HP Operations Orchestration

Software Version: 10.20
Windows and Linux Operating Systems

Benchmark Performance Document

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Executive Summary

This document provides an overview of the performance of HP Operations Orchestration version 10.20, and includes the following:

- Performance improvements in HP OO 10.20
- Performance results for HP OO 10.20

Following are the results which are described in more detail throughout this document:

- HP OO version 10.20 shows a significant increase in the overall execution throughput in comparison with HP OO version 9.07.0003.
- HP OO version 10.20 shows a slight drop in performance for a short sequential flow runs in comparison with HP OO version 9.07.0003. In order to understand the reason behind this degradation see Analysis of Results section of this document.

Objectives

This document details the performance improvements done in HP Operations Orchestration version 10.20, and the performance tests and results using flow/step execution throughput (steps/time) with HP Operations Orchestration version 10.20, and includes the following:

- HP OO throughput in several environments:
  - Low cost FOSS environments (Free and Open-Source Software).
  - High cost non-FOSS environments.
  - Oracle and SQL Server based environments
  - Clustered and stand-alone environments.
- Single flow performance results of various scenarios comparing HP OO 10.20 to HP OO 9.07.0003.
- Resource usage during the described tests.

Basic tuning was applied to the environments described in this document. These configurations are described in the "Recommendations for Environment Tuning" on page 17 section.

Performance Improvements in HP OO version 10.20

HP OO version 10.20 introduces many performance improvements across different areas of HP OO, which enables faster execution of flows and work in Studio.

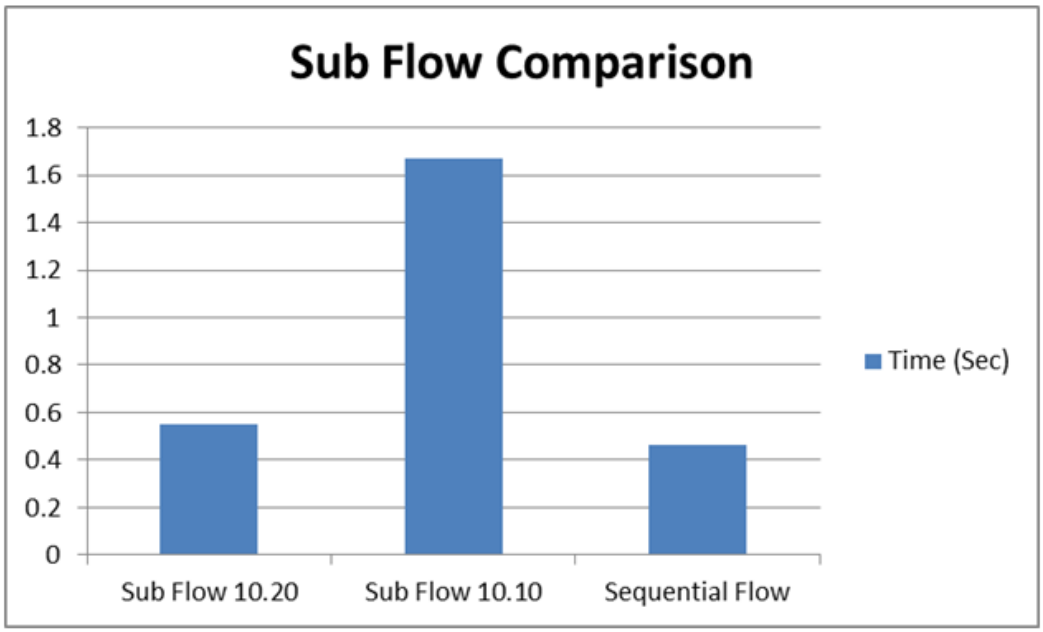
Engine Performance Improvements

Following are the engine improvements:

- Removal of one of the step log tables which both:
  - Reduced the persistence overhead of the step log tables
  - Reduced the size of the persisted step log data
- Performance Optimization in subflows

  As a result subflows now have a minimal overhead due to the subflow mechanism and should have a response time that is close to the equivalent sequential flows.

