Liferay DXP Cloud Performance
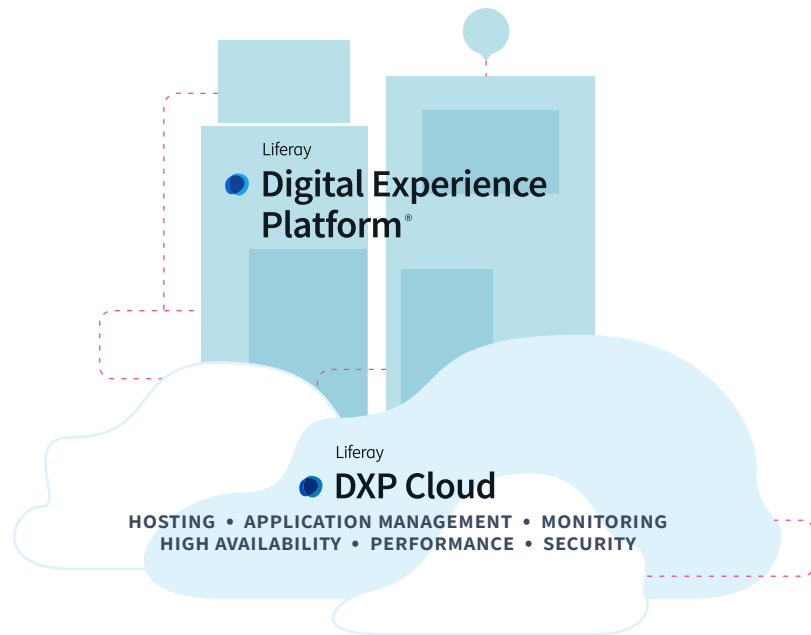
Benchmark Study of Liferay DXP 7.2 on DXP Cloud

⊞ Liferay ®

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Executive Summary

Liferay DXP (Digital Experience Platform) is a software used to create, manage, and optimize digital experiences across multiple customer touchpoints. DXP Cloud allows organizations to deploy, manage, and scale Liferay DXP projects in the cloud. Designed to be a solid foundation for an organization's digital experience initiatives, it helps set up elastic deployments, DevOps practices, CI/CD pipeline, backups & restore, and networking.

Liferay
● **Digital Experience Platform** ®

Liferay
● **DXP Cloud**

HOSTING • APPLICATION MANAGEMENT • MONITORING
HIGH AVAILABILITY • PERFORMANCE • SECURITY

To demonstrate the scalability of DXP Cloud, the Liferay engineering team performed intensive testing in a collection of use cases and project configurations, including infrastructure portal, collaboration, and content management. These tests utilized the virtualized hardware resources of the typical DXP Cloud sizing.

The goals of this study were to:

- Determine the maximum number of concurrent virtual users supportable by the Standard Availability configuration, with one Liferay DXP instance in the Production Environment, and the High Availability configuration, with two Liferay DXP instances, across defined test cases.

- Demonstrate scalability and performance improvements when comparing the Standard Availability configuration to the High Availability configuration.

- Provide statistics to help Liferay Global Services, Liferay DXP Cloud customers, and Liferay Service Partners during capacity planning.

To help accurately demonstrate "enterprise scale," this study was commissioned with:

- 100,000 total users
- 10,000 message board threads and 100,000 messages
- 10,000 blog posts and 100,000 comments
- 100,100 documents with an average of 100KB per document

Key Findings

The key findings of the study are:

1. In the Isolated Login Transaction scenario, DXP Cloud supports 9,000 virtual users using Standard Availability, with a maximum throughput of 257+ logins per second. The High Availability configuration, supports 20,000 virtual users with a maximum throughput of 532+ logins per second. Both configurations sustained login mean times well under a quarter second (250ms).

2. In the Message Board Social Collaboration scenario, Standard Availability supports 6,300 virtual users and High Availability supports 20,000, both configurations demonstrated average individual transactions times of under 1.8 seconds (1,800ms).

3. In the Blogging Social Collaboration scenario, Standard Availability supports 4,700 virtual users and High Availability supports 8,300, both configurations demonstrated average total times of all tests in the scenario under three quarters of a second (750ms).

4. The platform's Document Repository supports 6,300 virtual users while accessing 100,100 documents in the document repository, using Standard Availability, while High Availability supports 18,000 virtual users.

5. When moving from Standard Availability to High Availability, DXP Cloud has demonstrated linear scalability across the Transaction Centric, Message Board Collaboration Centric, and Content and Document Management scenarios. In the Blogging Collaboration Centric scenario High Availability demonstrated a significant performance increase with an 89% addition in capacity when compared to Standard Availability.

Test Scenarios

The document utilizes the following conventions when describing test cases and results:

- Virtual Users – Simulated users concurrently transacting on the Liferay DXP instance system.
- Total Users – The total number of users stored in the database.

Liferay Cloud team collaborated with clients across a broad spectrum of industries to determine the scenarios that best-modeled product use cases.

Transaction centric scenario

- Applies to financial, insurance, and e-commerce deployments where a large number of users will login and perform transactions like online banking (e.g., bill payments), online insurance applications, airline, and hotel booking.
- Authenticated user accesses with longer user session times.

Collaboration centric scenarios

- Applies to corporate intranets looking to leverage shared document repositories with other social collaboration tools like blogs, wikis, and forums.
- Applies to social networks and communities.
- Authenticated access; 5:1 ratio between reading and write transactions.

Content and document management scenario

- Applies to corporate intranets and customers looking to manage and share documents.

Benchmark Configuration and Methodology

DXP Cloud Configurations

DXP Cloud offers two configurations: Standard, with one instance in the Production Environment, and High Availability, with two Liferay DXP instances in the Production Environment. Additionally, High Availability adds another instance of the Web Server and two more instances of Liferay Enterprise Search. High Availability serves mission-critical systems that require continual uptime and serve a larger number of users concurrently.

DXP Cloud Components:

- Liferay DXP
- Liferay Enterprise Search
- Database
- Web Server
- Backup Service
- Monitoring Services
- Content Delivery Network (CDN)
- VPN Service

Below you will find diagrams detailing the configurations for High Availability with two Liferay DXP instances and Standard Availability with one Liferay DXP instance.

