MariaDB Enterprise Server performance on Red Hat Enterprise Linux

IBM Power E1080 versus Intel Xeon Gold 6348

IBM

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Abstract
This white paper describes the performance of MariaDB Enterprise Server version 10.6.17-12 on IBM® Power® servers featuring IBM Power10 processor technology. The target audience is users and system integrators interested in using Linux® on Power10 and MariaDB Enterprise Server.

Introduction
The performance results in this paper demonstrate how MariaDB and IBM Power perform using the sysbench 1.0.20 benchmark suite. This white paper details the results on the IBM Power E1080 server running MariaDB Enterprise Server version 10.6.17-12 on Red Hat® Enterprise Linux (RHEL) 9.1.

The innovative design of the IBM Power10 processor technology is built to withstand very demanding, data-intensive applications, making it well-suited for MariaDB customers.

The IBM Power server combines the computing power, memory bandwidth, and I/O in ways that are easier to consume and manage, building on strong resiliency, availability, and security demonstrated by:
- Computing power with 50% more cores than prior generation servers and smart acceleration enabled by the Coherent Accelerator Processor Interface (CAPI).
- Massive memory with over twice the bandwidth of prior generation servers to process data faster and achieve greater speed and efficiency for transactional applications such as MariaDB.
- Systems that are easy to deploy and manage with open source technologies such as OpenStack, kernel-based virtual machine (KVM), simplified virtualization management, and flexible capabilities to drive rapid adoption and dramatically simplify IT consumption.
- Better cloud economics for scale-out infrastructures, with price-performance advantages and security to confidently move data-centric applications to the cloud.

MariaDB Enterprise Server is an enterprise-grade database management system. With a purpose-built storage engine architecture, it supports transactional, analytical, and mixed workloads for relational and JSON data models. It also offers high availability, resilient clustering, and easy scale out.

The subsequent sections provide clear examples of the advantages of MariaDB Enterprise Server, and its performance advantages over other platforms on Linux on Power.

Advantages of MariaDB on IBM Power
The key advantages of MariaDB Enterprise Server running on IBM Power servers include:
- Performance: It allows up to 900,000 transactions per second and up to 4.22 times the performance of Intel® x86-64 (Ice Lake) based systems (see Table 1).
- Economics: It enables high-performance workloads on fewer cores than other platforms, which in turn means reduced software and support costs.

MariaDB architecture
The MariaDB architecture consists of the components in Figure 1. All MariaDB components ran in a single hardware partition. The sysbench online transaction processing (OLTP) and TPC-C-like benchmark components were used as workload drivers to MariaDB, with sysbench running in a separate hardware partition.

All benchmark comparisons between the Power E1080 and Intel Xeon® Gold 6348 ran on a MariaDB server configured with 8 cores. The Power10 scalability benchmark ran on MariaDB servers configured with 2 to 8 cores.

