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Cost advantages of running Red Hat OpenShift on IBM Power Systems

Modernizing with Power Systems

Increasingly, Power Systems™ 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 (OCP) running on IBM® Power Systems as an effective platform for application modernization for a hybrid cloud environment. IBM tests show that the same multi-tier online transaction processing (OLTP) workloads on Red Hat OpenShift, running IBM WebSphere® Hybrid Edition on an IBM E950 Power System, can process 3.2x more transactions per second and can reduce the cost per transaction in a three-year TCO model by 53% versus compared x86 servers.[1] In addition to reducing IT costs, IBM Power Systems 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 OCP offers Kubernetes container orchestration tooling to simplify application development and delivery across diverse vendor environments. OCP can easily deploy workloads across multiple public and private clouds on a variety of servers. When moving to cloud, Power Systems customers often face the question of what hardware to select. Should they stay on Power Systems or move to commodity x86 servers? Power Systems are well known for reliability, availability, and serviceability (RAS) features,[2] such as Chipkill and Active Memory Mirroring, and are designed to deliver 99.999% availability.[3] RAS continues to be an important consideration for workload placement for most enterprises.

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[1] This is an IBM internal study designed to replicate multi-tier banking OLTP workload usage with IBM WebSphere Hybrid Edition in the marketplace on an IBM E950 (40-core Model 9040-MR9) with a total of 1 TB memory. The OpenShift cluster consisted of three master nodes and two worker nodes using OpenShift version 4.5.6 and Red Hat Enterprise Linux CoreOS (RHCOS) for IBM Power across five PowerVM LPARs. A sixth PowerVM LPAR on the system ran the OpenShift load balancer. SMT8 mode was enabled across all Power LPARs. The x86 cluster configuration comprised of two servers running VMware ESXi 6.7 with eight VM guests (three masters, four workers, and one load balancer) using OpenShift version 4.5.6. Each worker node guest had access to all vCPUs on the physical server on which it was running. Compared x86 models for the cluster were 2-socket Cascade Lake servers containing 48 cores and 512 GB each for a total of 96 cores and 1 TB of memory. Both environments used JMeter to drive maximum throughput against four OLTP workload instances using a total of 500 JMeter threads. The results were obtained under laboratory conditions, not in an actual customer environment. IBM's internal workload studies are not benchmark applications. Prices, where applicable, are based on U.S. prices as of 03/03/2021 from our website and x86 hardware pricing is based on IBM analysis of U.S. prices as of 03/03/2021 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] https://www.ibm.com/support/pages/ibm-power-systems%E2%84%A2-reliability-availability-and-scalability-ras-features & ITIC 2020 report on server outage https://itic-corp.com/blog/2020/05/itic-2020-reliability-poll-ibm-lenovo-hpe-huawei-mission-critical-servers-deliver-highest-uptime-availiability/. 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] ITIC 2020 report, https://www.ibm.com/it-infrastructure/us-en/resources/power/five-nines-power9.

For customers basing their decision on cost implications, we conducted a test to see which platform – Power® E950 or x86 (Cascade Lake) servers – can provide a more cost-effective option.[1]

OpenShift Container Platform on POWER9 versus x86

To examine how OpenShift workloads on Power Systems compare to running on x86, we used a two-tier OLTP banking microservices application simulating a real customer workload. Test application users on both POWER9™ and x86 were driven by Apache JMeter instances running on another server, one for each application instance (one for each x86 server and one for each Power logical partition (LPAR)). Testing measured the throughput in number of transactions per second (TPS) for 500 users requiring a service level agreement (SLA) of under 107 milliseconds response time on both platforms. All tests were run three times in a steady state for 10 minutes each.

Test banking application

The following figure shows the configuration of the test application consisting of seven lightweight Java™ microservices running in WebSphere Liberty and accessing an off-platform database. All microservices ran in Red Hat OpenShift pods.