  The following graph shows a performance comparison of a subflow execution in OO 10.20 compared to an equivalent sequential flow and to a similar subflow in OO 10.10:

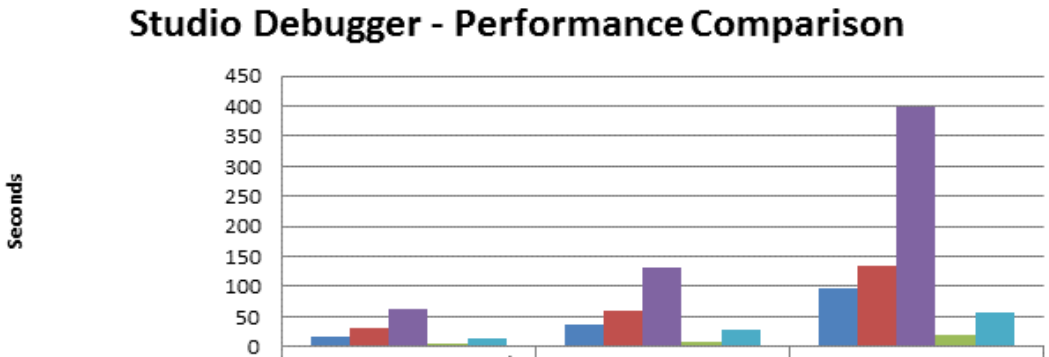


Studio Performance Improvements

OO Studio performance was improved in a number of areas in versions 10.20, mainly in the following:

- **Debugger**: Two major changes were implemented in the Studio Debugger:
  - The unification of the Studio and engine used to execute debugger flows.
  - Removal of the debugger events persistency.

  The following graph shows a performance comparison of various debugger operations.As you can see there is a significant improvement in the performance of local/remote debug compared to previous OO versions.



	5000 steps sequential flow	10000 steps sequential flow	20000 steps sequential flow
9.07 Studio (Public Repo)	18	38	96
10.10 Local Debug	31	59	135
10.10 Remote Debug	63	132	400
10.20 Local Debug	5	8	20
10.20 Remote Debug	13	27	58

- **SCM operations**: Additional performance improvements were also implemented in Studio's SCM operations, mainly when SCM refresh is triggered as a result of various SCM operations:

  The following table shows the improvement percentage of various SCM operations:

SCM Operation	% Improvement
Move between projects	60%
Move between folders	60%
Rename item	50%

SCM Operation	% Improvement
Create flow	70%
Delete item	70%
Update/Revert item	90%
Commit	35%
Lock/unlock an item	50%
Unlock all	85%
Save a flow	80%

Note: Baseline for comparison is HP OO 10.10.

The performance improvement in Studio SCM is affected by the size of flows or projects the SCM operations involves, SCM operations on small flows or projects will still show better performance, but may yield smaller performance improvement.

- **Editor**: Several performance improvements were implemented to the Studio's editor performance, particularly when editing large flows.

Central Performance Improvements

OO Central has introduced a major performance improvement in the deployment of content. The new version improves both the time to deploy content and the central memory consumption during content deployment.

The Central memory consumption is mostly affected by the uncompressed size of the deployed content.

The following table compares the deployment performance Operations Orchestration 10.20 compared to 10.10:

Operations Orchestration	Base-CP (sec)	Test-CP (sec)
10.10	140	47
10.20	116	36

HP OO 10.20 Benchmark results

Setup

This section describes the different benchmark tests that are described in this document, including details of the servers environment, the tools used, the flow runs and scenarios used to run the benchmark testing, and the results achieved.

Environment

The following table describes the hardware and software components used for the benchmark tests:

	Model	Processors	Memory	Storage	Network	Notes
Server	ProLiant BL460c G7	12 cores 2667Mhz	16 GB	Local	1 GB	Windows 2012/RHEL 6.3
Database	ProLiant DL380 G7	12 Cores 2933Mhz	32 GB	DAS	1 GB	RHEL 6.3 - Oracle/PostgreSQL, Windows 2012 - MS-SQL

Tools

The following tools were used to produce this benchmark:

- HP LoadRunner 11.52
- HP Sitescope 11.20

Flows

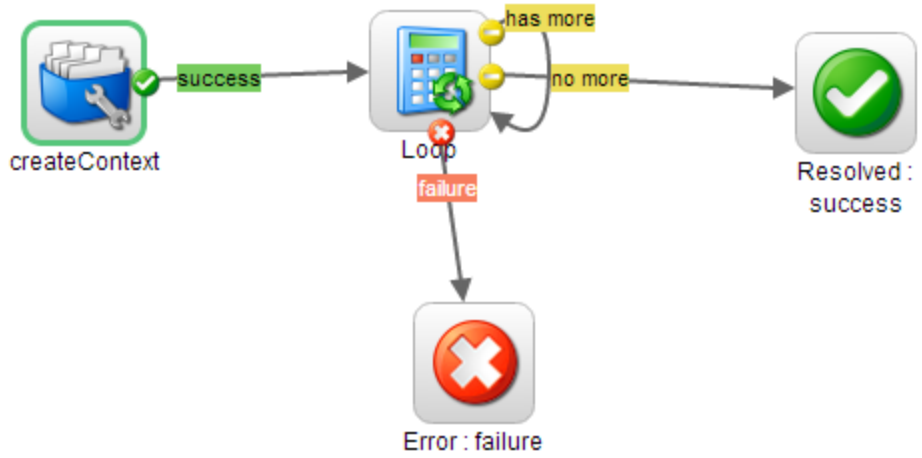
This section describes the flows that were used during the benchmark tests.

These flows were designed to stress the different functionality aspects of HP OO and to load the different resources of the system (CPU, memory, and so on). By running a mix of all of these flows,we tried to simulate a heterogeneous customer environment.

Note: The purpose of these flows was to load HP OO as a platform, and not to perform any actual work, as the goal of the benchmark is to verify the performance of HP OO as a platform and not to verify the performance of the HP OO content.

Large Context Flow

This flow receives a 4 MB context and has 103 steps.

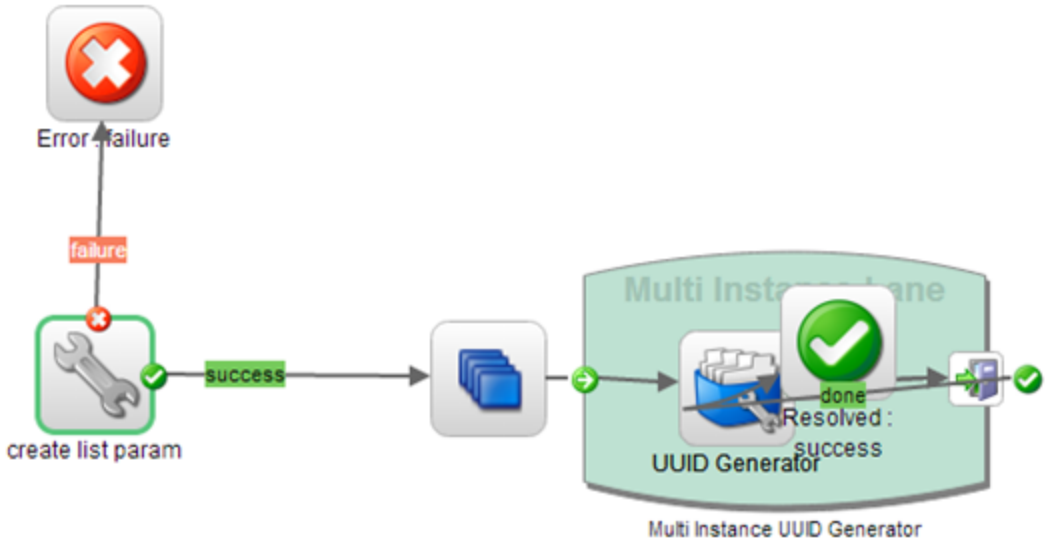


Short/Medium/Large Flows

The following flows differ in the number of steps created in each of the flow. These flows run 2/102/10002 steps respectively.