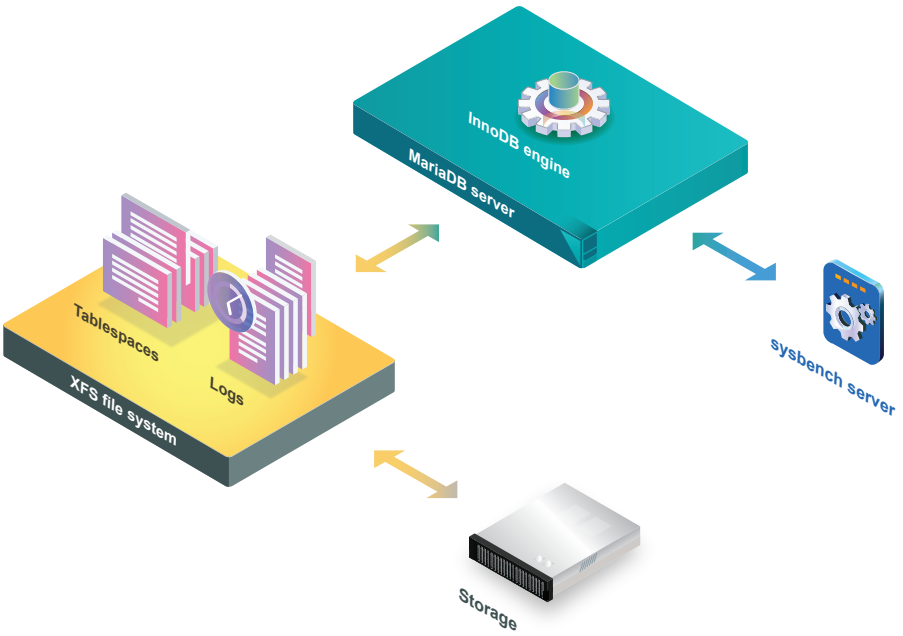

Figure 1: MariaDB and sysbench architecture and test topology

sysbench OLTP and TPCC-like benchmarks
sysbench is a very common benchmarking tool in the MariaDB world. It was written by a MySQL AB employee many years ago and is developed in public. Benchmarks in sysbench are scripted in Lua, making them very customizable. This paper describes the results of the sysbench OLTP 90:10, Point Select, and TPCC-like benchmarks.

sysbench operation modes and query mix
The sysbench OLTP benchmarks mimic the database workload from an OLTP application. That means transactions are rather short, tables are well-indexed, and the required behavior is high throughput and low latency. The OLTP 90:10, Point Select, and TPCC-like benchmarks all simulate OLTP workloads to different degrees of complexity.

An OLTP benchmark can be run in two modes: read-only and read/write. In the read/write mode, it is possible to tune sysbench to a specific read/write ratio. This paper uses the OLTP 90:10 benchmark, which is a 90%:10% mix of read and write operations composed of 9 Point Select read queries and 1 write query to a non-index column. For this paper, the OLTP 90:10 benchmark was run against a database with 16 InnoDB tables with 1 million rows in each table.

This paper also uses the read-only Point Select benchmark, which runs as many read queries as possible, with each query reading a single value from a random table and row. The database for this benchmark was composed of 16 InnoDB tables with 1 million rows in each table.

The sysbench TPCC-like benchmark simulates a more complex workload. The original TPC-C benchmark was created by the Transaction Processing Performance Council (TPC). The sysbench TPCC-like benchmark has not been validated by the TPC, so results cannot be directly compared with the official TPC benchmarks. The sysbench TPCC-like workload simulates a hypothetical order entry application, running transactions against a simulated product sales dataset.

MariaDB performance

The main measure of performance used in the sysbench benchmark study is the transactions per second (TPS) count. Additional metrics such as average response time per transaction, 99 percentile response time, and processor utilization are also measured. All these measures can help provide a comprehensive view of the behavior of the implementation of MariaDB on a given architecture.

Performance of IBM Power E1080 and Intel Xeon Gold 6348

The benchmark comparisons between the Power E1080 and Intel Xeon Gold 6348 servers running on a MariaDB server produced the following results.

Read/write OLTP 90:10 performance

When considering the performance of these configurations on the OLTP 90:10 benchmark, the IBM Power10 processor-based server, Power E1080, demonstrated strong performance, up to 4.22 times faster per core than the Intel Xeon Gold 6348 server (see Figure 2).

Read-only Point Select performance

IBM Power E1080 with RHEL 9.1 was up to 3.64 times faster per core than Intel Xeon Gold 6348 with RHEL 9.1 when running the sysbench Read-only mode benchmark (see Figure 3).

TPCC-like performance

When running the sysbench TPCC-like benchmark, IBM Power E1080 with RHEL 9.1 was up to 1.59 times faster per core than Intel Xeon Gold 6348 running RHEL 9.1 (see Figure 4).

Scalability

IBM Power E1080 also resulted in better scalability for read/write workloads. Due to higher scalability and excellent speed-up performance, over 1.1 million queries per second were conducted on 8 cores of IBM Power10 (see Appendix A).

The conclusion drawn from this testing is that the Power E1080 server is a capable and high-performing system well suited for MariaDB workloads and its customers' growing data-intensive demands. MariaDB Enterprise Server is a high performance database management system capable of handling enterprise-grade production workloads.