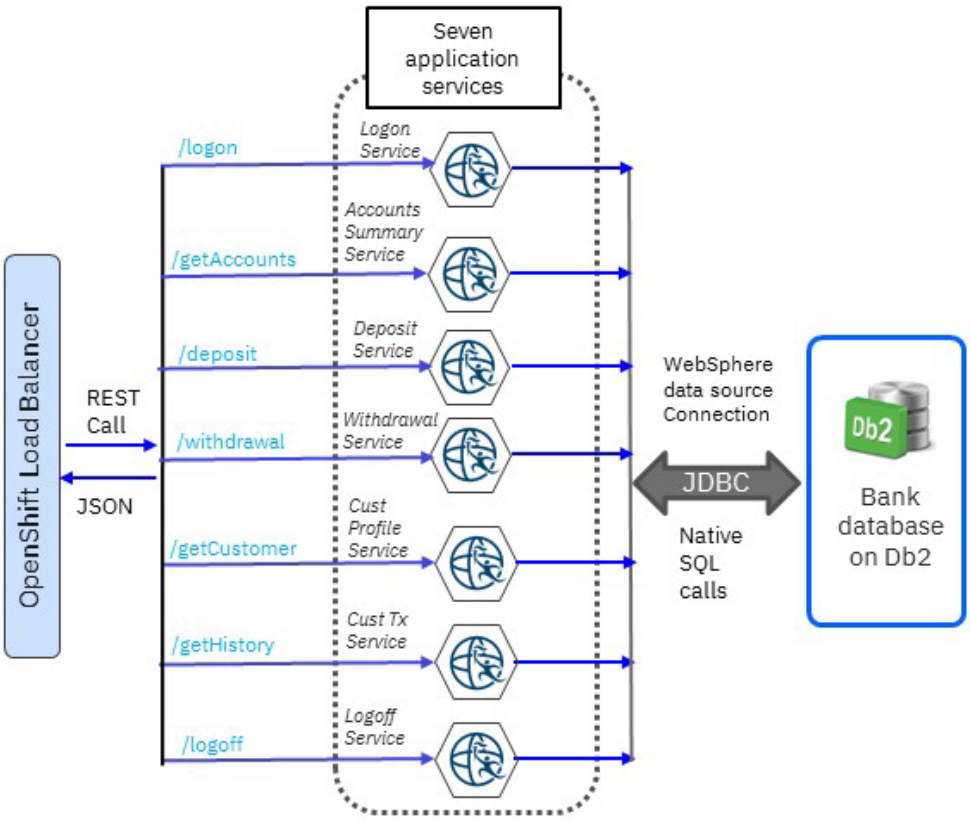

Figure 1: Test application built with microservices

Test hardware environment

For the banking application test, we used a 40-core Power E950 server for the Power Systems environment and two 2-socket x86 Cascade Lake servers with a total of 96 cores for the x86 environment. Both environments ran WebSphere Liberty on OpenShift version 4.5.6. Two separate instances of the banking application, each supporting 250 users, were deployed in each environment. In the x86 configuration, each physical server hosted one application instance to avoid inter-communication delays between the two physical servers. Both the POWER9 and x86 configurations connected to same database on another server.

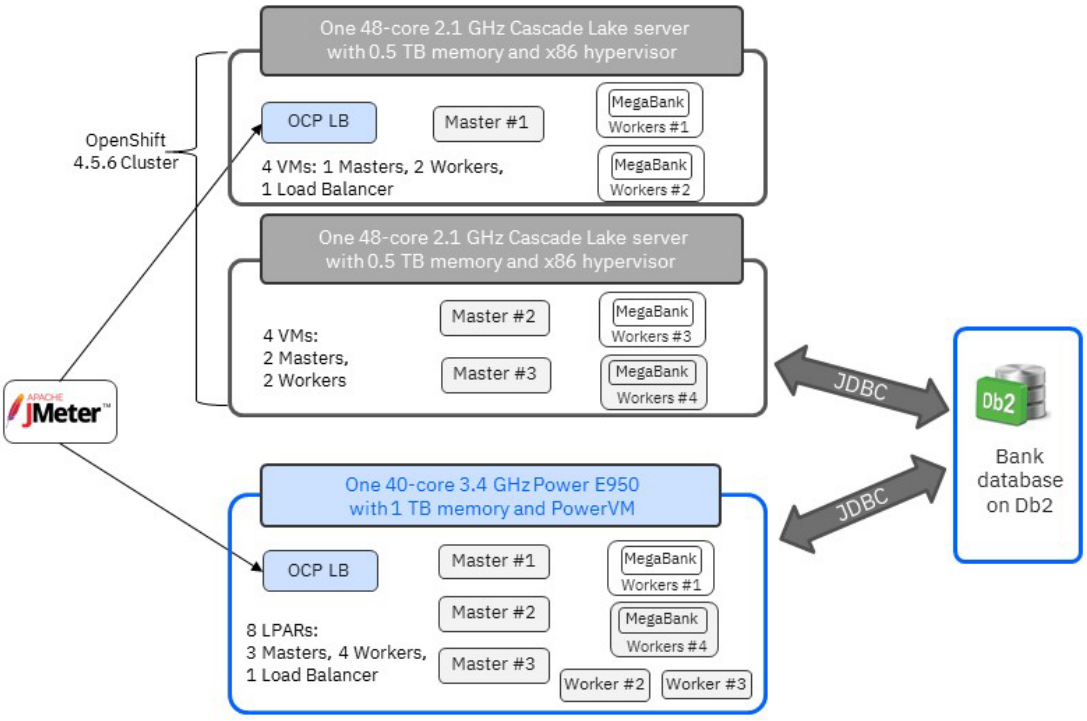

Figure 2: Test hardware configuration

Test findings

Through repeated tests we found that the OLTP banking workload on Red Hat OpenShift running on POWER9 achieved on average 20,596 TPS within the established SLA of 107 milliseconds per response compared to 15,427 TPS in the x86 environment. The Power E950 environment delivered 1.3 times more TPS for 500 users than the compared x86 Cascade Lake servers, resulting in 3.2x more TPS per core with POWER9.[1]

Not only did the IBM Power E950 configuration deliver better performance overall, it also achieved the SLA without transaction errors. In the x86 environment, testing found an error rate of 0.09%-0.13%, or approximately 20 errors out of every 15,000

transactions, that did not match expected results. For some workloads, this error rate could be considered too high, and would necessitate throttling down the throughput.