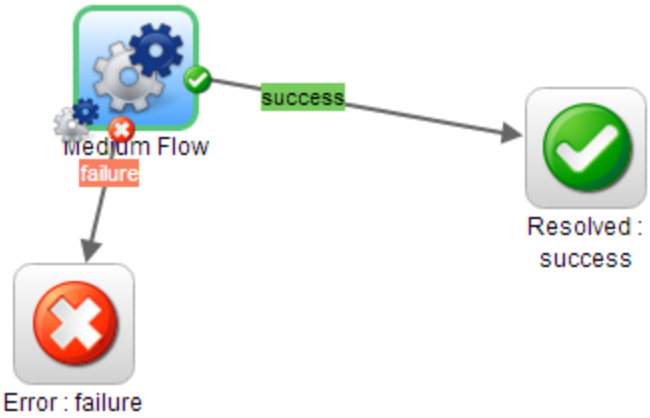
Multi-instance Flow

This flow contains a multi-instance implementation of the UUID generator and it runs with 300 lanes per flow.



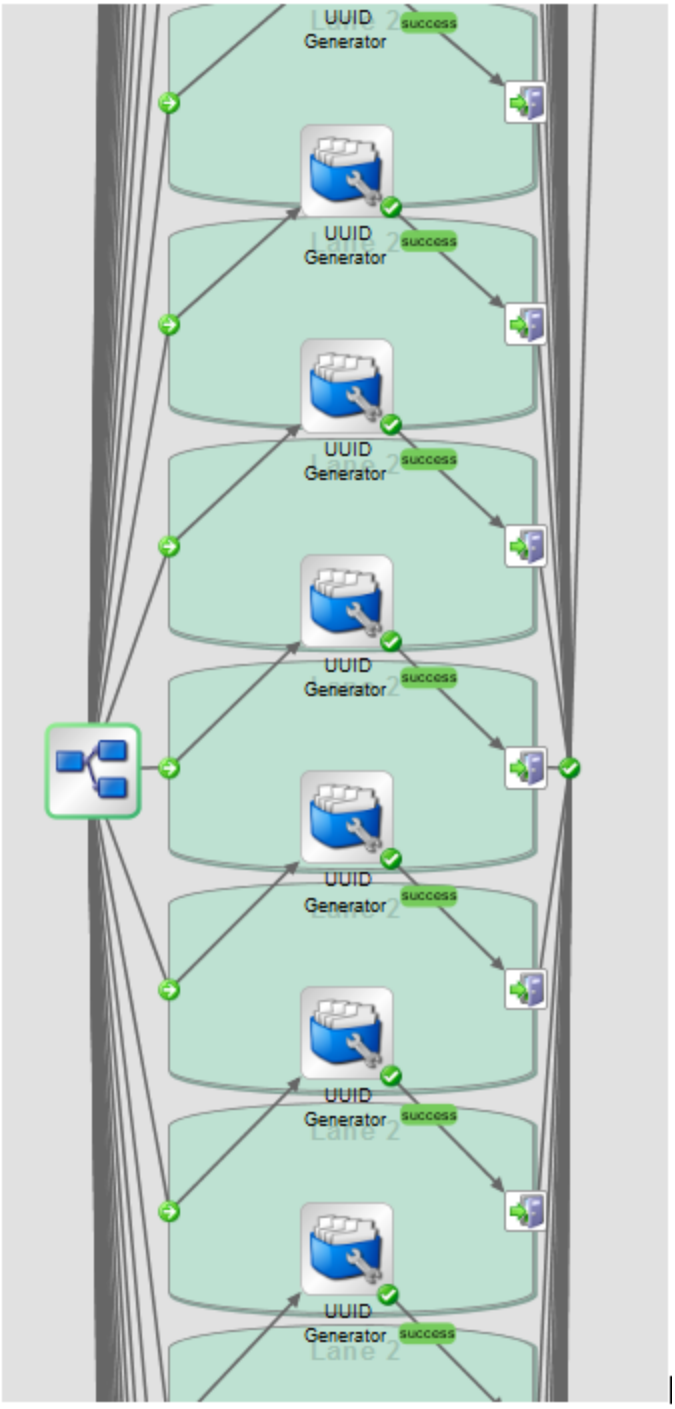
Subflow

This flow runs an instance of medium flow as a sub-flow.



Parallel Flow

This flow runs 55 lanes parallel split (only part of the flow can be seen in the following image).



Scenario

This section describes the scenario used for the benchmark.

