Technical Brief

Performance Benchmarks for High-Volume Automation

Stonebranch and Dell: High Performing and Horizontally Scalable

In cooperation with

DELL EMC

stonebranch

stonebranch

Table of Contents

stonebranch

1. Management Summary

Stonebranch has partnered with Dell, a leading technology company and major SAP® partner, to demonstrate UAC's performance benchmarks with SAP HANA on Dell PowerEdge servers.

SAP HANA is a column-oriented, in-memory database that meets the performance needs of today's always-on, mission-critical business processes. However, it requires an automation platform robust enough to support its real-time, event-based scenarios. Most traditional job schedulers cannot perform at the level required; their underlying architecture is designed to serve a simpler time.

High-Performance Automation for Today... and Whatever Comes Next

The Stonebranch Universal Automation Center (UAC) is a modern service orchestration and automation platform (SOAP) designed for today's complex IT environments.

The UAC makes it easy to set-up, maintain, and monitor advanced workflows based on real-time events and scheduled instances. Using a fully web-based interface, the platform is available as SaaS in the AWS cloud or as an on-premises installation. It's regularly certified for SAP HANA and performance-tested on Dell hardware to ensure that Stonebranch effectively supports the latest SAP features at the required performance levels.

Key Findings

7.9 MILLION
SAP function module calls per day
with a single OMS server

4.6 MILLION
ABAP jobs per day
(read and write)

9.4 MILLION
Linux tasks per day
using a single OMS server

15.9 MILLION
Linux tasks per day
using two OMS servers on a shared SSD

23.0 MILLION
Linux tasks per day
using three OMS servers on a shared SSD

ZERO DEGRADATION
in SAP HANA performance,
remaining fully stable

7X IMPROVEMENT
in UAC performance

HORIZONTALLY SCALABLE
by adding additional OMS servers

2. Stonebranch and Dell: High-Performance Orchestration

2.1 Universal Automation Center

While traditional schedulers seek to extend their legacy architectures to fit today's complex hybrid IT environments, Stonebranch leverages today's modern technologies and methodologies.

As a service orchestration and automation platform, the UAC expands beyond traditional IT job scheduling and workload automation — though it continues to excel in those areas — to orchestrate business services across functions, applications, and IT environments.

It's a flexible, easy-to-use solution that can simultaneously lower license and operational costs, and increase your ability to meet your business requirements.

Can you imagine your citizen automators trying to understand the archaic job schedulers used decades ago? The UAC improves on workload automation by making it accessible, auditable, and reportable.

With the ability to integrate with any platform or application on your mainframe, the cloud, or in a container, the UAC is the only automation solution you'll need, now and well into the future.

The Universal Automation Center is also truly universal. The core server and agents can run on Windows, UNIX, and Linux operating systems, and as a native z/OS application.

Universal Automation Center Advantages

Manage the workload of your entire enterprise from a single web-based interface and across any on-prem, cloud, or hybrid IT environment.

- Initiates processes based on real-time business data
- End-to-end auditability of versions and system/user changes
- Clustering for fault tolerance and high availability
- Leverages automation directly from business areas (web event, file, message queue, etc.)
- Limitless integrations to control other applications and systems
- Supports dev/test/prod lifecycle management
- Visual workflow designer and reporting dashboards
- Self-service dashboards available online, accessible from any device
- Available on-premises or SaaS

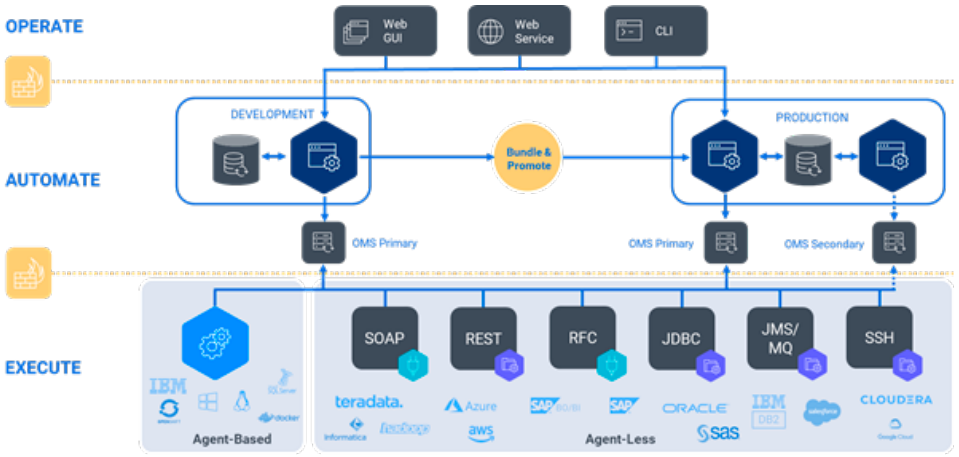

Figure 1: Universal Automation Center (UAC)

How each business chooses to implement the UAC is flexible, not dictated by software restrictions. This seamless integration reduces complexity, minimizes errors, and vastly improves your ability to gain a true macro-level view of your data and workflows.

Summary

Whether deployed on-premises or as a SaaS, the Universal Automation Center applies emerging technology to today's automation challenges — with an eye on the future. It's a service orchestration and automation platform that allows you to manage workflows across your entire enterprise, including DevOps methodologies, big data pipelines, cloud migrations, self-service infrastructure provisioning, and so much more.

2.2 Dell PowerEdge Server for Universal Automation Center

To carry out this benchmarking evaluation, the UAC — comprised of the Universal Controller, Universal Agent, and database — was installed on cost-efficient, scalable Dell PowerEdge C6320 rack servers.

The Dell PowerEdge C6320 rack servers offer impressive performance and energy efficiency results. Their computing, processor, and memory capabilities are optimized to deliver the most demanding high-performance computing and scale-out workloads. The servers feature the Intel® Xeon® processor E5-2600 v4 product family and iDRAC8 with Lifecycle Controller.

Optimized for High-Performance Computing

High-performance computing workloads — such as scientific simulations, seismic processing, and data analytics — rely on compute performance, memory bandwidth, and overall server efficiency to reduce processing time and data center costs. The Dell PowerEdge C6320 provides an optimized compute and storage platform for HPC and scale-out workloads with up to four independent two-socket servers with flexible, high-capacity storage (twenty-four 2.5" or twelve 3.5" drives) in a compact 2U shared infrastructure platform.

With up to 44 cores per node, dynamic drive assignment, dual-port Intel 82559ES 10GbE LOM, and embedded systems management automation (thanks to the iDRAC8 with Lifecycle Controller), the C6320 is a scale-out modular compute workhorse.

The Ideal Balance of Compute, Memory, Local Storage, and Management Automation

Computationally intense workloads demand dependable performance across the environment. In addition to a leap in processor performance with the next-generation Intel Xeon processor E5-2600 v4 product family, the C6320 has increased core counts over prior E5-2600 v3 models. C6320 supports up to 512GB of memory per server node, for a total of an impressive 2TB of memory in a highly dense and modular 2U solution.

The C6320 leverages the scale and cost efficiencies of the integrated Dell Remote Access Controller 8 (iDRAC8) with Lifecycle Controller, proven by operation in millions of servers worldwide. iDRAC8 with Lifecycle Controller delivers intelligent management and configuration automation for hyper-converged solutions and appliances. It enables you to select the management functions you need, streamlining operations by reducing the time and number of steps to deploy, monitor, and update C6320 servers throughout their lifecycle.

Flexibly Mix Workloads in One Chassis

With numerous options for compute, storage and connectivity in one advanced shared infrastructure 2U chassis, the C6320 provides flexibility to configure servers for your specific workloads. Tailor the C6320 for your scale-out workload requirements with up to 44 cores per node, memory bandwidth up to 2400MHz and dynamic drive assignment.