High Availability
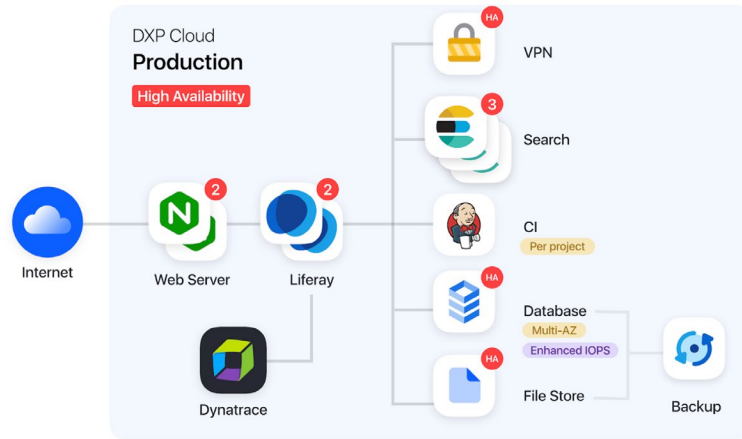
Standard Availability
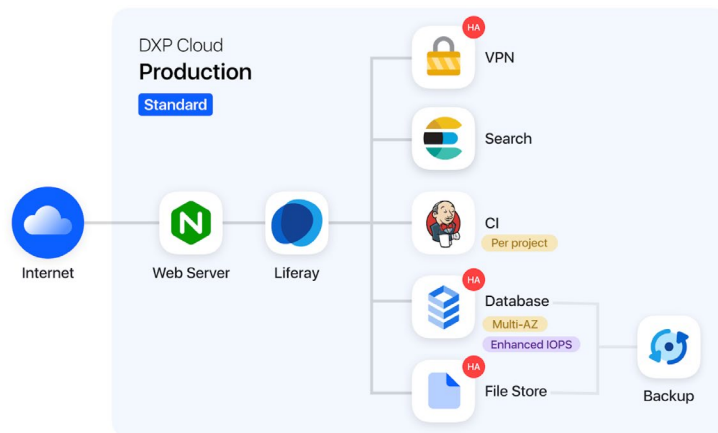
The following charts detail the configuration of each instance and the software included.

Configuration (per instance):

Service	CPU	Memory	Storage
Web Server	1 Core	512Mb	
Liferay DXP	12 Cores	16Gb	
Database	4 Cores	15Gb	SSD 100Gb
Search	8 Cores	8Gb	

Software:

Liferay DXP 7.2	MySQL 5.7.9 Community Server
OpenJDK 8 (1.8.0_202)	NGINX: 1.16.1
Tomcat 9.0.17	HAProxy: 1.8.14
Debian GNU/Linux 9.8	Liferay Enterprise Search

Methodology

The Liferay Cloud team utilized the Grinder load testing tool and its distributed load injectors. The injectors ramped up users at a rate of one user every 100ms until achieving the desired virtual user load.

After an initial ramp-up time of 10 minutes, the benchmark data was gathered to initialize all application elements and warm up all injectors. The following metrics were gathered:

- OS level metrics for web, application, and database servers (e.g. CPU, IO performance).
- JVM garbage collection metrics and logs.
- The average transaction times, standard deviations, and throughput.

Additional tables and charts have been made available in the Appendix.

Benchmark Results

Transaction Centric Scenarios

Isolated Login

Isolated Login is the first of two Transaction Centric tests that focus on the login process of Liferay DXP. The login and permission retrieval processes are one of the most resource-intensive processes within the platform. At login, the platform must retrieve user and security information from the database and calculate authorizations.

We will examine Liferay DXP's performance with simple content portlets on the page. These portlets are extremely fast, lending average rendering times of less than 10ms.

Table 1 illustrates the performance observed during this test using Standard Availability. The mean time for login remained less than a tenth of a second as the performance inflection point was approached. At 9,000 virtual users, there was a mean time (μ) of 35.3ms with 95% of the logins (2σ) under 55.02ms. The optimal performance point with a relatively small standard deviation occurs around 9,562 virtual users.

At 10,000 virtual users, the established performance limit of this test was exceeded as CPU usage eclipsed the safe value of 80%.

Virtual Users	Login μ(ms)	Login σ(ms)	Login 2σ(ms)	Login Throughput (TPS)	Max CPU Utilization
5000	30.3	5.29	40.88	143	37%
8000	34.4	9.42	53.24	228	68%
9000	35.3	9.86	55.02	257	71%
10000	76.3	268	612.30	284	87%

Table 1: Isolated Login - Standard Availability

Table 2 illustrates the performance observed during the tests using High Availability. The mean time for login remains less than 250ms as the performance inflection point was approached. At 20,000 virtual users, there was a mean time (μ) of 187ms with 95% of the logins (2σ) under 883.00ms. The optimal performance point where the standard deviation passes 200ms occurs somewhere around 20,000 virtual users. Even though the tests with 23,000 and 25,000 virtual users have a mean time of less than one second, it must be noted that the CPU usage was greater than a safe value of 80%.

Virtual Users	Login μ(ms)	Login σ(ms)	Login 2σ(ms)	Login Throughput (TPS)	Instance 1 Max CPU Utilization	Instance 2 Max CPU Utilization
5000	32.3	5.12	42.54	143	20%	18%
8000	32.9	6.18	45.26	228	31%	30%
9000	34.8	7.73	50.26	257	39%	40%
10000	34.2	7.85	49.90	285	39%	41%
12500	37.1	11.1	59.30	356	50%	48%
15000	51.9	134	319.90	425	59%	59%
20000	187	348	883.00	532	79%	77%
23000	160	240	640.00	562	90%	85%
25000	169	285	739.00	539	77%	93%

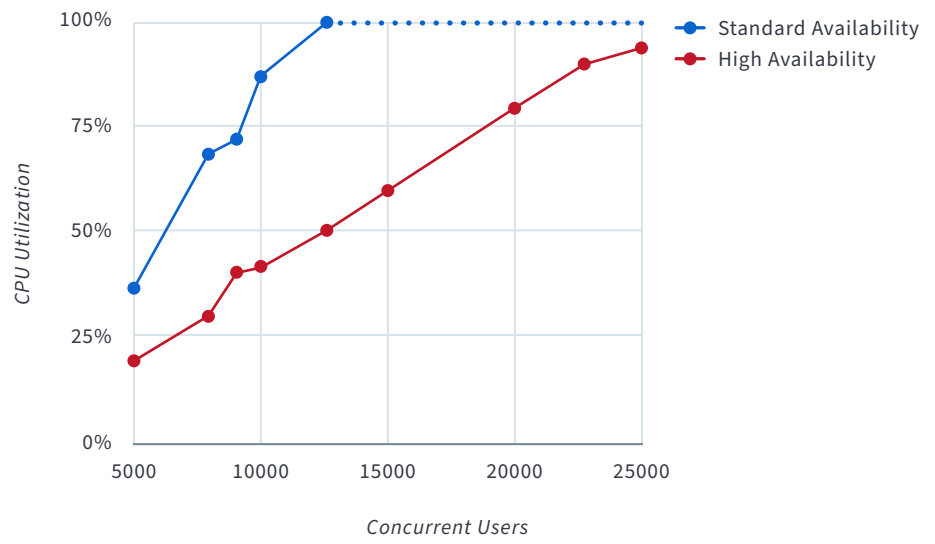Table 2: Isolated Login - High Availability
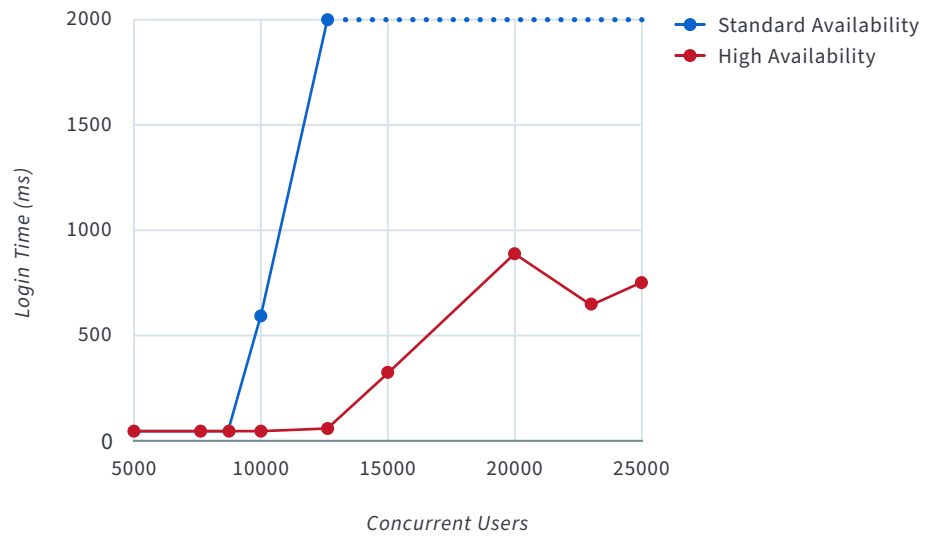
Figure 1: Login Transaction - CPU Utilization