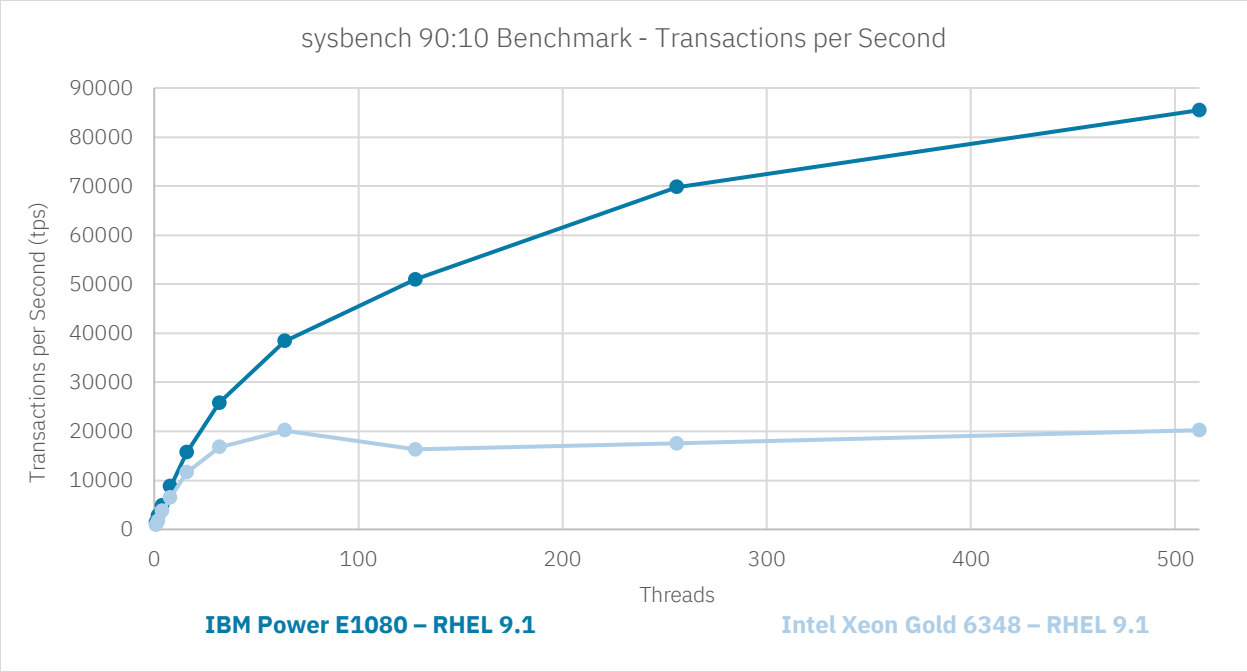

Figure 2: sysbench 90:10 benchmark performance on IBM Power E1080 and Intel Xeon Gold 6348

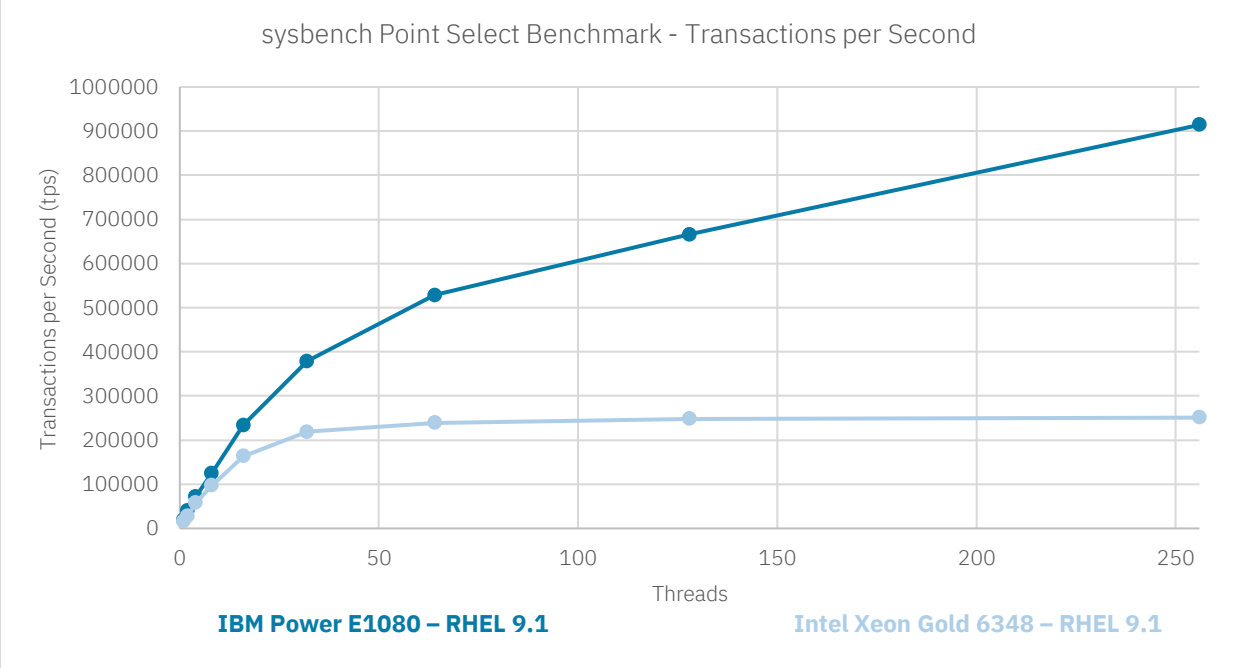

Figure 3: sysbench Point Select benchmark performance on IBM Power E1080 and Intel Xeon Gold 6348