The C6300 enclosure supports up to twenty-four 2.5" or twelve 3.5" drives with multiple SATA, SAS, and SSD options. With the expander backplane option, dynamic drive assignment for 2.5" drives provides even more flexibility by zoning any number of drives to each node, giving nodes additional or fewer storage resources, depending on workload demand. The x8 PCIe 3.0 mezzanine slot in each node supports a variety of options for 1Gb and 10GbE, Mellanox® InfiniBand®, and additional drive controllers, while the x16 PCIe 3.0 slot adds still more flexibility.

The PowerEdge C6320 server is part of Dell's award-winning and groundbreaking PowerEdge C server line. The C6320 lowers operational costs and energy consumption by bringing in maximum compute power in a minimal amount of space. These performance-optimized servers are specifically designed to handle the most demanding high-performance computing, hosting, data analytics, and cloud building use cases.

2.3 SAP HANA In-Memory Database

The SAP Hana in-memory database was then installed on a SAP Hana-certified Dell EMC XC730xd-24 server that runs as a hyper-converged appliance solution.

The Dell EMC XC family of hyper-converged infrastructure (HCI) solutions combine computing, networking, and storage resources provided by industry-leading XC series appliances, XC Core nodes, integrated Nutanix software, and Dell EMC PowerEdge servers. The Dell EMC XC family is certified to host SAP HANA production (and non-production) environments. SAP's certification also applies to both XC series and XC Core offerings. With the Dell EMC XC family, you can expect:

- Maximum performance levels
- The ability to combine test, dev, QA, and production on a single platform
- The capacity to consolidate multiple SAP instances
- Compelling business benefits that unlock new opportunities for innovation

The XC family seamlessly supports SAP and the SAP HANA-certified solutions that enable your business to innovate faster and accelerate IT operations. SAP HANA provides both transactional and analytical processing in production-grade database instances on a single XC family cluster, dramatically accelerating analytics, business processes, and predictive capabilities. The family also enables users to analyze volumes of historical data quickly and make instant decisions to drive rapid innovation.

The Power of Hypervisor Deployment

Running the SAP HANA platform virtualized on Nutanix AHV delivers a new deployment architecture to SAP HANA customers, who can deploy on-premises for maximum control, in the cloud for fast time-to-value, or with a hybrid model that supports a variety of deployment scenarios. Deploying SAP HANA on the Dell XC family with Nutanix software offers greater agility, high availability, security, cost savings, and easy provisioning. This solution also gives SAP customers the ability to provision instances of SAP HANA in virtual machines faster.

Improved SAP HANA Performance

Virtual deployment of SAP HANA with Nutanix Enterprise Cloud OS platform can also lower total cost of ownership (TCO) and improve operational performance and availability. Benefits include:

- Increased security and better monitoring of service level agreements (SLAs)
- Built-in multi-tenancy support using system encapsulation in a VM
- Abstraction of the hardware layer
- Higher hardware utilization rates

Combine OLAP and OLTP Processing

SAP HANA is an in-memory relational database management system that's deployable both as an on-premises appliance and in the cloud. It's best suited for performing real-time analytics and developing/deploying real-time applications.

2.4 Dell-SAP Competence Center

All performance tests were carried out on-site and remotely in the Dell-SAP competence center in Walldorf, Germany.

Dell-SAP competence centers provide application validation, performance characterization, and sizing configurations for the technical enablement of SAP on Dell. Through the Dell-SAP competence center, customers can experience ease of configuration, ease of acquisition, and ease of deployment for Dell-SAP solutions. The centers are also used to increase Dell-SAP product performance, quality, service, and support through performance engineering, support service training, and product quality testing.

Dell and SAP continually enhance their joint solutions for customers at these Dell-SAP competence centers, which are located in Walldorf, Germany; Austin, Texas; and Kawasaki, Japan.

As an Intel-based hardware provider, Dell relentlessly pursues technical leadership in the SAP space. Dell and SAP work together on development initiatives to further these efforts, including Intel IA-64 for Itanium processor-based solutions and Linux. Through their joint efforts, Dell and SAP strive to help to bring more value to customers seeking technologies that help them do better business. Both Dell and SAP are passionate about and motivated by this joint initiative.

> *"SAP's vision in creating the SAP e-business platform is to empower customers, partners and employees to collaborate successfully anytime, anywhere. We value Dell as a global technology partner, because of its commitment to jointly develop solutions with SAP and take them quickly and efficiently to market. This offers our customers compelling value propositions that turn vision into reality. Dell's Infrastructure Accelerator initiative is a further example of this, and we look forward to working with Dell in the future to leverage our close relationship to create new solutions to meet customers' needs."*
>
> Karl-Heinz Hess, SAP extended executive board member

3. Benchmark Test Environment

3.1 Introduction

The objective of this evaluation is to provide a general guideline when sizing the Universal Automation Center solution. This use case focuses on meeting SAP and general automation SLAs for an enterprise banking industry customer using Dell hardware.

As every customer has different automation workflows, test cases have been selected to execute single jobs, as well as a high number of parallel jobs in a workflow. It's then up to the customer to determine which scenarios are most applicable to their situation.

For this test, Dell Labs and Stonebranch have selected a cost-efficient and scalable rack server architecture (consisting of 2 Dell PowerEdge C6320 rack servers) for the UAC installation.

The target SAP system consisted of three NetWeaver application servers installed on a virtual server-based Linux VMware cluster. The NetWeaver application servers were then connected to an SAP HANA in-memory database installed on an SAP HANA-certified Dell EMC XC730xd-24 series hyper-converged appliance solution.

The performance benchmarks determined the maximum throughput of the system, referred to as *agent task throughput per second (AT/s)*. The T/s was also measured for Linux tasks and SAP tasks.

Linux Task

The executed Linux task ran an *exit 0* Linux command on the target server where the Universal Agent is installed. This "simple" command was selected to minimize the impact of the target Linux server on the performance test. Regarding scheduling, the *exit 0* jobs went through the same job status (defined, waiting, queued, started, running, success) as any other "complex" Linux task.

SAP Task

Two types of SAP jobs were also executed via an SAP XBP3 remote function call (RFC) connection from the Universal Agent SAP connector towards the SAP system:

- ABAP report, which writes out a report to the SAP spool file
- SAP function module call, which reads from the SAP System the configured output devices

The following set of **Linux task execution scenarios** were successfully executed:

- Sequential execution of Linux tasks – executed in succession
- Concurrent execution of Linux tasks – executed in parallel
- Horizontal scalability – executed with one OMS, two OMS, and three OMS servers to validate horizontal scalability

The following set of **SAP task execution scenarios** were successfully executed:

- Sequential execution of SAP tasks – executed in succession
- Concurrent execution of SAP tasks – executed in parallel

3.2 Test Infrastructure

The following section describes the logical and physical set-up of the test infrastructures used in benchmarking.

3.2.1 Deployment – Logical View

The following deployment diagram illustrates the component deployment used in the performance test.

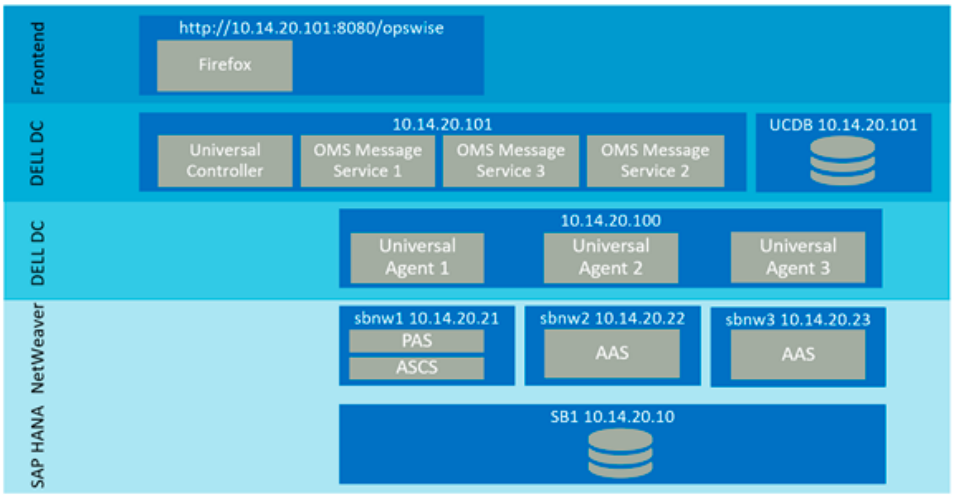

Figure 2: performance test architecture

3.2.2 Software Components

Universal Automation Center

The following software components were used for Universal Automation Center.