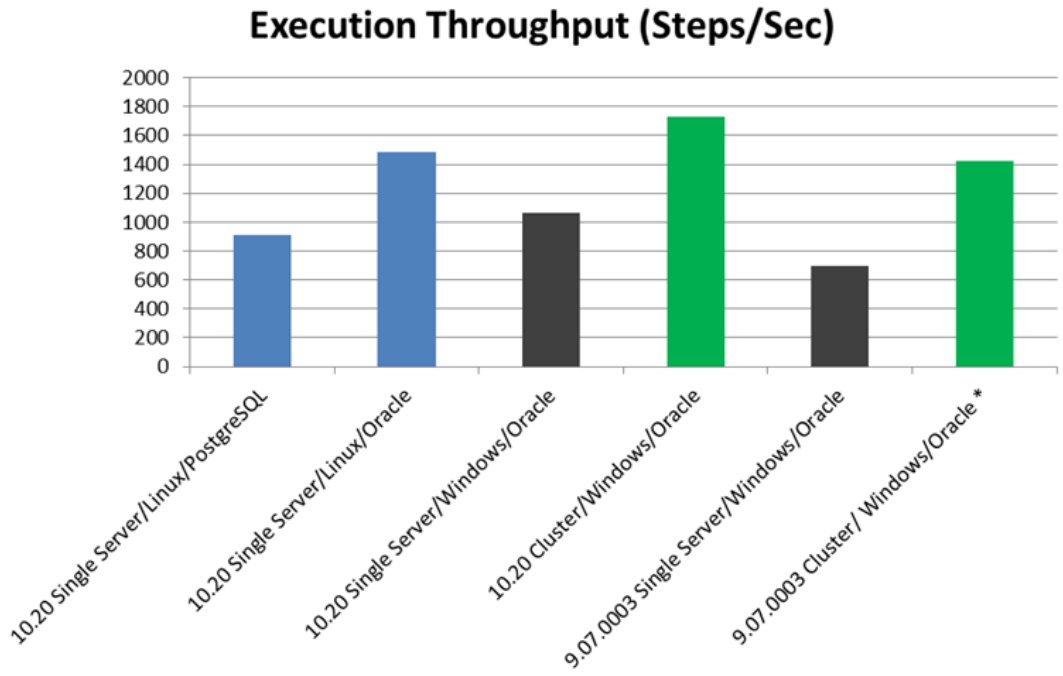
- The workload was generated using HP Loadrunner.
- The flow triggering was done using REST.
- The number of flows ran in each benchmark is 5000, which amounts to 1660640 steps.
- Distribution of the flows was as follows:

Flow	Number Per Flow Type
Medium Flow	1000
Parallel Flow, Short Flow, Sub Flow, Multi-Instance Flow	980
Large Context Flow, Long Flow	40

- HP Sitescope integration with Loadrunner was used to monitor the different parts of the system during the tests, including JMX monitors for the JVM monitors (memory, garbage collection).

Comparison

The following graph compares the throughput between the different HP OO deployments used in this benchmark.