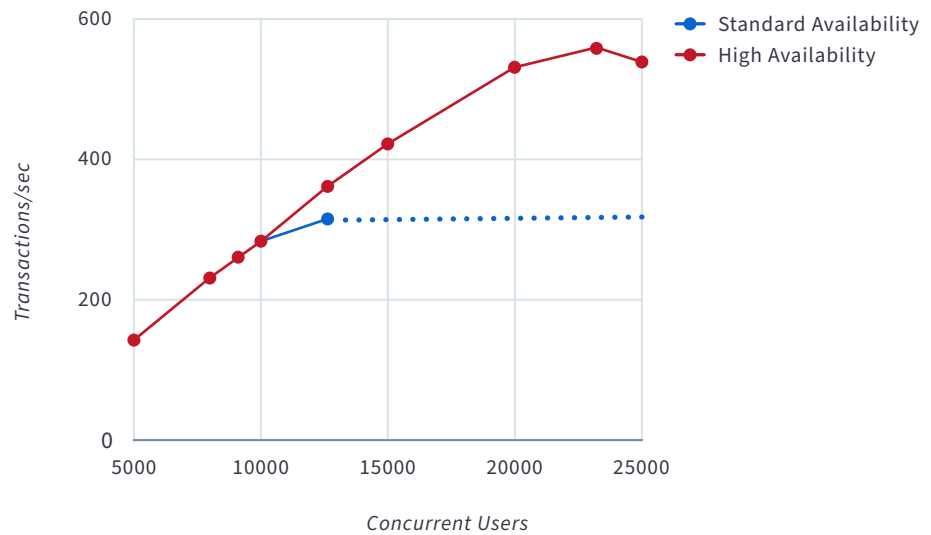Figure 2: Login Transaction - Mean Time

Figure 3: Login Transaction - Isolated Throughput - During peak load, near 100% CPU usage, the platform has an maximum throughput of 315 logins per second using Standard Availability and 539 logins per second using High Availability.

The benchmark results showed that DXP Cloud was able to exceed 20,000 virtual users using High Availability. With an optimal performance point slightly over 20,000 users, High Availability recorded a performance increase of 112% when compared to the Standard Availability optimal performance point of 9,562 users. Both configurations recorded mean times for logins under one-quarter of a second (250ms) and CPU utilization under 80% at their optimal performance points.

Legacy Simulator

The Legacy Simulator test adds a portlet to the login process that sleeps for 2 seconds, simulating the impact of integrations with systems like Salesforce.com or interacting with a company's enterprise service bus. The hypothesis is that the added portlet will impact the portal solution's performance in a manner comparable to integrations that may exist in a real-world scenario.

Unlike in the isolated login test, this test case was only able to utilize 40 - 44% of the CPU at optimal performance; this is due to the slower transaction response times caused by the portlet used to simulate legacy integrations. This issue can potentially be resolved by adding a second JVM to service requests. Figure 4 illustrates the inflection point where CPU usage spikes on both configurations. While the CPU usage for both configurations is well under the safe value of 80%, overall performance begins to suffer.

At 3,700 users, the Standard Availability configuration reaches its performance threshold with a login mean time of 2030ms, a maximum throughput of 96 logins per second, and CPU usage of 44%. For the remainder of the tests, up to 5,000 users, the maximum throughput stays virtually unchanged while the login time increases.

Using High Availability, the performance threshold for the test is 7,000 users; at this point, there is a maximum throughput of 189 logins per second with CPU usage at 40%. At 7,500 users, the login time increases by 430ms to 2,460ms, while the maximum throughput stays relatively the same at 192 logins per second.
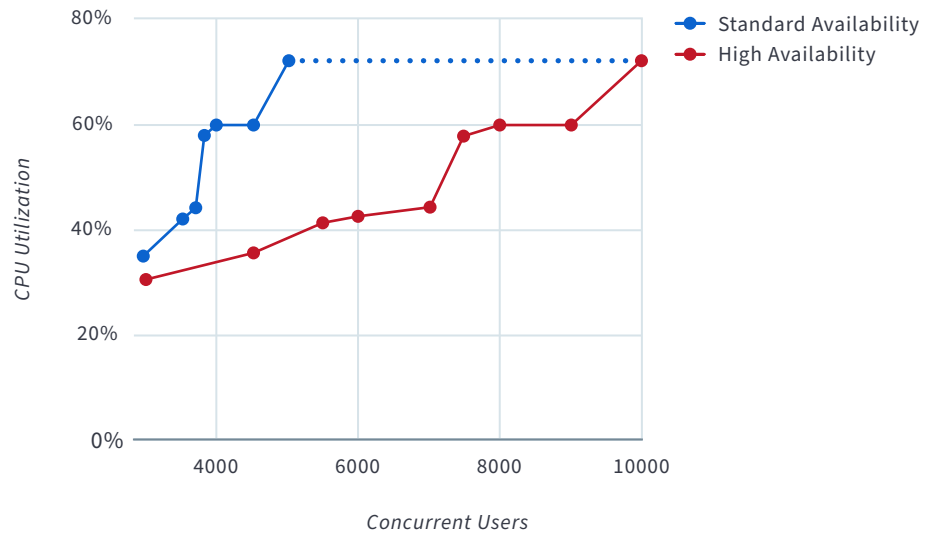
Figure 4: Legacy Login - CPU Utilization

The benchmark results showed that the High Availability configuration was able to support 7,000 virtual users; this is a performance increase of 89% when compared to the 3,800 users supported on Standard Availability. At their optimal performance points, both configurations supported login times of under 2.1 seconds, with 2 of those seconds coming from the portlet used to simulate legacy integrations.