Name	Comment
RDMS – Universal Controller	MySQL database – UCDB 10.14.20.101
Universal Controller	Universal Controller v6.5 running as Apache Tomcat applet
OMS Opswise Message Service	OMS 1 – v6.5 – 10.14.20.101 OMS 2 – v6.5 – 10.14.20.101 Two OMS servers were configured to test horizontal scalability
Universal Agent	Universal Agent 1 – v6.5 – 10.14.20.100 Universal Agent 2 – v6.5 – 10.14.20.100
Java Runtime Environment	Java Runtime Environment JRE 1.8 is required to run the Universal Controller
Application Container	Apache Tomcat v8 The controller is a Java web application running in a Tomcat web container
SUSE Enterprise Linux 15	SUSE Enterprise Linux 12 SP4 for all hosts as operating system

Table 1: UAC software components

SAP System

The following software components were used for SAP.

Name	Comment
SAP NetWeaver	Three SAP NetWeaver Application Server: SAP NetWeaver v7.5 – sbnw1 10.14.20.21 SAP NetWeaver v7.5 – sbnw2 10.14.20.22 SAP NetWeaver v7.4SR2 – sbnw4 10.14.20.23
SAP HANA Database	SAP HANA 2.0 SP3-rev33 – SB1 10.14.20.10
OMS Opswise Message Service	OMS 1 – v6.5 – 10.14.20.101 OMS 2 – v6.5 – 10.14.20.101 Two OMS servers were configured to test horizontal scalability
SUSE Enterprise Linux 15	SUSE Enterprise Linux 12 SP4 OS for all three SAP application servers

Table 2: SAP software components

3.2.3 Hardware

Universal Automation Center

The following hardware components were used for Universal Automation Center.

Item	Value
Hostname	sbua1.gscoe.intern
OS	Sles12 SP4
IP	10.14.20.100
RAM	256GB
CPU	2 socket 16 cores (2.6 GHz)
Server Commercial Name Dell	PowerEdge C6320
CPU Type	Intel Xeon CPU E5-2660 v3 @ 2.60GHz
Storage System Type	Internal disks (SSD)
Storage System Commercial Dell Name	Solid-state drives (SSDs)
Storage RAID Type	RAID 1
Storage Connection Type	SAS
Total Usable Storage Capacity	1TB

Table 3: Universal Agent server: UA-1, UA-2, UA-3

Item	Value
Hostname	sbuac.gscoe.intern
OS	Sles12 SP4
IP	10.14.20.101
RAM	256GB
CPU	2 socket 16 cores (2.6 GHz)
Server Commercial Name Dell	PowerEdge C6320
CPU Type	Intel Xeon CPU E5-2660 v3 @ 2.60GHz
Storage System Commercial Dell Name	Solid-state drives (SSDs)
Storage System Type	Internal disks SSD
Storage RAID Type	RAID 1
Storage Connection Type	SAS
Total Usable Storage Capacity	1TB

Table 4: Universal Controller server, including OMS-1, OMS-2, OMS-3, and MySQL

SAP System

The following hardware components have been used for SAP.

Item	Value
Hostname	sbnw1.gscoe.intern
OS	Sles12 SP4
IP	10.14.20.21
RAM	128GB
CPU	16
Server Commercial Name Dell	VMware virtual machine
CPU Type	Intel Xeon CPU E7-8890 v4 @ 2.20GHz
Storage System Commercial Dell Name	PowerMax2000
Storage System Type	Block storage for VMware
Storage Connection Type	Fiber channel

Table 5: SAP NetWeaver server 1

Item	Value
Hostname	sbnw2.gscoe.intern
OS	Sles12 SP4
IP	10.14.20.22
RAM	128GB
CPU	16
Server Commercial Name Dell	VMware virtual machine
CPU Type	Intel Xeon CPU E7-8890 v4 @ 2.20GHz
Storage System Commercial Dell Name	PowerMax2000
Storage System Type	Block Storage for VMware
Storage Connection Type	Fiber channel

Table 6: SAP NetWeaver server 2

Item	Value
Hostname	sbnw3.gscoe.intern
OS	Sles12 SP4
IP	192.168.198.23
RAM	128GB
CPU	16
Server Commercial Name Dell	VMware virtual machine
CPU Type	Intel Xeon CPU E7-8890 v4 @ 2.20GHz
Storage System Commercial Dell Name	PowerMax2000
Storage System Type	Block storage for VMware
Storage Connection Type	Fiber channel

Table 7: SAP NetWeaver server 3

Item	Value
Hostname	sbana1.hscoe.intern
OS	Sles12 SP4
IP	10.14.20.10
RAM	512GB
CPU	2 socket 16 cores
Server Commercial Name Dell	XC730xd-24
CPU Type	Intel Xeon CPU E5-2698 v3 @ 2.30GHz
Storage System Commercial Dell Name	Internal disks – SSD
Storage System Type	RAID 5
Storage Connection Type	SAS

Table 8: SAP HANA database server

3.2.4 Deployment – Physical Set-Up

The following diagram provides an overview of the physical hardware layout.