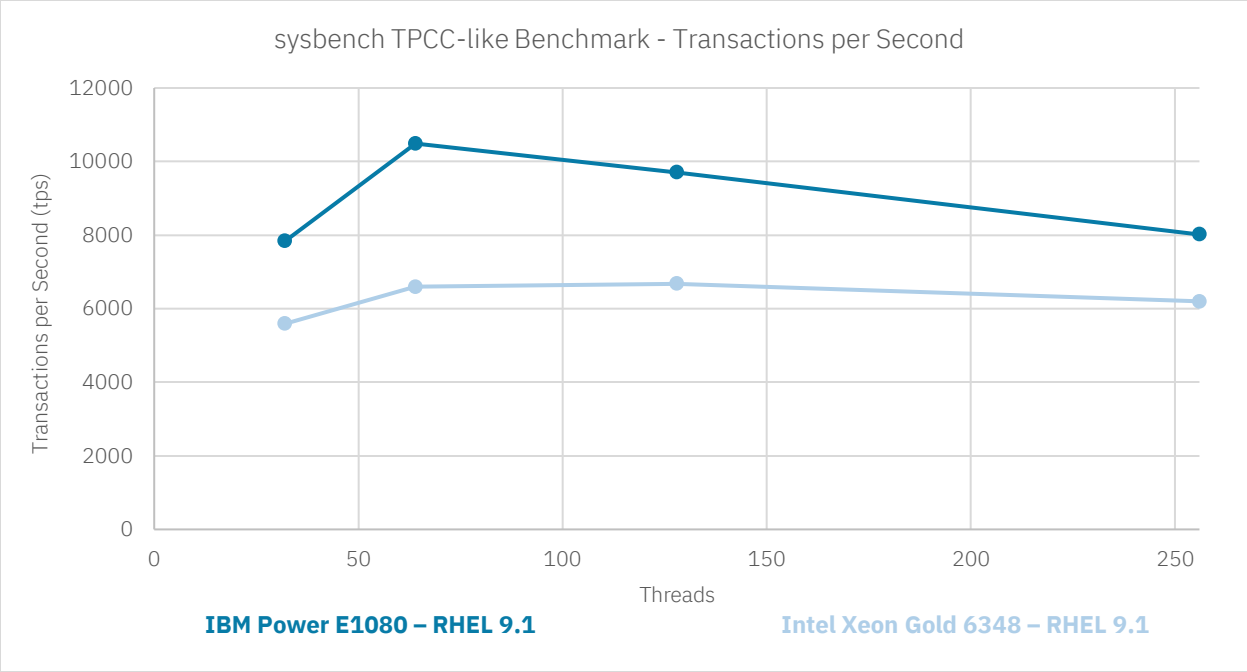

Figure 4: sysbench TPCC-like benchmark performance on IBM Power E1080 and Intel Xeon Gold 6348