Collaboration Centric Scenarios

Message Boards

Message Boards represent one of the foundational elements around social collaboration. The message board test cases demonstrate the full range of capabilities of the Liferay Message Board, simulating how an end-user may utilize the features. This scenario consists of seven separate transaction tests: Login, View Message Board Page, View Recent Posts, View Message Board Category, View Message Board Thread, Add Message Board Thread, and Add Reply.

Using Standard Availability the optimal performance point is just before 6,500 users, where there is a combined mean time of 2,763ms, across all transaction tests at 81% CPU usage. At 6,500 users, the system records sub-one second mean times across all transactions with Login, View Message Board Page, and Add Message Board Thread showing mean times of 460ms, 217ms, and 499ms respectively.

Under the High Availability configuration, the system begins to exceed the ideal performance point at 20,000 virtual users. Under this configuration, all of the tests had a CPU usage below the 80% limit, so the ideal performance point is based on the mean time of one of the more intensive transactions, View Recent Posts, reaching an acceptable usability threshold of three seconds (3040ms). With this amount of virtual users less intensive transactions such as View Message Board Page and View Message Board Thread still recorded mean times of less than one second, 795ms and 780ms respectively.
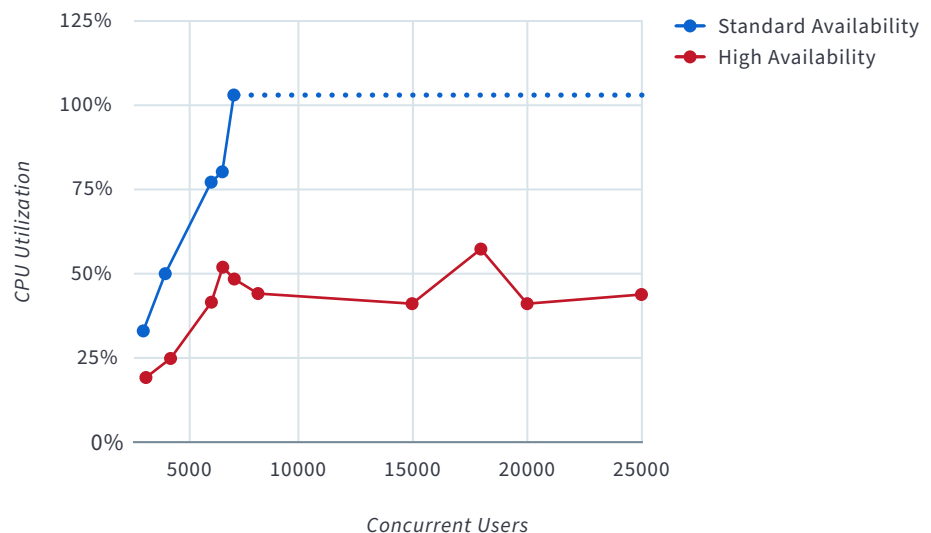

Figure 5: Message Board - CPU Utilization

The benchmark results showed DXP Cloud on the High Availability configuration was able to handle 20,000 virtual users before transaction mean times exceeded acceptable performance limits. This is an increase of 208% when compared to Standard Availability, which reached 6,500 virtual users as it's CPU utilization exceeded the safe range of 80%.

Blogging

Blogging is another cornerstone of social collaboration. As with the message board cases, this test simulated the real end-user behaviors of browsing, reading, and contributing to blogs. While the blogging components in Liferay DXP reuse some of the Message Boards components, the performance does differ due to the reduced complexity of the Blogs features (e.g., no nested categories and thus reduced entitlement validation). This scenario consisted of five separate transaction tests: Login, View Blog Page, View Blog Entry, Add Blog Entry, and Add Blog Reply.

As shown in Figure 5, the statistics point to a performance inflection point of roughly 4,500 virtual users using Standard Availability, at this mark CPU utilization is 78%, which is close to exceeding the safe value of 80%. At 4,800 the CPU utilization reaches 95%, so the optimal performance point is determined to be 4,500 virtual users.

Using High Availability the system's inflection point is around 8,000 virtual users, where we see a CPU utilization of 72%. At 9,000 virtual users the CPU utilization recorded is 97%, far exceeding the safe value, therefore the optimal performance point is determined to be 8,500 virtual users.
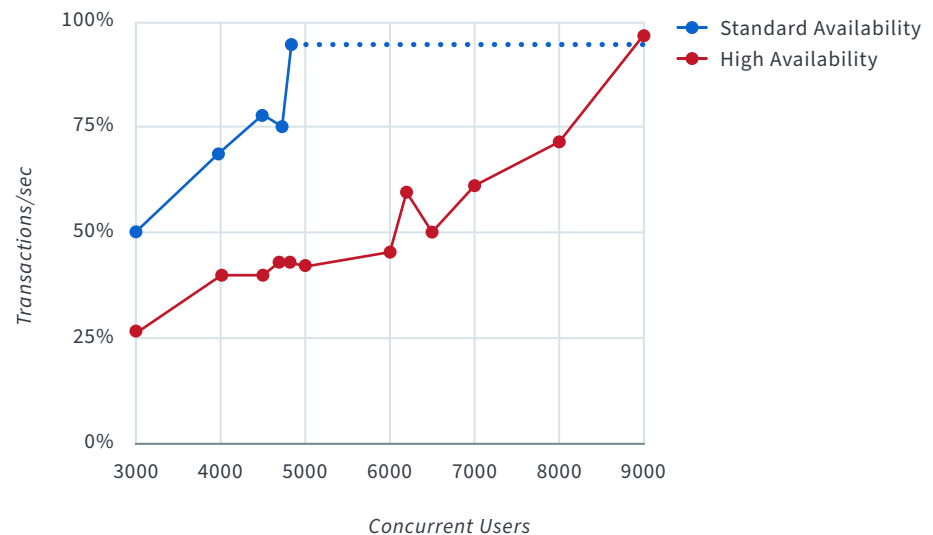

Figure 6: Blogging - CPU Utilization

The benchmark results showed that the High Availability configuration was able to support 8,500 virtual users. When compared to Standard Availability, which supported 4,500 virtual users, that is a performance increase of 89%. Both configurations completed all testing transactions in under one second while at full capacity, with Standard Availability recording a mean time of 381.4ms and High Availability recording a mean time of 637ms.

Content and Document Management

Liferay DXP provides rich capabilities for both Web Content Management and Document Management. The Documents and Media features are backed by a full-featured content repository that supports multilevel workflow approvals, custom document metadata definitions, and social collaboration features (e.g., ratings, comments). The performance test scenario demonstrates the typical usage and includes the five tests: Login, View Folder, View File, Download File, and Upload File.

Using Standard Availability, the test data points to a performance inflection point of 6,500 virtual users at a CPU utilization of 80%. 6,500 virtual users is also the optimal performance point, as at higher numbers the performance becomes unstable and the CPU utilization rapidly increases from 81% at 6,800 users, to 100% at 7,000 users.