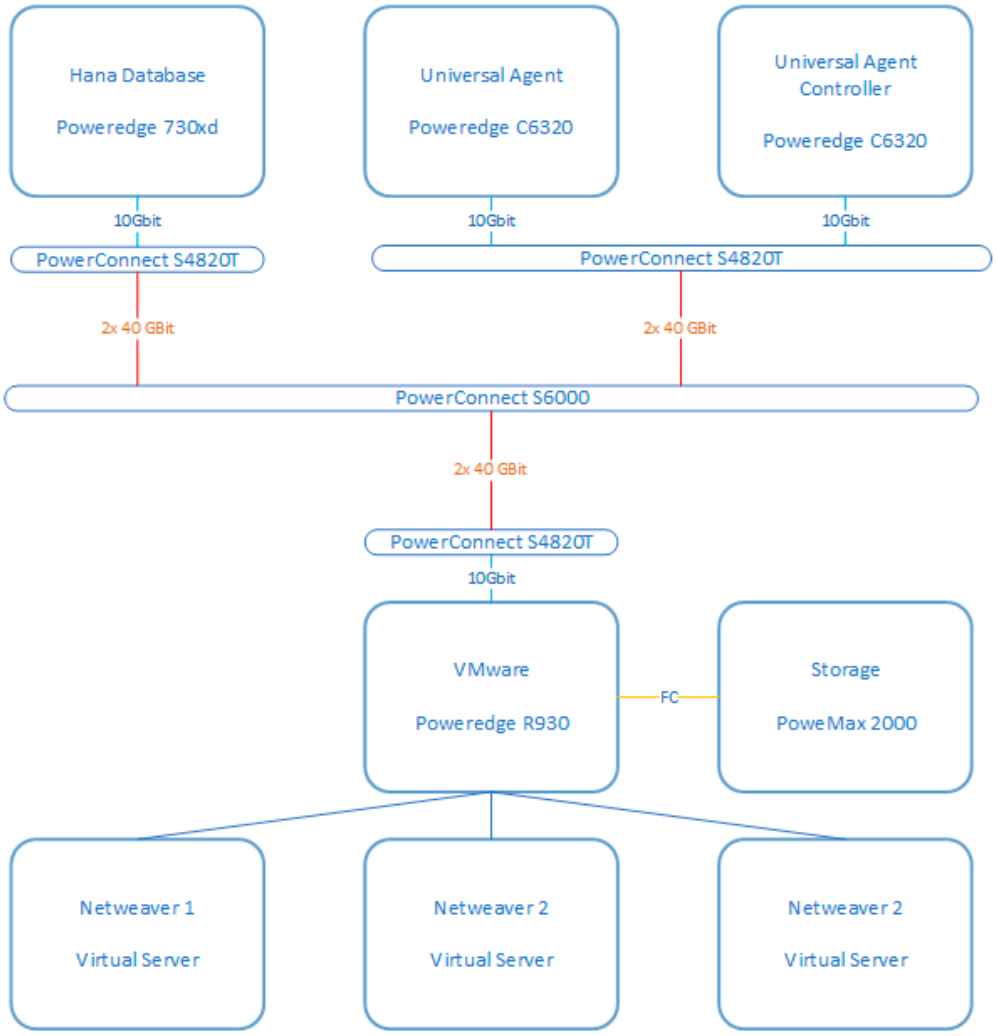

Figure 3: Dell hardware set-up

3.3 Test Cases

The performance benchmarks determined the maximum throughput of the system, referred to as *agent task throughput per second* (AT/s). The AT/s was measured for both Linux and SAP tasks.

Linux Task

The executed Linux task runs an *exit 0* Linux command on the target server where the Universal Agent is installed. This "simple" command was selected to minimize the impact of the target Linux server on the performance test. Regarding scheduling, the *exit 0* jobs go through the same job status (defined, waiting, queued, started, running, success) as any other "complex" Linux task.

Horizontal Scalability

The test scenarios for Linux were executed with one OMS, two OMS, and three OMS servers to prove horizontal scalability. The picture below outlines the set for the horizontal scalability test:

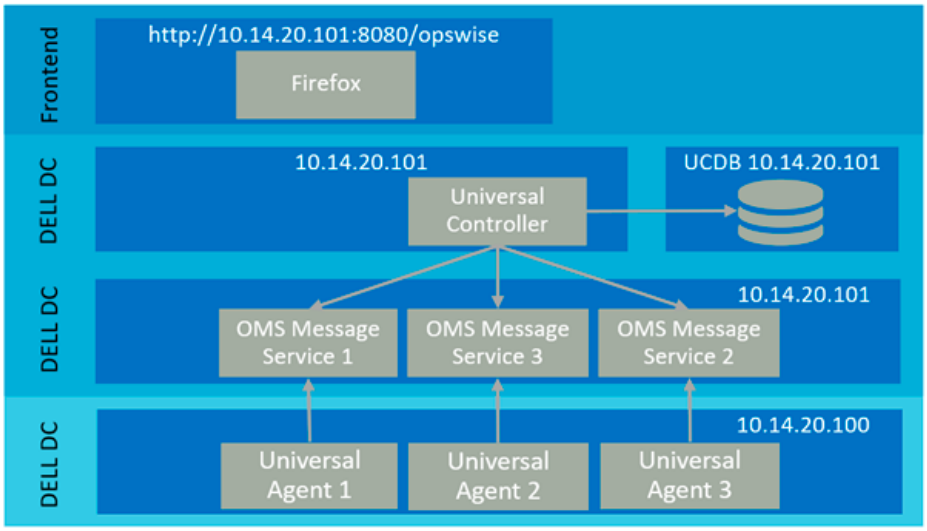

Figure 4: architecture of performance test – horizontal scalability, multiple OMS servers

Description

- Three OMS servers were started on the Dell server (10.14.20.101)
- All three OMS servers were registered at the Universal Controller (10.14.20.101)
- All three OMS servers wrote their message to the same shared 1TB SSD disk
- One agent was connected to each OMS server
- All three agents run on the server (10.14.20.100)
- The Linux tasks were distributed evenly over the three agents

SAP Task

Two types of SAP jobs were executed via an XBP3 RFC connection (SAP-certified) from the Universal Agent SAP connector towards the SAP system:

- An ABAP report, which writes out a report to the SAP spool file
- An SAP function module call, which reads from the SAP system the configured output devices

An AT/s of 1.0 means that one single task has been successfully executed in one second, going through all the lifecycle statuses. The statuses of a successful tasks are defined as follows:

Step	Status	Description
1	Defined	A task instance has been created from the task definition.
2	Waiting	The task has been loaded by a workflow and is waiting to run.
3	Queued	The task has been queued on a resource.
4	Started	The task has started. For agent-based tasks, this means the agent has received the task.
5	Running	The task is running. For agent-based tasks, the agent has started running the program.
6	Success	The task has completed successfully. Workflows will transition to *success* status when all its tasks have transitioned to *success*, *finished*, or *skipped* status.

Table 9: task lifecycle statuses

All task instance lifecycle statuses are recorded in the Universal Controller.

Several different scenarios were carried out under conditions that as closely as possible resembled real-life conditions.

Task Execution

In the case of Linux task execution, all tasks were run under production conditions with all logging and transaction security features enabled. Each transaction status is committed on the disk to ensure a secure restart in case of a system failure (except test case S5). *Note: In test case S5, messages are written in package of 50 to the message bus.*

In the case of both Linux and SAP task execution, the tested scenarios were all executed over a period of 24 hours to ensure that the system performance did not degrade over time. The following scenarios were executed:

Linux Task Execution

- **Sequential execution of Linux tasks –** In this scenario, n= {16,32,64} workflows are each configured containing 50 Linux tasks, which are executed sequentially in a workflow. The n workflows are executed concurrently. The scenario of 64 workflows containing 50 Linux tasks is executed with 1 OMS and 3 OMS servers to verify that the system distributes the load horizontally.
- **Concurrent execution of Linux tasks** – In this scenario, 16 workflows are each configured containing 50 Linux tasks, which are executed concurrently in a workflow. The 32 workflows are executed concurrently, resulting in 800 Linux tasks executed in parallel. In addition, 100 workflows containing 30 Linux tasks are executed concurrently (3000 concurrent tasks), to analyze whether a high number of parallel jobs will have an impact on performance. The scenario of 16 workflows containing 50 Linux tasks is executed with one OMS, two OMS, and three OMS servers to verify that the system distributes the load horizontally.

SAP Task Execution

- **Sequential execution of SAP tasks –** In this scenario, n= {32, 64} workflows are each configured containing 60 SAP tasks, which are executed sequentially in a workflow. The 64 workflows are executed concurrently. These scenarios are executed for SAP task-calling and ABAP reporting, and SAP tasks calling an SAP function module.
- **Concurrent execution of SAP tasks –** In this scenario, n= {32, 64} workflows are each configured containing 60 SAP tasks, which are executed concurrently in a workflow. The 32 workflows are executed concurrently, resulting in 1920 SAP tasks executed in parallel. In addition, 32 workflows containing 120 SAP tasks are executed concurrently (3840 concurrent tasks), to analyze if a high volume of parallel SAP jobs would have an impact on performance.

3.3.1 List of Linux Test Cases

Abbreviation	Details
WF#	Number of workflows running concurrently
T/WF	Number of tasks in each workflow

Table 10: legend test cases

Sequential Execution of Tasks

Type	Test Case	OMS	WF#	T/WF	Total N#	Description
Linux	LX-S1-16-50	1	16	50	800	16 workflows containing 50 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.
Linux	LX-S1-32-50	1	32	50	1,600	32 workflows containing 50 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.
Linux	LX-S1-64-50	1	64	50	3,200	64 workflows containing 50 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.
Linux	LX-S3-64-50	3	64	50	3,200	64 workflows containing 50 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured using three OMS servers.