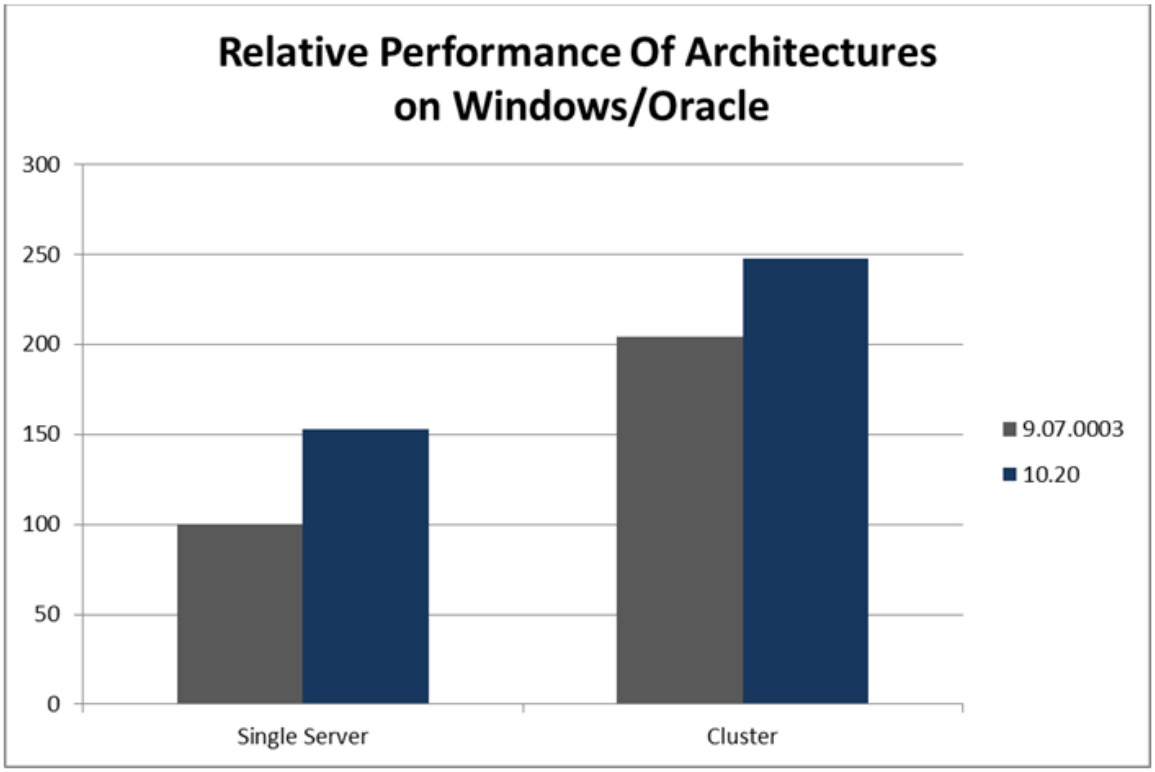
Note: A higher result shows better performance.

Deployment	Execution Throughput (Steps/Sec)
10.20 Single Server/Linux/PostgreSQL	910
10.20 Single Server/Linux/Oracle	1485
10.20 Single Server/Windows/Oracle	1066
10.20 Cluster/Windows/Oracle	1730
9.07.0003 Single Server/Windows/Oracle	698
9.07.0003 Cluster/ Windows/Oracle *	1426

Note: HP Operations Orchestration scaling out (both in version 9.07.0003 and in 10.20) was done by adding additional Central servers.

* Operations Orchestration in version 9.07.0003 showed significantly better performance when running on a Windows operating system. For this reason, we have used Windows as the base of the comparison to HP OO version 10.20.

The following graph shows a comparison of the execution throughput in versions 9.07.0003 and 10.20.



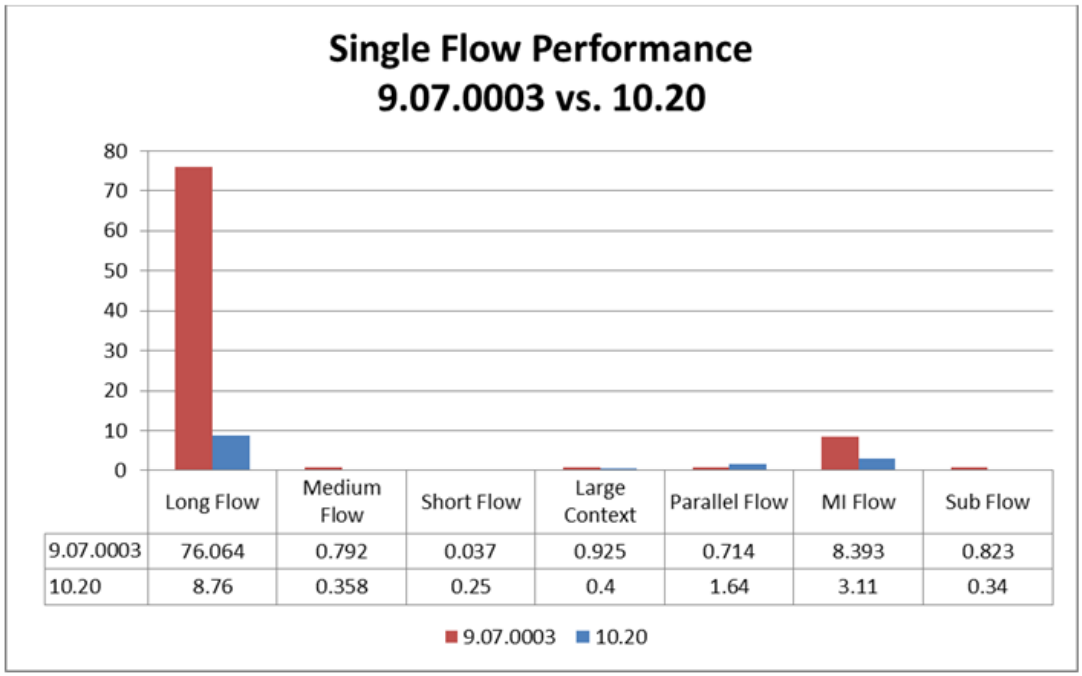
Note: The graph above shows the relative difference in percentage. A higher result shows better performance.