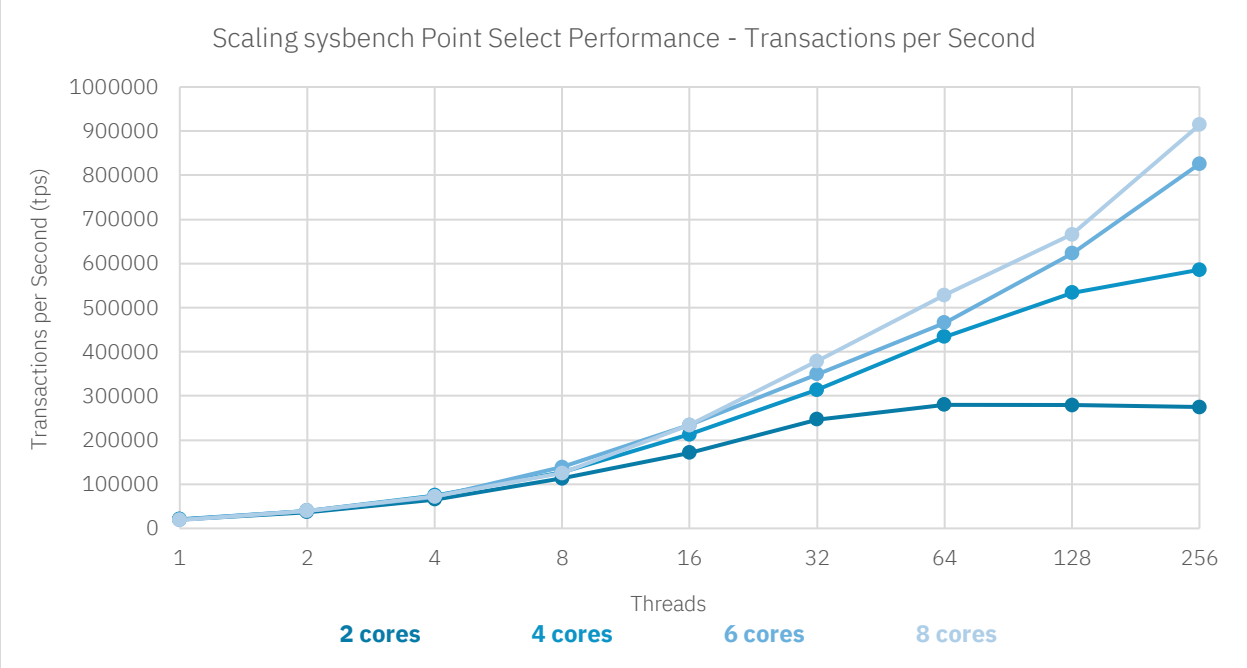

Figure 5: IBM Power E1080 scaling performance on the sysbench Point Select benchmark

For more detailed benchmark data, refer to “Appendix A: Benchmark run details”. For a detailed description of the configurations used in this study, refer to “Tested configuration details.”

Tested configuration details

Configuration of the IBM Power E1080 server with RHEL 9.1

Hardware

- Processor: IBM Power10, E1080-HEX, 3.55 GHz, 64 MB L3 Cache
- Memory: 32 GB
- Storage: IBM FlashSystem® 9200
- One logical unit number (LUN) of 500 GB
- Storage connectivity: 4x32 Gbps Fiber Channel

Base software

- OS: RHEL 9.1; Linux kernel: 5.14.0-162
- Virtualization: IBM PowerVM® Hypervisor
- File system: xfs

Application software

- sysbench 1.0.20 with scalability patches
- Application: MariaDB 10.6.17-12

Configuration of Intel Xeon Gold 6348 with RHEL 9.1

Hardware

- Processor: Intel Xeon Gold 6348 at 3.5 GHz, 16 MB L3 Cache
- Memory: 32 GB
- Storage: 3.5 TB Local NVMe

Base software

- OS: RHEL 9.1; Linux kernel: 5.14.0-162
- Virtualization: KVM
- File system: xfs

Application software

- sysbench 1.0.20 with scalability patches
- Application: MariaDB 10.6.17-12

For instructions to download and install MariaDB 10.6.17-12, refer to the MariaDB documentation and the MariaDB Enterprise download portal at https://mariadb.com/docs/server/deploy/topologies/single-node/enterprise-server-10-6/ and https://mariadb.com/downloads/. To download and run MariaDB benchmarks using sysbench 1.0.20, refer to https://github.com/hgxl64/mariadb-benchmarks/tree/master/regressiontest

Summary

The performance results in this paper demonstrated how the MariaDB application and IBM Power servers perform using the sysbench benchmark suite.

The tested performance results of the IBM Power E1080 indicate that the Power10 server is a capable and high-performing system well-suited for MariaDB workloads and the growing data-intensive demands of its customers. The results also demonstrate that IBM Power servers running under a virtualized environment can perform very well and use resources efficiently.

The IBM Power E1080 can deliver over two times the per-core performance compared to similarly configured virtualized servers on x86 systems (see Appendix A). The per-core performance can clearly

be observed when comparing the total throughput of the IBM Power processor-based server to that of the Intel processor-based server. This directly translates into a significant reduction in the total cost of ownership (TCO) for Power customers.