Table 11: sequential execution of Linux tasks

Concurrent Execution of Tasks

Type	Test Case	OMS	WF#	T/WF	Total N#	Description
Linux	LX-C1-16-50	1	16	50	800	16 workflows containing 50 concurrent tasks are executed in parallel (800 concurrent tasks) in a loop. Elapsed time per workflow is measured.
Linux	LX-C2-16-50	2	16	50	800	16 workflows containing 50 concurrent tasks are executed in parallel (800 concurrent tasks) in a loop. Elapsed time per workflow is measured.
Linux	LX-C3-16-50	3	16	50	800	16 workflows containing 50 concurrent tasks are executed in parallel (800 concurrent tasks) in a loop. Elapsed time per workflow is measured.
Linux	LX-C1-100-30	1	100	30	3,000	100 workflows containing 30 concurrent tasks are executed in parallel (3000 concurrent tasks) in a loop. Elapsed time per workflow is measured.

Table 12: concurrent execution of Linux tasks

3.3.2 List of SAP Test Cases

Sequential Execution of Tasks

Type	Test Case	Job Type	WF#	T/WF	N# Tasks	Description
SAP	SAP-A-S1-64-60	ABAP-Report	64	60	3,840	64 workflows containing 60 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.
SAP	SAP-F-S1-32-60	SAP FM Call	32	60	1,920	32 workflows containing 60 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.
SAP	SAP-F-S1-64-60	SAP FM Call	64	60	3,840	64 workflows containing 60 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.

Table 13: sequential execution of SAP tasks

Concurrent Execution of Tasks

Type	Test Case	OMS	WF#	T/WF	N# Tasks	Description
SAP	SAP-A-C1-32-60	ABAP-Report	32	60	1,920	16 workflows containing 60 concurrent tasks are executed in parallel (800 concurrent tasks) in a loop. Elapsed time per workflow is measured.
SAP	SAP-F-C1-64-60	SAP FM Call	16	60	960	16 workflows containing 60 concurrent tasks are executed in parallel (960 concurrent tasks) in a loop. Elapsed time per workflow is measured.
SAP	SAP-F-C1-32-60	SAP FM Call	32	60	1,920	16 workflows containing 60 concurrent tasks are executed in parallel (1920 concurrent tasks) in a loop. Elapsed time per workflow is measured.
SAP	SAP-F-C1-32-120	SAP FM Call	32	120	3,840	32 workflows containing 120 concurrent tasks are executed in parallel (3840 concurrent tasks) in a loop. Elapsed time per workflow is measured.

Table 14: concurrent execution of SAP tasks

3.3.3 Sample Screenshots

Linux Concurrent Execution

The following figure is a screenshot of the configuration in the Universal Controller web GUI of the sample test case: LX-C1-16-50 — *16 workflows containing 50 concurrent tasks are executed in parallel (800 concurrent tasks) in a loop. Elapsed time per workflow is measured.*

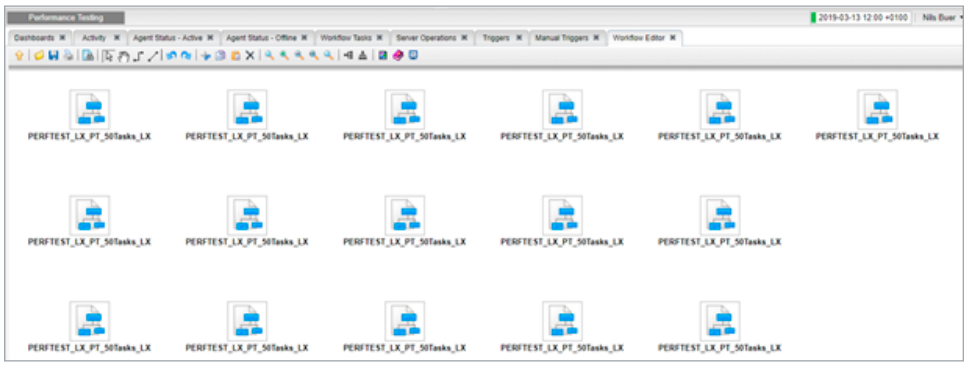

Figure 5: 16 workflows with 50 concurrent Linux tasks

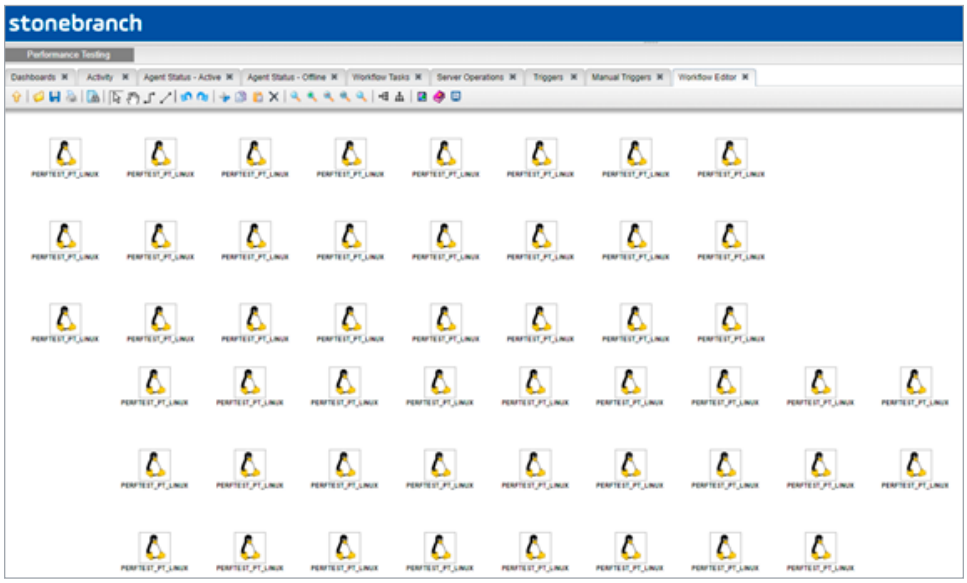

Figure 6: workflow with 50 concurrent Linux tasks

SAP Sequential Execution

The following shows a screenshot of the configuration in the Universal Controller web GUI of the sample test case: SAP-S1-32-60 – *32 workflows containing 60 sequential SAP tasks are executed in parallel in a loop. Elapsed time per workflow is measured.*

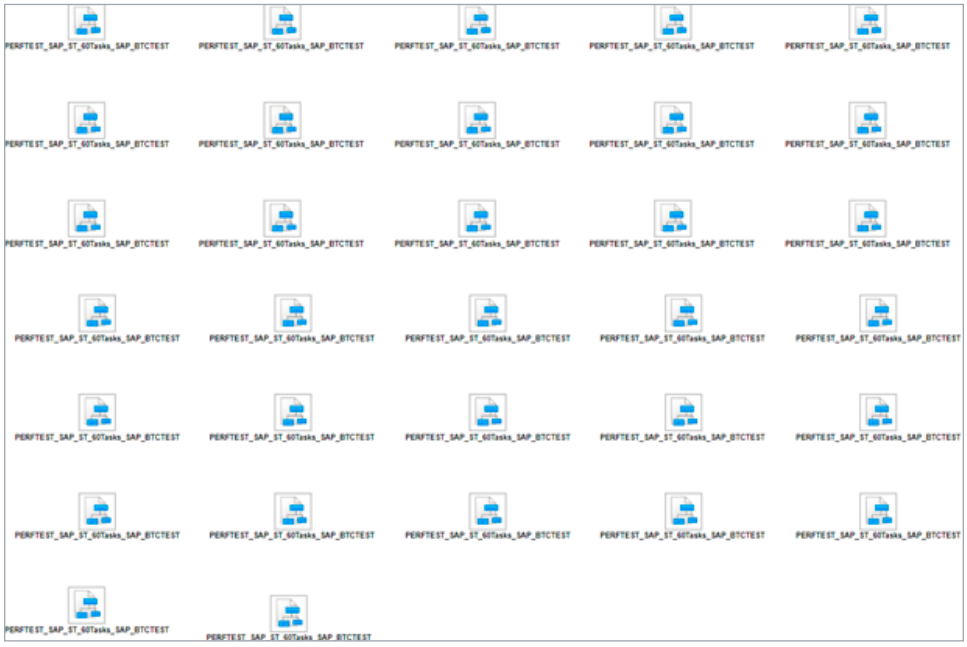

Figure 7: workflows with 60 concurrent SAP tasks

Figure 8: workflow with 60 sequential SAP tasks

4. Benchmark Results

The following results have been achieved.

