Liferay Experience Cloud Self-Managed Performance

Benchmark Study of Liferay DXP 7.3 on Liferay Experience Cloud Self-Managed

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Executive Summary

Liferay Experience Cloud Self-Managed (SM) allows organizations to deploy, manage, and scale Liferay DXP (Digital Experience Platform) with cloud-native capabilities. Designed to be a solid foundation for an organization's digital experience initiatives, it helps set up DevOps best practices. Liferay Experience Cloud SM includes a CI/CD pipeline, backups & restore, and immutable deployments via containers, alongside a feature-complete PaaS platform.

In order to demonstrate the performance limits of Liferay Experience Cloud SM, the Liferay Engineering team performed intensive testing. These tests utilized virtualized hardware resources of a typical Liferay Experience Cloud SM project, e.g. High Availability configuration with Sizing S (detailed below), and advanced performance testing methodology.

The goals of this benchmark study were to:

- Determine the optimal number of concurrent virtual users supported by the High Availability configuration, with two Liferay DXP instances, across defined test cases.
- Provide statistics to help Liferay Experience Cloud SM customers, Liferay Global Services, and Liferay Service Partners during capacity planning.

Key Findings

The key findings of this preliminary study are:

- In the Isolated Login Transaction scenario, the configuration supports 16,000 virtual users with a maximum throughput of 439+ logins per second. Sustained login mean times are under 472 ms.
- In the Message Board Social Collaboration scenario, the platform can support 5,000 virtual users with a total meantime for all tests under one second at 716.24 ms.
- In the Blogging Social Collaboration scenario, the configuration supports 4,500 virtual users with a total meantime of under one second at 801.90 ms.
- The platform's Document Repository can support 6,300 virtual users while accessing 100,100 documents in the document repository, with mean times for all individual tests under one-quarter second and total testing times recorded at 678.40 ms.

Test Scenarios

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

- Virtual Users – the number of simulated users concurrently transacting on the Liferay DXP system.
- Total Users – The total number of users stored in the database.
- Meantime (μ) - The average time in milliseconds it took for a test to be completed at a specific number of concurrent users.
- Standard Deviation (σ) - The amount of variation (or dispersion) in the transaction times at a specific number of concurrent users.
- Two Sigma (2σ) - In a normal distribution, two sigma represents the confidence interval where 95% of all test results are under the given value. For example, a Two Sigma value of 1000 ms would mean that 95% of all users would complete the test in under one second at that load.

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

TRANSACTION CENTRIC SCENARIO

- Applies to solutions across a variety of industries where a large number of users will login and perform transactions like online banking, online insurance applications, airline, and hotel booking.
- Authenticated user accesses with longer user session times.

COLLABORATION CENTRIC SCENARIOS

- Applies to corporate intranets and other solutions 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, self-service portals, and other solutions where users manage and share documents.

1. Benchmark Configuration and Methodology

1.1 Liferay Experience Cloud SM Configurations

Liferay Experience Cloud SM's High Availability configuration includes two Liferay DXP instances in the Production Environment. Additionally, High Availability includes two instances of the Web Server and three instances of Liferay Enterprise Search. High Availability serves mission-critical systems that require continual uptime and serve a larger number of users concurrently.

Components of a Liferay Experience Cloud SM Environment:

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

Liferay Experience Cloud SM - High Availability Configuration

The following charts detail the configuration of each Liferay Experience Cloud SM stack and the software included.

Configuration (per instance):

Service	CPU	Memory	Storage
Web Server	1 Core	512 MB	N/A
Liferay DXP	12 Cores	16 GB	NFS 100 GB
Database	4 Cores	15 GB	SSD 100 GB
Search	8 Cores	8 GB	SSD 100 GB

1.2 Methodology

The Liferay Experience Cloud SM performance testing methodology was improved this year, including new processes and testing thresholds. For this whitepaper, the Liferay Experience Cloud SM performance testing methodology has evolved, including new processes and testing thresholds that relate closer to the end-user experience. Due to this change, results are not directly comparable to past testing scenarios. In all scenarios, the Fixed Pressure Test was used to define the desired number of virtual users to then run the test at that load for a sustained period of time.