Moving to the High Availability configuration greatly improves capacity as we see a performance inflection point at 16,000 users. The optimal performance point is 18,000 users, where CPU utilization meets the safe value of 80%.
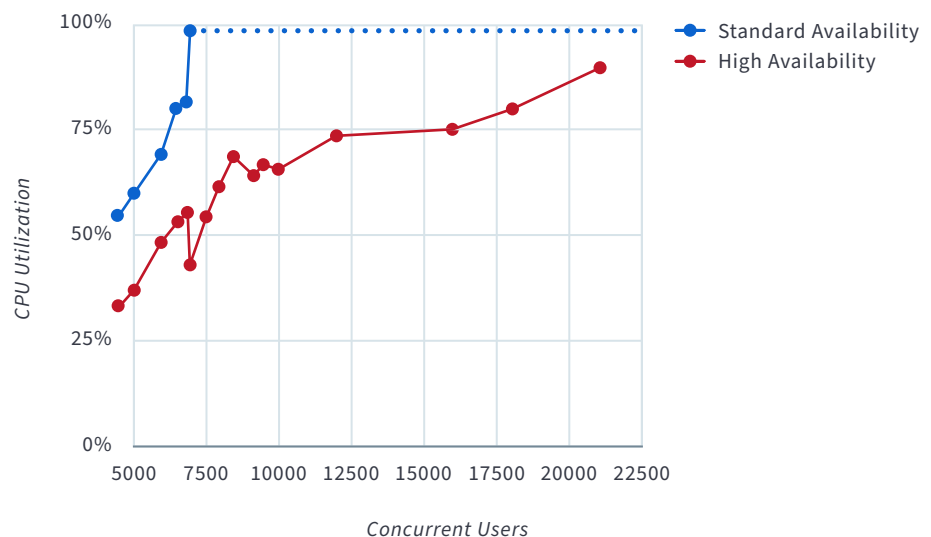
Figure 7: Document Management - CPU Utilization

The benchmark results showed High Availability supported 18,000 virtual users before CPU utilization exceeded the safe value of 80%. When compared to Standard Availability, which supports 6,500 virtual users, this is an increase of 177%. At full capacity, Standard Availability completed each test transaction in under one second, while High Availability completed every test under one second, except Upload File which was completed in 1600ms.

Summary

In collaboration with various clients and partners, Liferay commissioned this benchmark study to demonstrate the performance and scalability of DXP Cloud, in both Standard and High Availability configurations, and to provide statistics for future capacity planning.

Based on the results of this study, Liferay determined that DXP Cloud provides an extremely scalable and high performance environment for building out connected solutions for any combination of transaction, collaboration and content-centric scenarios now and in the future. With its proven performance and scalability, Liferay believes that DXP Cloud is uniquely positioned to help enterprises successfully achieve digital transformation. When using the High Availability configuration, which doubles the number of Liferay DXP instances, performance improved in the Isolated Login, Legacy Login, Message Board, Blogging, and Document Management testing scenarios by 112%, 89%, 208%, 89%, and 176%, respectively. The data clearly shows the High Availability configuration of DXP Cloud provides significant performance increases across all five tests.

DXP Cloud offers an auto scaling feature that allows customers to handle unexpected peak traffic volumes, leading to a more seamless experience when these scenarios occur. Using auto scaling, DXP Cloud adds capacity when workloads exceed user-defined thresholds, providing a balance between cost and scalability.

Moving Forward

Contact Us

For more information about Liferay DXP Cloud, contact us at sales@liferay.com.

Appendix

Transaction Centric Scenarios

Legacy Simulator

Virtual Users	Time Delayed Login μ(ms)	Time Delayed Login σ(ms)	Time Delayed Login 2σ(ms)	Login Throughput (TPS)	Max CPU Utilization
3000	2020	22.81	2066	76.5	35%
3500	2020	39.672	2099	90	42%
3600	2030	40.97	2112	93	43%
3700	2030	240.96	2512	96	44%
3800	2460	109.91	2680	97.5	58%
4000	3120	106.72	3333	97	60%
4500	6090	116	6322	97.5	60%
5000	9050	122.09	9294	98	72%

Table 3: Legacy Login - Standard Availability

| Virtual Users	Time Delayed Login μ(ms)	Time Delayed Login σ(ms)	Time Delayed Login 2σ(ms)	Login Throughput (TPS)	Max CPU Utilization	Instance 2 Max CPU Utilization
3000	2020	16.7	2053.4	128	31%	28%
4500	2020	21.89	2063.78	150	32%	35%
5500	2020	38.08	2096.16	177	41%	37%
6000	2030	39.33	2108.66	183	38%	42%
7000	2030	120.48	2270.96	189	44%	40%
7500	2460	637.47	3734.94	192	58%	52%
8000	3120	618.97	4357.94	191	54%	60%
9000	6090	672.8	7435.6	192	60%	54%
10000	9050	708.12	10466.24	193	72%	65%

Table 4: Legacy Login - High Availability
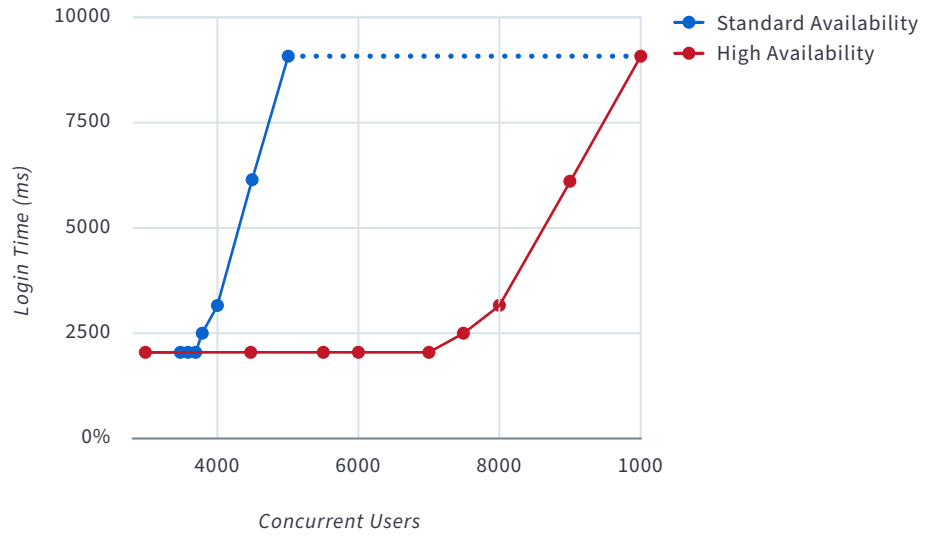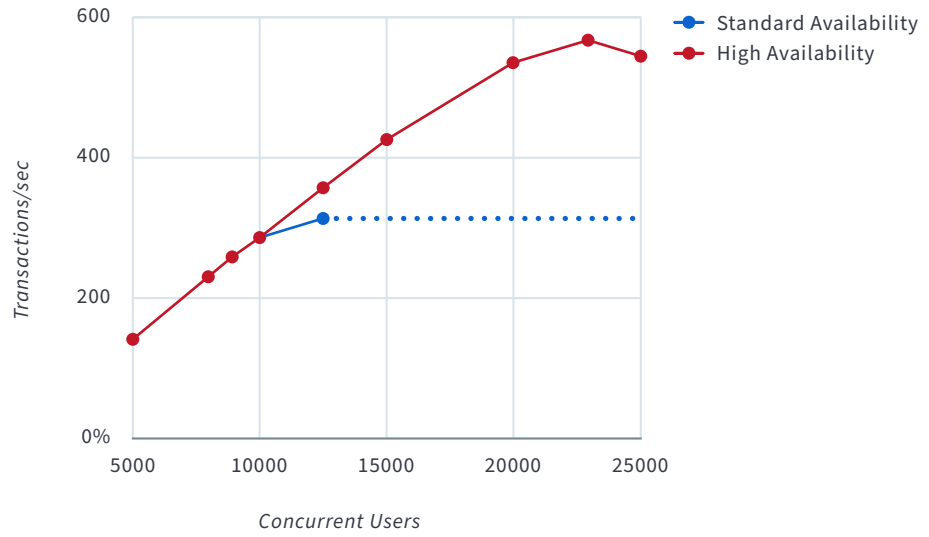
Figure 8: Legacy Login - Mean Time