Abbreviation	Details
LX-S1-16-50	Linux, sequential, 1 OMS, 16 workflows, 50 tasks per workflow
LX-C1-16-50	Linux, concurrent, 1 OMS, 16 workflows, 50 tasks per workflow
SAP-A-S1-64-60	SAP, ABAP job, sequential, 1 OMS, 64 workflows, 60 tasks per workflow
SAP-F-S1-32-60	SAP function module call, concurrent, 1 OMS, 32 workflows, 60 tasks per workflow
SAP-A-C1-32-60	SAP, ABAP job, concurrent, 1 OMS, 32 workflows, 60 tasks per workflow
SAP-F-C1-32-60	SAP, function module call, concurrent, 1 OMS, 32 workflows, 60 tasks per workflow
WF#	Number of workflows running concurrently
WF [s]	Workflow execution time in seconds
AT/s	Number of tasks per seconds
AT/h	Number of tasks per hour
AT/d	Number of tasks per day
T/WF	Number of tasks in each workflow

Table 15: legend for benchmark results

4.1 Linux Test Cases

4.1.1 Sequential Execution of Linux Tasks

Test Case	WF [s]	AT/s	AT/h	AT/d	Description
LX-S1-16-50	7.5	107	384,000	9,216,000	16 workflows containing 50 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.
LX-S1-32-50	14.0	114	411,429	9,874,286	32 workflows containing 50 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.
LX-S1-64-50	27.7	116	416,486	9,995,662	64 workflows containing 50 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.
LX-S3-64-50	12.0	267	960,000	23,040,000	64 workflows containing 50 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured using three OMS servers.

Table 16: sequential execution of Linux tasks

4.1.2 Concurrent Execution of Linux Tasks

Test Case	WF [s]	AT/s	AT/h	AT/d	Description
LX-C1-16-50	7.3	110	394,521	9,468,493	16 workflows containing 50 concurrent tasks are executed in parallel (800 concurrent tasks) in a loop. Elapsed time per workflow is measured.
LX-C1-100-30	26.0	115	415,385	9,969,231	100 workflows containing 30 concurrent Tasks are executed in parallel (3000 concurrent tasks) in a Loop. Elapsed time per workflow is measured using one OMS server.
LX-C2-16-50	4.2	190	685,714	16,457,143	16 workflows containing 50 concurrent tasks are executed in parallel (800 concurrent tasks) in a loop. Elapsed time per workflow is measured using two OMS servers.
LX-C3-16-50	3.0	267	960,000	23,040,000	16 workflows containing 50 concurrent tasks are executed in parallel (800 concurrent tasks) in a loop. Elapsed time per workflow is measured using three OMS servers.

Table 17: concurrent execution of Linux tasks

4.2 SAP Test Cases

4.2.1 Sequential Execution of SAP Tasks

Test Case	WF [s]	AT/s	AT/h	AT/d	Description
SAP-A-S1-64-60	83	46	166,554	3,997,301	64 workflows containing 60 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.
SAP-F-S1-32-60	21.0	91	329,143	7,899,429	32 workflows containing 60 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.
SAP-F-S1-64-60	21.0	91	329,143	7,899,429	64 workflows containing 60 sequential tasks are executed in parallel in a loop. Elapsed time per workflow is measured.

Table 18: sequential execution of SAP tasks

4.2.2 Concurrent Execution of SAP Tasks

Test Case	WF [s]	AT/s	AT/h	AT/d	Description
SAP-A-C1-32-60	36.0	53	192,000	4,608,000	16 workflows containing 60 concurrent SAP tasks are executed in parallel (800 concurrent tasks) in a loop. Elapsed time per workflow is measured.
SAP-F-C1-64-60	11.1	86	311,351	7,472,432	16 workflows containing 60 concurrent SAP tasks are executed in parallel (960 concurrent tasks) in a loop. Elapsed time per workflow is measured.
SAP-F-C1-32-60	22.0	87	314,182	7,540,364	16 workflows containing 60 concurrent SAP Tasks are executed in parallel (1920 concurrent tasks) in a loop. Elapsed time per workflow is measured.
SAP-F-C1-32-120	43.8	88	315,616	7,574,795	32 workflows containing 120 concurrent SAP Tasks are executed in parallel (3840 concurrent tasks) in a loop. Elapsed time per workflow is measured.

Table 19: concurrent execution of SAP tasks

4.2.3 Sample Screenshots – Horizontal Scalability with 2 OMS

The following figure shows the Universal Controller activity monitor after 25 hours of triggering the scenario:

LX-C2-16-50 – *16 workflows containing 50 concurrent tasks are executed in parallel (800 concurrent tasks) in a loop. Elapsed time per workflow is measured using 3 OMS server.*

Note: The activity monitor shows that 17.4 million tasks have been executed with a very stable duration of four seconds per 50 tasks.

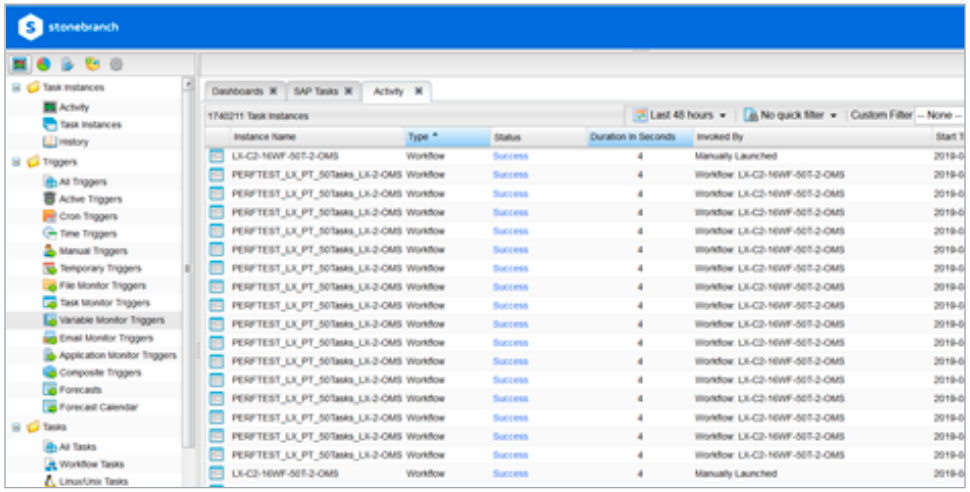

Figure 9: activity monitor showing 17 million tasks after 25 hours of processing

5. Test Results 2014 Compared to 2019

The table below illustrates a comparison of the case results from 2014 with the results from 2019.

Note: In 2014 no SAP performance test was done. Therefore, only the Linux test cases can be compared.