The limit of virtual users tested is defined by the *2σ (ms)* metric, which represents the amount of time it will take for 95% of the users to complete the given testing scenario. For the Isolated Login Scenario, a *Login 2σ* result of under 1,000 ms is considered to be within the acceptable range. For the remaining scenarios, Messaging Boards, Blogging, and Document Management, a *Total 2σ (ms)* metric of under 2,000 ms is considered within an acceptable range.

2. Benchmark Results

2.1 Transaction Centric Scenario

2.1.1 Isolated Login

Isolated Login is a transaction-centric test that focuses on the login process of Liferay DXP. The login is a very resource-intensive process that triggers the portal's auth pipeline, which includes: retrieving and building the user's permission bag, assembling the user's session, rendering the landing page, and others.

In Liferay DXP 7.3 all pages, including the landing page after login, now use Content Pages, Fragments, and other more modern features. When compared to the former widget pages with traditional portlets on Liferay DXP 7.2, these new features require more computing capacity. The preliminary tests were conducted considering these newly added features.

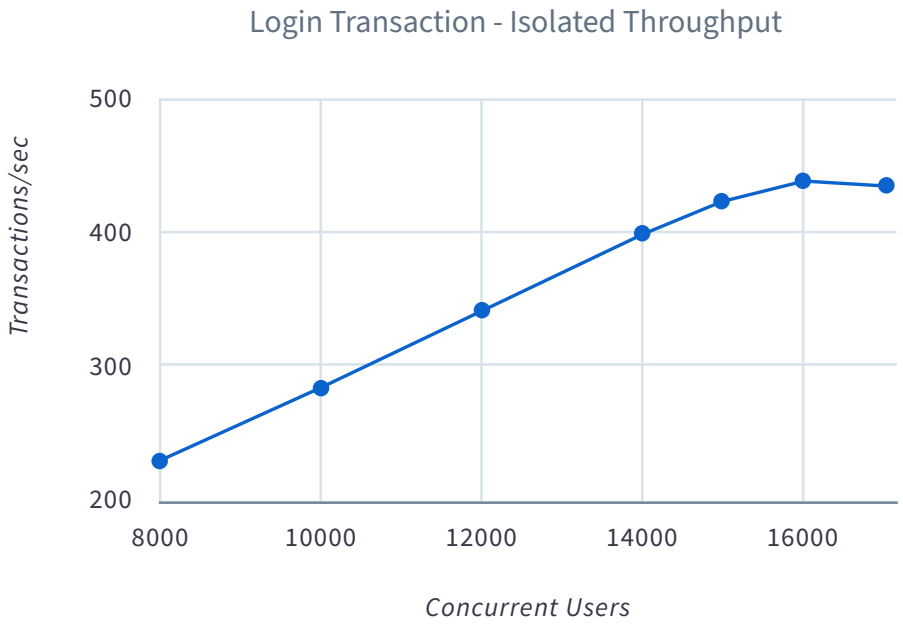

Figure 1: Login Transaction - Isolated Throughput - At 16,000 users the platform has a maximum throughput of 439 logins per second.

Virtual Users	Login μ(ms)	Login σ(ms)	Login 2σ(ms)	Login Throughput (TPS)	Instance 1 Max CPU Utilization	Instance 2 Max CPU Utilization
4000	47.8	13.7	75.2	114	28%	27%
6000	51.7	16.4	84.5	171	44%	42%
8000	50	18.3	86.6	228	49%	47%
10000	53.4	20	93.4	285	62%	64%
12000	64.9	36.2	137.3	342	88%	81%
14000	75.1	38.9	152.9	398	104%	99%
15000	70.8	30.8	132.4	427	104%	90%
16000	472	226	924	439	118%	106%
17000	616	247	1110	435	113%	110%

Table 1 - Isolated Login

Table 1 illustrates the performance observed with the High Availability configuration. At 16,000 virtual users, login mean times increase by over 600%, from 70.80 ms at 15,000 users to 616 ms. This indicates that the performance inflection point, where login times increase at an exponential rate for the first time, is somewhere between 15,000 and 16,000 virtual users.