Appendix A: Benchmark run details

The following two architectures were used in the benchmark runs:

- IBM Power E1080 server running RHEL 9.1
- Intel Xeon Gold 6348 running RHEL 9.1

The following list describes the tables containing the results of the benchmark runs:

- Table 1: Comparison results of running the sysbench OLTP 90:10 benchmark on Power E1080 and x86 with varying thread counts
- Table 2: Comparison results of running the sysbench Point Select benchmark on Power E1080 and x86 with varying thread count
- Table 3: Comparison results of running the sysbench TPCC-like benchmark on Power E1080 and x86 with varying thread count
- Table 4: Scalability results of running the sysbench Point Select benchmark on Power E1080 with varying core counts

Note: Some software thread counts were not tested in the middle range as they did not represent peak values for that specific hardware configuration and, therefore, did not offer additional technical meaning and are represented with an asterisk (*) symbol in the following tables.

Details of the OLTP 90:10 benchmark on Power10 and x86 (measure is transactions/sec - higher values are better)			
Threads	IBM Power E1080 – RHEL 9.1	Intel(R) Xeon(R) Gold 6348 – RHEL 9.1	Performance Advantage
1	1401	926	151%
2	2767	1773	156%
4	4841	3748	129%
8	8729	6535	134%
16	15683	11628	135%
32	25827	16793	154%
64	38408	20164	190%
128	50933	16262	313%
256	69783	17545	398%
512	85484	20235	422%

Table 1: MariaDB 10.6.17-12 sysbench OLTP 90:10 benchmark details

Details of the Point Select benchmark on Power10 and x86 (measure is transactions/sec - higher values are better)			
Threads	IBM Power E1080 – RHEL 9.1	Intel(R) Xeon(R) Gold 6348 – RHEL 9.1	Performance Advantage
1	18903	16019	118%
2	39842	27955	143%
4	72156	58494	123%
8	125085	96981	129%
16	233675	163688	143%
32	378717	218949	173%
64	528056	239206	221%
128	665600	248431	268%
256	914086	250977	364%

Table 2: MariaDB 10.6.17-12 sysbench Point Select benchmark details

Details of the TPCC-like benchmark on Power10 and x86 (measure is transactions/sec - higher values are better)			
Threads	IBM Power E1080 – RHEL 9.1	Intel(R) Xeon(R) Gold 6348 – RHEL 9.1	Performance Advantage
32	7833	5590	140%
64	10489	6592	159%
128	9702	6675	145%
256	8017	6192	129%

Table 3: MariaDB 10.6.17-12 sysbench TPCC-like benchmark details

Power E1080 Scaling: sysbench Point Select Performance (measure is transactions/sec - higher values are better)				
	Number of Cores			
Threads	2	4	6	8
1	20066	20565	19695	18903
2	36985	39558	39323	39842
4	65861	74909	71341	72156
8	112989	127572	138986	125085
16	171136	212427	234161	233675
32	246788	313871	349434	378717
64	279874	434218	465548	528056
128	279240	533373	622937	665600
256	274940	586018	825638	914086
512		574971	899184	1192191

Table 4: scaling MariaDB 10.6.17-12 sysbench Point Select benchmark details

Appendix B: Resources

The following websites contain useful resources to supplement the information in this paper:

- IBM Power official website
- MariaDB official website
- Best Practices Guide for deploying MariaDB Enterprise Server on IBM Power with Red Hat Enterprise Linux

About the authors

Murali Neralla is a Technical Consultant in the IBM Power ISV Technical Engineering department. You can reach Murali at neralla1@us.ibm.com.

Geoffrey Pascal is a Technical Consultant in the IBM Power ISV Technical Engineering department. You can reach Geoffrey at geoffrey.pascal@fr.ibm.com.

Axel Schwenke is a Performance Analyst at MariaDB plc. You can reach Axel at axel@mariadb.com.

Ben Grieser is a Partner Solutions Architect at MariaDB plc. You can reach Ben at ben.grieser@mariadb.com.

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Gina King is the Director of ISV Ecosystem and Alliances for IBM Power. You can reach Gina at glking@us.ibm.com.

Andrew McIntyre is the Strategic ISV Ecosystem and Alliances Leader at MariaDB plc. You can reach Andrew at andrew.mcintyre@mariadb.com.

Jenna Murillo is a Technical Content Professional in the IBM Power ISV Technical Engineering department. You can reach Jenna at jenna.murillo@ibm.com.

IBM Corporation
New Orchard Road
Armonk, NY 10504

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