Test Case	Tasks/d 2019	Tasks/d 2014	Δ 2014–2019	Description
LX-S1-16-50 – 1 OMS	9,216,000	3,248,640	⇧2.8x	16 workflows containing 50 sequential tasks are executed in parallel in a loop.
LX-S1-32-50 – 1 OMS	9,874,286	3,205,440	⇧3.1x	32 workflows containing 50 sequential tasks are executed in parallel in a loop.
LX-S1-64-50 – 1 OMS	9,995,662	3,188,160	⇧3.1x	64 workflows containing 50 sequential tasks are executed in parallel in a loop.
LX-S3-64-50 – 3 OMS	23,040,000	3,188,160	⇧7.2x	64 workflows containing 50 sequential Tasks are executed in parallel in a Loop.
LX-C-100-30 – 1 OMS	9,969,231	3,283,200	⇧3.0x	100 workflows containing 30 concurrent tasks are executed in parallel in a loop.
LX-C1-16-50 – 1 OMS	9,468,493	3,265,920	⇧2.9x	16 workflows containing 50 concurrent tasks are executed in parallel in a loop.
LX-C2-16-50 – 2 OMS	16,457,143	3,265,920	⇧5.0x	16 workflows containing 50 concurrent tasks are executed in parallel in a loop.
LX-C3-16-50 – 3 OMS	23,040,000	3,265,920	⇧7.1x	16 workflows containing 50 concurrent tasks are executed in parallel in a loop.

Table 20: comparison of test results (2014 to 2019)

OMS Throughput

The OMS throughput was measured using the Stonebranch *omsadm* tool, which writes 1000 512-byte blocks to the test file *iotest*.

```
./omsadm -test io -iofile /var/opt/universal/spool/oms/iotest -iocount 1000
```

Note: 2019 – I/O write test: count=1000, flush interval=1, rate=4500.47 blocks/sec

Test Case	Blocks/sec 2014	Blocks/sec 2019	Δ 2014–2019	Description
Writes 1000 512-byte blocks to the test file *iotest* with flush interval=1	1,650	4,500	⇧2.8x	2014: disk array of twenty-four 2.5" 15K SAS hard disks 2019: single SSD disk was used

Table 21: OMS throughput

Comparison Test Results 2014/2019

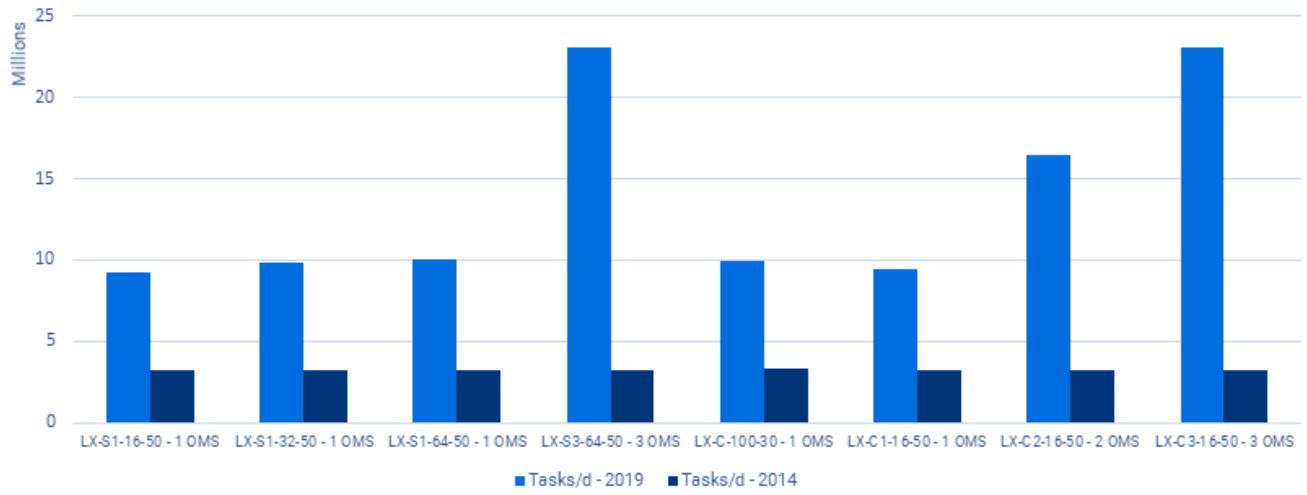

Figure 10: comparison test results 2014 vs 2019

Summary

OMS throughput improved considerably between the 2014 and 2019 benchmark assessments:

- 3x performance increase using 1 OMS server
- 5x performance increase using 2 OMS servers
- 7x performance increase using 3 OMS servers

2014–2019 Comparison Findings

3X BETTER
performance in 2019
with a single OMS server

5X BETTER
performance in 2019
with two OMS servers

7X BETTER
performance in 2019
using three OMS servers

How was this performance increase achieved?

Several factors contributed to the significant benchmark improvements between assessments:

- Using a single SSD disk, instead of a disk array
- Distributing the load over multiple OMS servers (test cases with 2 and 3 OMS servers) to achieve horizontal scalability
- Version 6.1 updates: rebuilding the Universal Controller with the Smart GWT framework (to replace the old glide) and improving OMS message persistence *(msg_data_flush_interval)*
- Increasing the number of supported agent connections per OMS server
- Improving the database index

6. SAP System Performance

The configuration of the SAP application servers and SAP HANA database were optimized accordingly for the two test scenarios. Performance was continuously analyzed to ensure resource availability to complete tasks quickly and reliably in the UAC. In every test scenario, the SAP system managed a high volume of tasks (dialog steps) to execute an ABAP report or an SAP function module call.

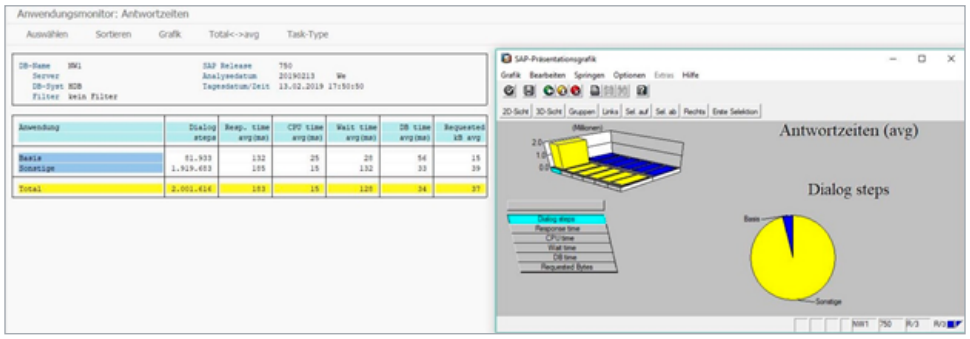

Figure 11: SAP GUI – application monitoring – response times

These dialog steps were balanced over three application servers. The SAP HANA database was accessed by these application servers.

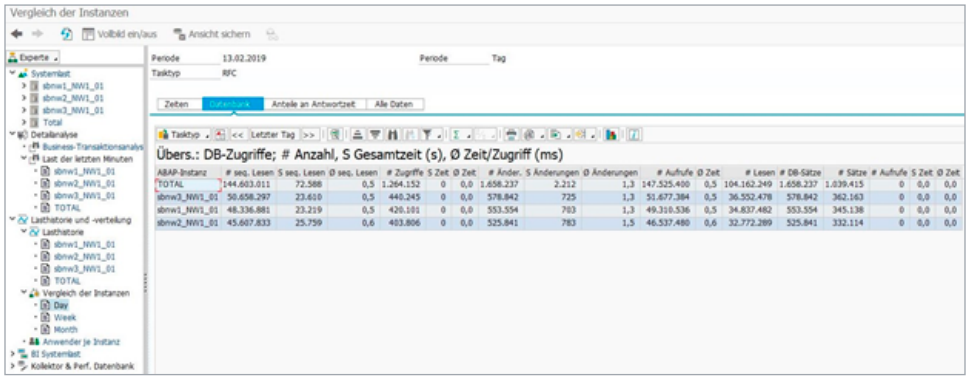

Figure 12: SAP GUI – comparison of NW instances

For such test scenarios, it's important to have enough free dialog work processes configured on all application servers.

In one test scenario, the tasks were scheduled sequentially, and in the other, in parallel.

To maximize performance when executing sequential tasks, the SAP work process needs to respond quickly over a RFC to the request from the UAC.

The parallel test scenario was more load-intensive on the SAP system than the sequential scenario. Setting up RFC profile parameters (*rdisp/rfc**) helps improve performance in the SAP system, as does correctly sizing the hardware.