Figure 9: Legacy Login - Isolated Throughput

Collaboration Centric Scenarios

Message Boards

Virtual Users	Login Time μ(ms)	Login Time σ(ms)	View MB Page μ(ms)	View MB Page σ(ms)	View Recent Posts μ(ms)	View Recent Posts σ(ms)	View MB Category μ(ms)	View MB Category σ(ms)	View MB Thread μ(ms)
3000	36.2	7.05	49.1	8.36	79.8	12.6	58.7	9.95	74.2
4000	40.5	9.01	56.6	9	97.3	16	67.9	10.5	85.8
6000	42.1	8.49	58.4	9.66	125	41	71.4	11.5	87.9
6300	49.8	111	59.3	57.7	128	78.6	72.4	61.8	87.9
6500	460	925	217	345	489	698	270	407	289

Table 5: Message Board Part 1 - Standard Availability

Virtual Users	View MB Thread σ(ms)	Add MB Thread μ(ms)	Add MB Thread σ(ms)	Add Reply μ(ms)	Add Reply σ(ms)	Total μ(ms)	Total σ(ms)	Total 2σ(ms)	Max CPU Utilization
3000	39	101	11	110	16.8	509	104.76	718.52	33%
4000	45.4	119	14.6	130	19.3	597.1	123.81	844.72	50%
6000	47.4	125	17.1	137	22.7	646.8	157.85	962.5	78%
6300	90.8	126	101	139	124	662.4	624.9	1912.2	75%
6500	413	499	773	539	808	2763	4369	11501	81%

Table 6: Message Board Part 2 - Standard Availability

Virtual Users	Login μ(ms)	Login σ(ms)	View MB Page μ(ms)	View MB Page σ(ms)	View Recent Posts μ(ms)	View Recent Posts σ(ms)	View MB Category μ(ms)	View MB Category σ(ms)	View MB Thread μ(ms)
3000	41.7	8.42	55.1	8.86	98.6	18.9	64.9	8.89	86.8
4000	40.3	15.4	53.7	16.6	94.2	26.3	64.2	18.8	80.5
6000	43.9	10.1	57.7	11.1	123	39.5	69.8	13.1	86.8
6300	138	584	92.7	225	333	889	122	286	122
6500	584	1390	271	525	1340	1910	407	681	319
7000	821	1630	369	630	1790	2080	550	787	418
8000	994	1720	465	674	1980	1970	623	796	474
18000	1660	1940	735	734	3010	1760	945	846	776
20000	1750	1870	795	731	3040	1690	977	809	780
25000	2170	1920	956	734	3580	1260	1170	775	946

Table 7: Message Board Part 1 - High Availability

Virtual Users	View MB Thread σ(ms)	Add MB Thread μ(ms)	Add MB Thread σ(ms)	Add Reply μ(ms)	Add Reply σ(ms)	Total μ(ms)	Total σ(ms)	Total 2σ(ms)	Instance 1 Max CPU Utilization	Instance 2 Max CPU Utilization
3000	47.5	124	15	134	20.7	605.1	128.27	861.64	20%	19%
4000	44.6	111	14.9	122	18.1	565.9	154.7	875.3	25%	24%
6000	47.3	122	18.5	135	23.3	638.2	162.9	964	41%	40%
6300	232	258	694	250	608	1315.7	3518	8351.7	39%	37%
6500	533	954	1580	927	1520	4802	8139	21080	51%	45%
7000	628	1410	1890	1280	1750	6638	9395	25428	48%	47%
8000	655	1620	1850	1480	1770	7636	9435	26506	45%	44%
18000	764	2690	1890	2260	1770	12076	9704	31484	57%	57%
20000	716	2670	1770	2390	1700	12402	9286	30974	44%	41%
25000	716	3330	1550	2730	1550	14882	8505	31892	58%	44%

Table 8: Message Board Part 2 - High Availability

Message Board - Activity Time | Standard Availability
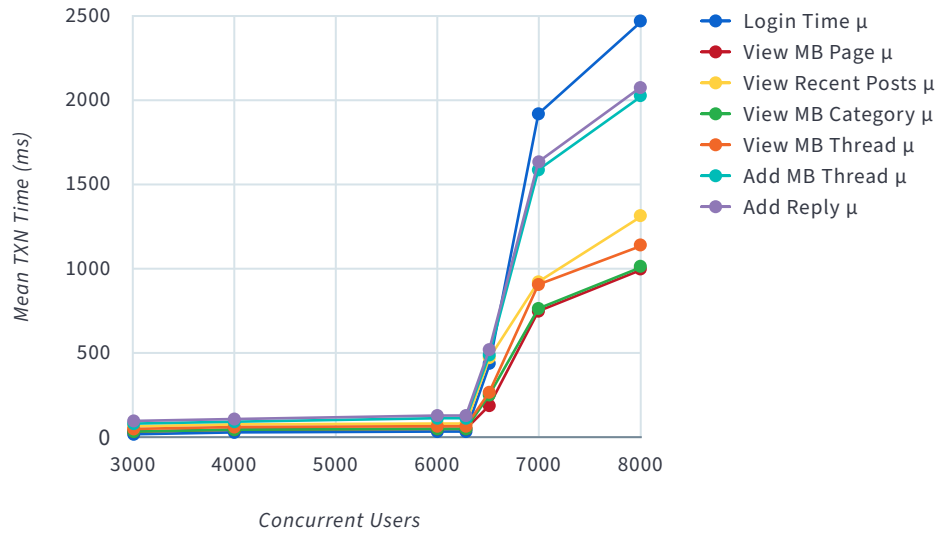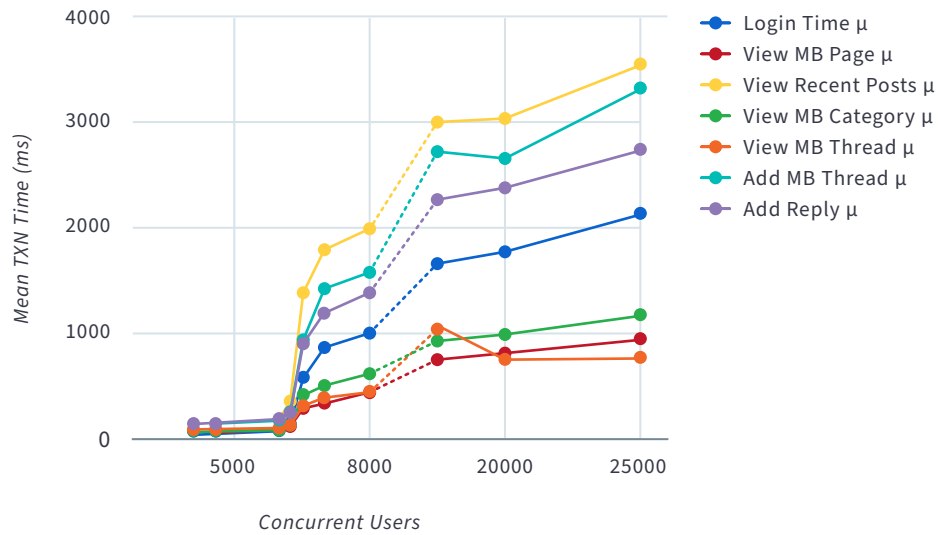

