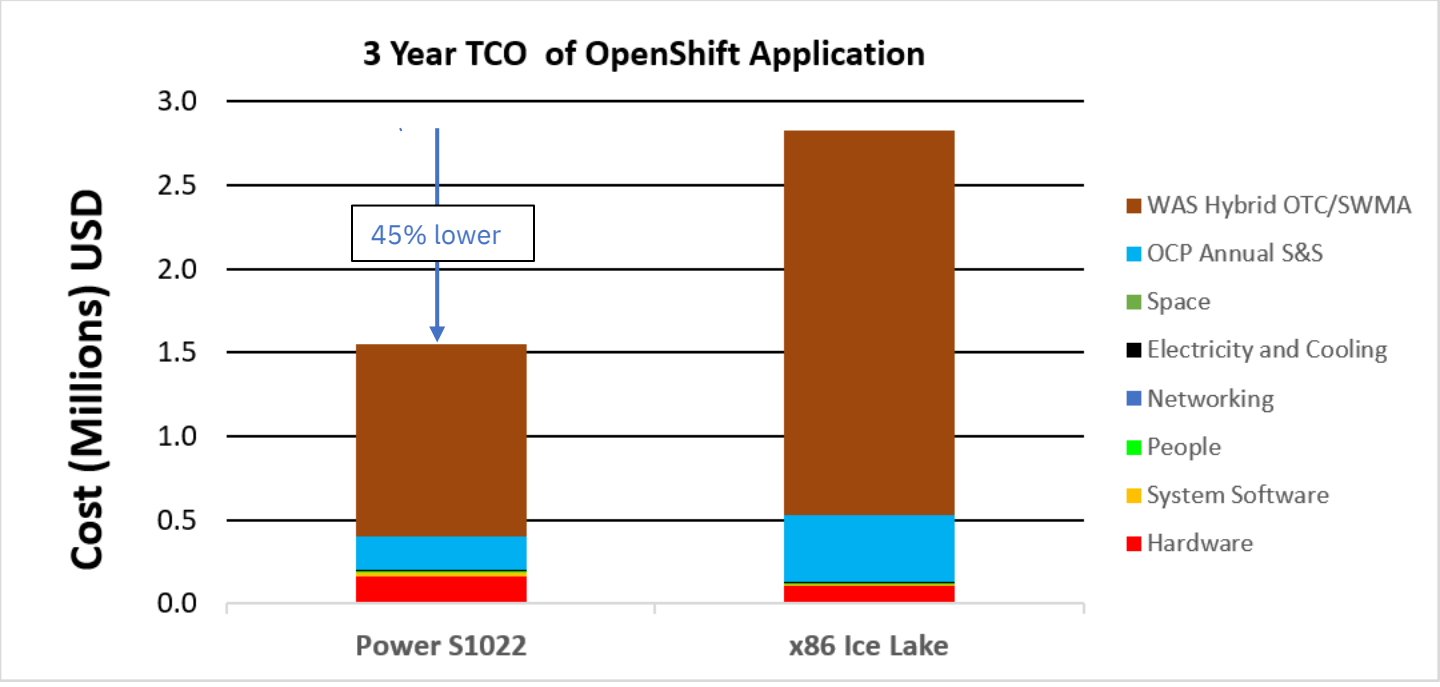

Figure 3: Total cost of ownership for Red Hat OpenShift application on Power10 and x86 Ice Lake servers

In terms of both performance and cost, the Power S1022 was found to bring greater transaction efficiencies with 3.6 times more TPS per core than x86 and a 69% lower cost per transaction than the compared x86 servers.[1]

	Txn per sec per server	Txn per sec per core	3 Year TCO	Cost per Transaction	TPS per server	TPS per core	Cost per Transaction
Power S1022 (40 cores)	76,763	1,919	$1,550,381	$20.20	1.8 times more TPS	3.6 times more TPS	69% lower cost per transaction
x86 Server (Ice Lake) (80 cores)	42,565	532	$2,824,856	$66.37			

Figure 4: TPS and TCO findings for Power10 versus x86 for Red Hat OpenShift test application

Additional benefits of running Red Hat OpenShift on Power

In addition to providing a lower overall total cost of ownership and greater throughput for SLAs, IBM Power servers offer other benefits for workloads on Red Hat OpenShift.