Lower total cost of ownership

In addition to measuring performance according to SLA TPS criteria, 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.[1]

The IBM Power E950 configuration resulted in a 38% lower total cost of ownership than the x86 configuration primarily due to the difference in software costs. In the tested configuration, the x86 environment required 2.4 times more cores than POWER9 (96 versus 40 cores) driving a 58% increase in x86 software costs since both Red Hat OpenShift and WebSphere Hybrid Edition are priced per core.[1]

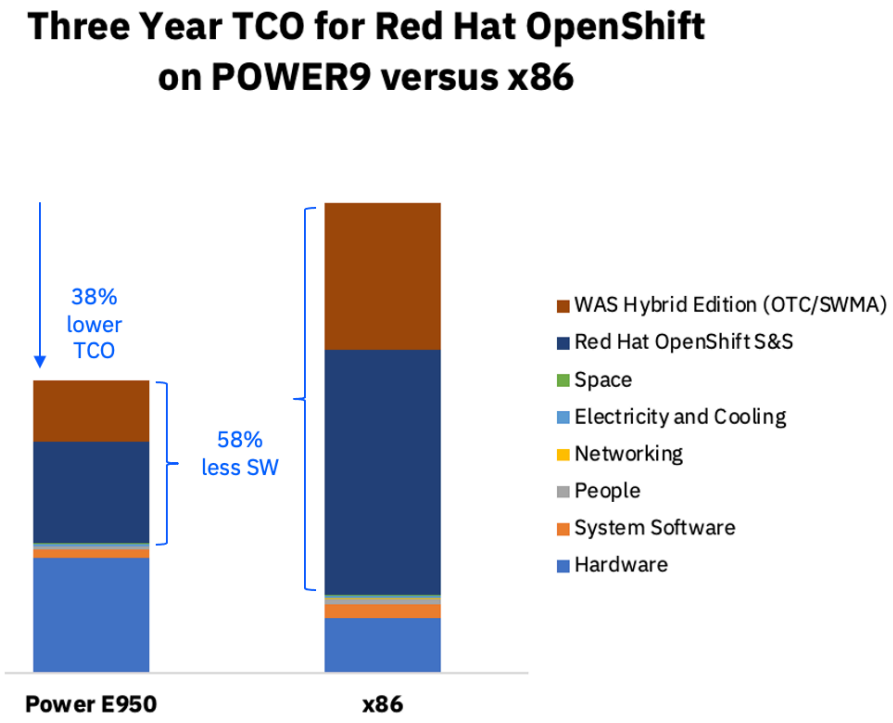

Figure 3: Total cost of ownership model for application on OpenShift on POWER9 versus x86

In addition, x86 virtualization is charged per socket while PowerVM™ virtualization is included in the purchase cost of IBM Power E950 servers, creating another cost consideration. In this model, x86 software costs more than offset the higher cost of Power hardware, resulting in an overall lower TCO for POWER9.

In terms of both performance and cost, the Power E950 was found to bring greater transaction efficiencies with 3.2 times more TPS than x86 and a 53% lower cost per transaction than the compared x86 servers.[1]

	TPS per SLA criteria	TPS per core	Cost per Transaction	3 Year TCO	Total TPS	TPS Per Core	Cost Per Transaction
x86 servers (96 cores)	15,427	161	$71.60	$1,104,641	**1.3 times more** TPS than x86	**3.2 times more** TPS than x86	**53%** lower cost per transaction than x86
Power E950 (40 cores)	20,596	515	$33.44	$688,659			

Figure 4: TPS and TCO findings for POWER9 versus x86 for application on OpenShift

Additional benefits of running OpenShift on Power

In addition to providing a lower overall total cost of ownership and greater throughput for SLAs, IBM Power Systems 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: Using Power Systems 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 Power Systems

If your organization is evaluating Red Hat OpenShift for the journey to modernization and digital transformation, the IBM Power Systems 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 the IBM IT Economics team at IT.Economics@us.ibm.com for more information about Red Hat OpenShift on IBM Power Systems. Ask for a no-charge hybrid cloud assessment to determine the most effective infrastructure for your application.

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