Message Board - Activity Time | High Availability

Figure 10: Message Board - Activity Time

Blogging

Virtual Users	Login μ(ms)	Login σ(ms)	View Blog Page μ(ms)	View Blog Page σ(ms)	View Blog Entry μ(ms)	View Blog Entry σ(ms)	Add Blog Entry μ(ms)	Add Blog Entry σ(ms)
3000	39.4	9.01	68.2	10.7	58.8	12.4	105	11.9
4000	59.1	170	81	89.7	75.8	112	123	142
4500	40.8	28.1	69.1	23.5	60.5	30.5	106	31.7
4700	123	330	113	158	119	198	182	272
4800	258	536	186	254	205	305	294	428

Table 9: Blogging Part 1 - Standard Availability

Virtual Users	Add Blog Reply μ(ms)	Add Blog Reply σ(ms)	Total μ(ms)	Total σ(ms)	Total 2σ(ms)	Max CPU Utilization
3000	99.3	14.4	370.7	58.41	487.52	50%
4000	122	152	460.9	665.7	1792.3	70%
4500	105	40.7	381.4	154.5	690.4	78%
4700	194	315	731	1273	3277	76%
4800	324	488	1267	2011	5289	95%

Table 10: Blogging Part 2 - Standard Availability

Virtual Users	Login Time μ(ms)	Login Time σ(ms)	View Blog Page μ(ms)	View MB Blog σ(ms)	View Blog Entry μ(ms)	View Blog Entry σ(ms)	Add Blog Entry μ(ms)	Add Blog Entry σ(ms)
3000	41.3	12.0	68.4	14.0	61.2	16.7	109	13.6
4000	43.6	11.3	70.9	12.9	63	17	112	21.4
4500	46.7	14.5	62.9	11.5	59.6	16.4	107	17
4700	50	18	69.1	14.3	61.5	21.1	109	17.8
4800	47.8	17.2	65.1	16.3	61.7	19.9	111	16.1
5000	42	18.2	70.6	20.1	62.3	25	111	29.2
6000	44.6	17.8	73.6	18.5	65.3	25.9	116	24.8
6200	44.9	16.7	74.4	17.7	65.8	23.5	118	25.2
6500	50.5	99.2	78.8	57.3	71.2	72.5	123	80.2
7000	55.8	114	84.1	65	78.1	87.4	133	101
8000	76.4	188	103	96.6	97.6	120	159	161
9000	672	1060	379	456	385	499	621	802

Table 11: Blogging Part 1 - High Availability

| Virtual Users	Add Blog Reply μ(ms)	Add Blog Reply σ(ms)	Total μ(ms)	Total σ(ms)	Total 2σ(ms)	Instance 1 Max CPU Utilization	Instance 2 Max CPU Utilization
3000	100	18.8	172	269.4	710.8	27%	27%
4000	108	19.2	397.5	81.8	561.1	40%	35%
4500	104	20.4	380.2	79.8	539.8	40%	36%
4700	107	23	396.6	94.2	585	44%	40%
4800	108	21.3	393.6	90.8	575.2	40%	44%
5000	107	28.2	392.9	120.7	634.3	42%	43%
6000	120	28.9	419.5	115.9	651.3	53%	46%
6200	118	26.8	421.1	109.9	640.9	58%	60%
6500	128	114	451.5	423.2	1297.9	59%	50%
7000	137	125	488	492.4	1472.8	66%	61%
8000	201	201	637	766.6	2170.2	70%	72%
9000	776	973	2833	3790	10413	83%	97%

Table 12: Blogging Part 2 - High Availability
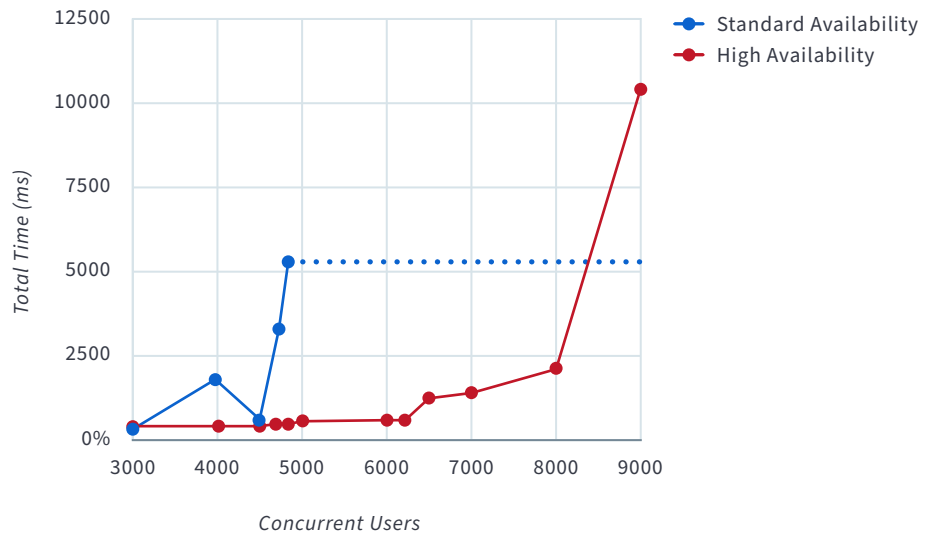
Figure 11: Blogging | All Tests - Total Time

Content and Document Management Test Results

Virtual Users	Login Time μ(ms)	Login Time σ(ms)	View Folder μ(ms)	View Folder σ(ms)	View File μ(ms)	View File σ(ms)	Download File μ(ms)	Download File σ(ms)
4500	43	8.62	108	28.5	45.7	9.17	14	4.94
5000	42.9	14.4	108	33.9	45.5	14.1	13.5	7.01
6000	44.1	14	114	39	46.9	13.5	14.6	14
6500	57.1	169	130	122	53.9	77.5	19	67.5
6800	46.8	18.7	125	53.9	49.4	17.8	14.4	7.57