- Co-location: Red Hat OpenShift can reside in a separate LPAR on the same physical server as existing backend applications on AIX, IBM i or Linux® environments, alleviating the potential for network, latency, and performance issues.
- Flexible consumption model: Customers can scale up and down applications, avoid over or under provision capacity, manage spikes, and support more cloud workloads per server (without taking your system or application down) with a pay-per-use, flexible, consumption-based pricing model.
- Power Virtual Server: Red Hat OpenShift is available on IBM Power Virtual Server using OpenShift's platform-agnostic installer. Using IBM Power Virtual Server, co-located with IBM Cloud®, customers can deploy AIX, IBM i and Linux applications in a hybrid cloud and access 200+ IBM Cloud services.

Modernize with Red Hat OpenShift and IBM Power

If your organization is evaluating Red Hat OpenShift for the journey to modernization and digital transformation, the IBM Power platform – built to handle mission critical workloads while maintaining security, reliability, and control of your entire IT infrastructure in a hybrid cloud – is a strong contender. Contact an IBM Representative for more information about Red Hat OpenShift on IBM Power servers.

Author

Angshuman Roy
Principal IT Economics Specialist
Email: aroy@us.ibm.com

Contributors

John F Ryan
Principal IT Economics Specialist
Email: jfryan1@us.ibm.com

Mel Bakhshi
Power Systems Performance Specialist
Email: melb@ca.ibm.com

New Orchard Road Armonk, NY 10504 U.S.A.
Produced in the United States of America,
08/2023

All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.

The information contained in this documentation is provided for informational purposes only. While efforts were made to verify the completeness and accuracy of the information contained in this documentation, it is provided "as is" without warranty of any kind, express or implied. In addition, this information is based on IBM's current product plans and strategy, which are subject to change by IBM without notice. IBM shall not be responsible for any damages arising out of the use of, or otherwise related to, this documentation or any other documentation. Nothing contained in this documentation is intended to, nor shall have the effect of, creating any warranties or representations from IBM (or its suppliers or licensors), or altering the terms and conditions of the applicable license agreement governing the use of IBM software.

References in these materials to IBM products, programs, or services do not imply that they will be available in all countries in which IBM operates. Product release dates and/or capabilities referenced in these materials may change at any time at IBM's sole discretion based on market opportunities or other factors and are not intended to be a commitment to future product or feature availability in any way.

---

[1] This is an IBM internal study designed to replicate multi-tier OLTP workload with IBM WebSphere Hybrid Edition on a 40-core IBM Power S1022 server (Model 9105-22A) with 1 TB memory running PowerVM hypervisor and compare it to 80-core x86 Ice Lake server with 1 TB of memory and KVM hypervisor. The OpenShift cluster consisted of four worker nodes using OpenShift version 4.9.18 and Red Hat Enterprise Linux CoreOS (RHCOS). For IBM Power server, SMT8 mode was enabled across all LPARs and for x86 server, hyperthreading was enabled. Each worker node guest had access to all vCPUs on the physical server on which it was running. Both environments used JMeter to drive maximum throughput using a total of 1600 users. All results were obtained using IBM internal testing. Prices, where applicable, are based on U.S. prices as of 07/19/2023 from our website and x86 hardware pricing is based on IBM analysis of U.S. prices as of 07/19/2023 from IDC. Price comparison is based on a three-year total cost of ownership including HW, SW, networking, floor space, people, energy/cooling costs and three years of service & support for production and non-production (dev/test and high availability) environments.

[2] IBM Power® RAS Whitepaper & ITIC 2022 Global Server Hardware, Server OS Reliability Report. Also, NIST Vulnerability Database for listing for Power Operating Systems (AIX, IBM I, Linux) and virtualization (PowerVM) versus x86 OS (Linux, Windows) and virtualization (VMware) https://nvd.nist.gov/vuln.

[3] DayTrader application info: https://cwiki.apache.org/confluence/display/GMOxDOC12/Daytrader

[4] DayTrader code: https://github.com/WASdev/sample.daytrader7