	Windows/Oracle Cluster	Windows/Oracle Single Server
9.07.0003	1426	698
10.20	1730	1066

Single Flow Performance

This section compares the single flow performance of HP Operations Orchestration 10.20 to HP Operations Orchestration 9.07.0003.

The following graph shows the performance of single flows used for the throughput benchmark runs.



Note: A lower result shows better performance.

Analysis of Results

HP Operations Orchestration version 10 introduced significant architectural refactoring, which includes, among other changes, the design goals for the new execution queue:

- Use bulk operations
- Utilize a task and worker design pattern
- Minimize database locking
- Statelessness

Due to the fact that the system now accumulates bulks of steps for execution, the overall throughput is increased.

Due to the short timeout in which the system waits for the bulk of steps for execution to fill up, we can see a slight overhead in the single flow performance of short sequential flows.

On the other hand, leveraging the task and worker design, this overhead does not exist when we compare flows that have a large number of steps or flows that have multiple lanes (parallel/multi-instance, and so on).

Why scale-out was done by adding Central servers and not RAS servers

During this benchmark, we scaled our system by adding additional Centrals and not RAS servers. This is currently the recommendation due to the following reasons:

- RAS servers have an additional overhead, because they have to receive work and send results from Central remotely by REST.
- HP OO balances the work between all the workers in the same group equally. Remote workers will decrease the average throughput of the system, due to their inherent overhead.

Therefore, for these reasons, it is recommended to scale out using RAS only when it is needed due to a functional requirement.

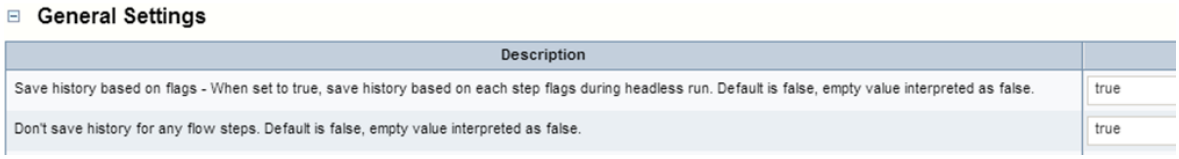
Note: See the 10.x Concepts Guide for more information. You can download this document from HPLN or the SSO Portal. It is also available in Central and Studio in the online help or in PDF format located in the HP OO Documentation folder.

Recommendations for Environment Tuning

The following configurations were made during the benchmark tests.

OO 9.07.0003

- Heap size was increased to 1 GB - 4 GB.
- Persistency for flow steps was turned off. This was done by setting the following parameters under **Administration** > **System Configuration**:



OO 10.20

- Heap size was increased to 1 GB - 4 GB.

  This can be configured in **<OO Installation>\oo\central\conf\central-wrapper.conf**.

- The number of database connections was increased to 20 - 100.

  This can be configured in **<OO Installation>\oo\central\conf\database.properties**.

- The number of execution threads was increased to 300, and `inBuffer` capacity was increased to 500. Thiscan be configured in the **engineContext.xml** file located in **<OO Installation>\oo\central\tomcat\webapps\oo\WEB-INF\lib\engine-webapp-10.20.274.jar**, the file is located in the **META-INF\spring directory**.
- In HP OO version 10.20, the recommended way to scale out is by adding additional Central servers. This was done as part of these benchmark tests.