Table 13: Document Management Part 1 - Standard Availability

Virtual Users	Upload File μ(ms)	Upload File σ(ms)	Total μ(ms)	Total σ(ms)	Total 2σ(ms)	Max CPU Utilization
4500	173	34.6	383.7	85.83	555.36	55%
5000	173	43.7	382.9	113.11	609.12	60%
6000	184	50.6	403.6	131.1	665.8	69%
6500	211	197	471	633	1737	80%
6800	202	73.3	437.6	171.27	780.14	81%

Table 14: Document Management Part 2 - Standard Availability

Virtual Users	Login Time μ(ms)	Login Time σ(ms)	View Folder μ(ms)	View Folder σ(ms)	View File μ(ms)	View File σ(ms)	Download File μ(ms)	Download File σ(ms)
4500	47	7.69	114	30.3	48.4	8.8	15	4.77
5000	52.2	9.39	134	36.7	54.2	10.4	15.8	5.3
6000	53	28.6	133	45.8	54.6	22.2	16.2	12.7
6500	55.6	47.1	146	63.2	58	34.7	17.6	24.8
6800	54.6	31.1	143	54.2	55.6	23.6	17.1	15.9
7000	48.8	22.6	126	45.9	50.6	19.2	15.6	11.3
7500	52.5	28.3	145	58.1	55.4	26.6	16.5	15.6
8000	47.6	13.2	127	40	49.7	13.5	15.1	6.53
8500	48	19.7	133	47.1	50.9	17.5	15.9	8.68
9200	47.1	36.1	137	60.5	50.5	27.3	15.8	13
9500	52.8	38.2	153	71.6	55.7	29.2	17.1	14.8
9900	50.9	17.9	158	72.6	54.1	18.9	16.4	7.75
10000	294	584	577	580	182	260	105	213
12000	836	1060	919	734	389	417	304	379
16000	1080	1180	1080	737	502	478	320	399
18000	826	985	936	674	470	451	338	387
21000	1580	1230	1440	599	710	487	437	433

Table 15: Document Management Part 1 - High Availability

Virtual Users	Upload File μ(ms)	Upload File σ(ms)	Total μ(ms)	Total σ(ms)	Total 2σ(ms)	Instance 1 Max CPU Utilization	Instance 2 Max CPU Utilization
4500	185	34.7	409.4	86.26	581.92	29%	34%
5000	212	42.5	468.2	104.29	676.78	37%	35%
6000	214	57.6	470.8	166.9	804.6	48%	42%
6500	235	86.2	512.2	256	1024.2	45%	53%
6800	229	70	499.3	194.8	888.9	42%	55%
7000	206	57.7	447	156.7	760.4	43%	43%
7500	235	76.1	504.4	204.7	913.8	54%	53%
8000	208	46.9	447.4	120.13	687.66	50%	54%
8500	216	58.2	463.8	151.18	766.16	46%	52%
9200	218	76	468.4	212.9	894.2	55%	54%
9500	247	95.1	525.6	248.9	1023.4	60%	52%
9900	256	99.4	535.4	216.55	968.5	66%	59%
10000	917	926	2075	2563	7201	66%	60%
12000	1540	1230	3988	3820	7140	74%	67%
16000	1890	1280	4872	4074	8664	69%	75%
18000	1600	1150	4170	3647	7514	80%	70%
21000	2420	1060	6587	3809	11594	91%	75%

Table 16: Document Management Part 2 - High Availability

Document Management - Activity Time | Standard Availability
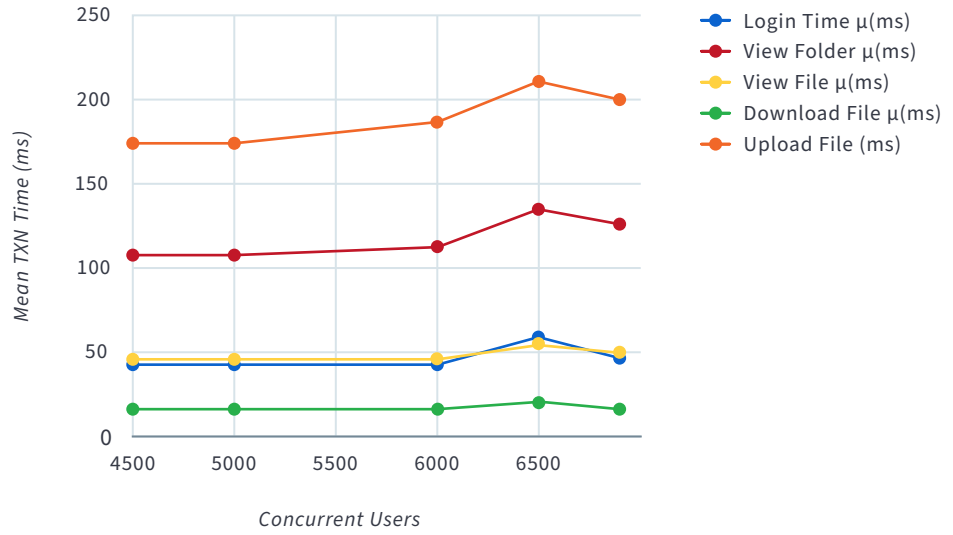
Document Management - Activity Time | High Availability

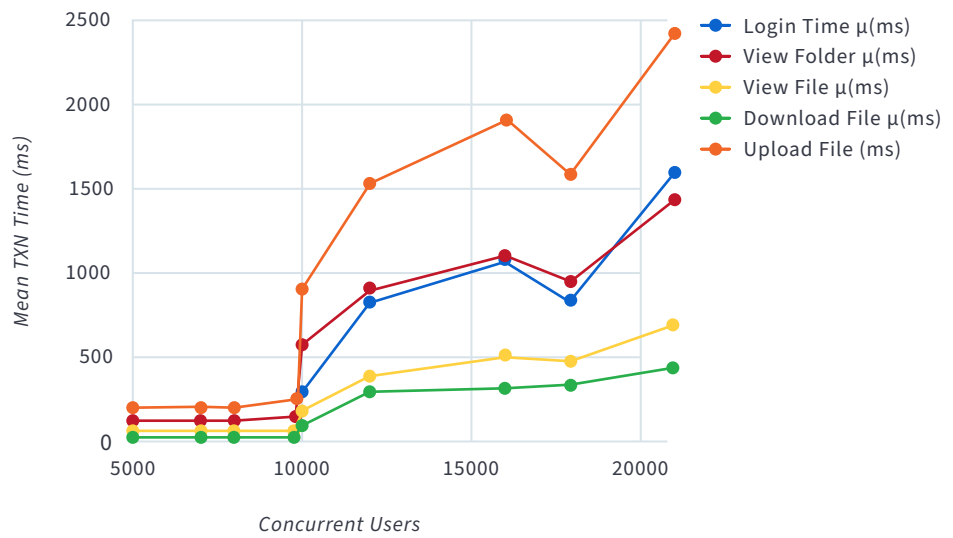Figure 12: Document Management - Activity Time

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