The performance of the SAP system was monitored during all tests. No bottlenecks were found. All three application servers performed very well, with low CPU workload, and no paging.

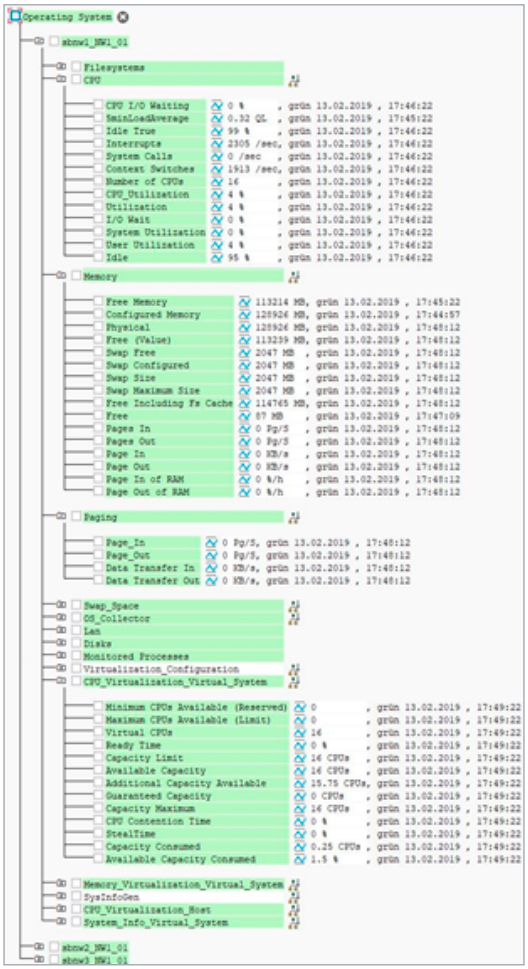

Figure 13: SAP system performance

7. Conclusion

In all, these performance test cases demonstrate that the system can handle the complete lifecycle of more than 4.6 million ABAP reports (read and write operations) and 7.9 million function module calls (read operations) using a single OMS server node.

The tests also illustrate that the system is horizontally scalable by distributing the load over multiple OMS servers. This set-up is independent of the task type in Linux or SAP.

By using horizontal scalability with three OMS servers, we could process 23 million Linux tasks per day, compared to 9.4 million Linux tasks per day using one OMS server. It must also be considered that all OMS servers are accessing the same controller and disk. It can therefore be assumed that an even higher number of tasks per day can be achieved by adding additional OMS servers with a distinct SSD disk for each OMS server.

Key Findings

7.9 MILLION
SAP function module calls per day
with a single OMS server

4.6 MILLION
ABAP jobs per day
(read and write)

9.4 MILLION
Linux tasks per day
using a single OMS server

15.9 MILLION
Linux tasks per day
using two OMS servers on a shared SSD

23.0 MILLION
Linux tasks per day
using three OMS servers on a shared SSD

ZERO DEGRADATION
in SAP HANA performance,
remaining fully stable

7X IMPROVEMENT
in UAC performance

HORIZONTALLY SCALABLE
by adding additional OMS servers

Performance Benchmark

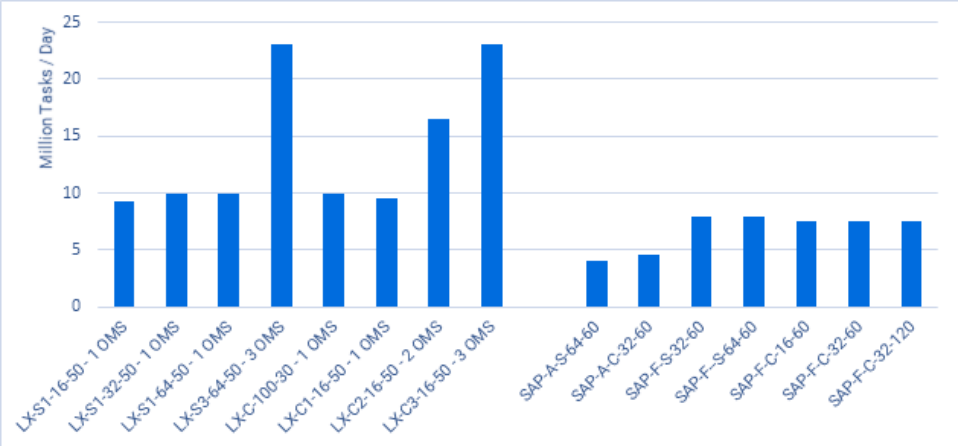

Figure 14: test case results 2019

7.1 REALTECH System Assessment for SAP

The performance tuning of the SAP system was run by REALTECH.

The REALTECH System Assessment for SAP helps you understand just how powerful your SAP system really is, compared to the rest of the market. It analyzes key factors like system availability and response time, then determines if they're within the expected range or if there's room for improvement.

Maintain your competitive edge with information and innovation. REALTECH enables you to objectively determine the health of your SAP environment: evaluate performance, identify optimization opportunities, and propose suitable efficiency-improvement measures.

8. Participating Companies

Company	About
DELL EMC	Dell EMC is an American multinational corporation headquartered in Hopkinton, Massachusetts, United States. Dell EMC sells data storage, information security, virtualization, analytics, cloud computing and other products and services that enable organizations to store, manage, protect, and analyze data. Dell EMC enables organizations to modernize, automate and transform their data center using industry-leading converged infrastructure, servers, storage and data protection technologies. Businesses get a trusted foundation to transform their IT and develop new and better ways to work through hybrid cloud, the creation of cloud-native applications and big data solutions.
REALTECH EMPOWER YOUR ENTERPRISE	REALTECH was founded in 1994 with headquarters in Walldorf, Germany. Today, the company is present on four continents — with its own offices or working with selected partners. Our customers benefit from the insights gained during 20 years of successfully completing thousands of IT projects. Germany's medium-sized enterprises value the high quality of our software products. They trust us to meet their needs and appreciate our approachability. Our projects always focus on the people. We listen to what our customers have to say, take in ideas, and provide new impetus to make our customers even more successful. We will work with you to develop a strategy that meets your unique needs, carefully review your business processes, and align your IT processes, applications, and infrastructures with your business objectives. Innovative technologies are built into the very fabric of our project delivery.
stonebranch	With decades of experience, Stonebranch set out to change the IT automation market for the better. To develop the right purpose-built solutions with user experience and accessibility in mind. To provide a true orchestration engine that empowers our customers to automate any on-prem or cloud solution. To ultimately enable you with the centralized control needed to better manage and scale with your expanding hybrid IT ecosystem. Stonebranch is a force to be reckoned with in the IT orchestration and automation platform space. We shoot past the point where others have stopped, challenging the status quo, and exceeding expectations. We do this with the personalized service and leading-edge technology that is lacking with other providers.

Table 22: participating companies

stonebranch

Figures and Tables

About Stonebranch

Stonebranch builds IT orchestration and automation solutions that transform business IT environments from simple IT task automation into sophisticated, real-time business service automation, helping organizations achieve the highest possible Return on Automation.

No matter the degree of automation, Stonebranch platform is simple, modern, and secure. Using the Stonebranch Universal Automation Platform, enterprises can seamlessly orchestrate workloads and data across technology ecosystems and silos.

Headquartered in Atlanta, Georgia, with points of contact and support throughout the Americas, Europe, and Asia, Stonebranch serves some of the world's largest financial, manufacturing, healthcare, travel, transportation, energy, and technology institutions.

www.stonebranch.com

UAC works in hybrid IT environments across multiple platforms and business applications in real-time. Available on-premises or as a SaaS-based deployment, the UAC is a modern platform built to scale with your business.

To learn more about how an automation platform can drive your business forward, contact us today.

CONTACT US **SCHEDULE DEMO**

stonebranch