Even though the inflection point has been surpassed at 16,000 virtual users, performance is still acceptable at this load, as the two sigma (2σ) value indicates that 95% of users will be able to login in less than one second.

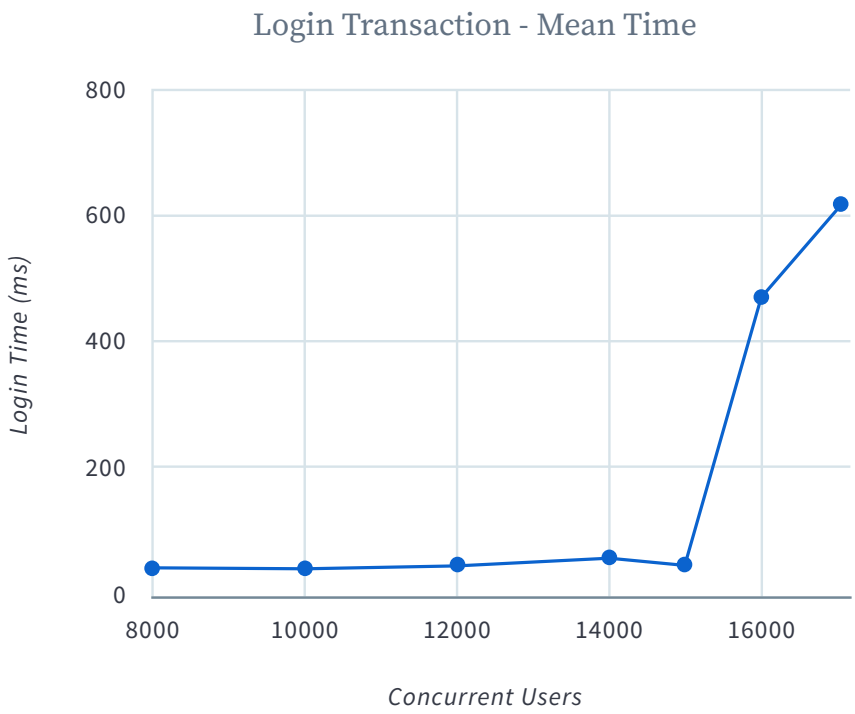

Figure 2: Login Transaction - Mean Time - At 16,000 users there is a mean time of 472 ms.

2.2 Collaboration Centric Scenarios

2.2.1 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.

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)
2500	43.7	9.04	60.3	10.8	94.8	11.9	69.8	9.49	54.1
3000	44.8	8.54	61.3	11	98.7	12.9	70.5	8.3	54.8
3500	44.5	8.42	61.5	11.4	102	13.7	70.5	8.28	54.4
5000	47.8	10.4	66.8	14.5	118	24.1	73.8	9.92	57.9
6000	202	756	145	425	473	1080	133	267	95
9000	1330	1790	752	1020	2360	1800	515	540	339

Table 2 - Message Boards Part 1

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
2500	31	87.7	9.59	76.7	9.76	426.8	91.58	609.96	32%	32%
3000	32	88.8	14.3	77.9	10.9	435.5	97.94	631.38	32%	31%
3500	31.9	87.5	9.7	77.4	10	436.3	93.4	623.1	33%	36%
5000	34.8	94.5	13.3	83.4	13.4	475.4	120.42	716.24	42%	25%
6000	194	197	442	180	406	1280	3570	8420	48%	54%
9000	417	1080	1030	871	889	6495	7486	21467	67%	64%

Table 3 - Message Boards Part 2

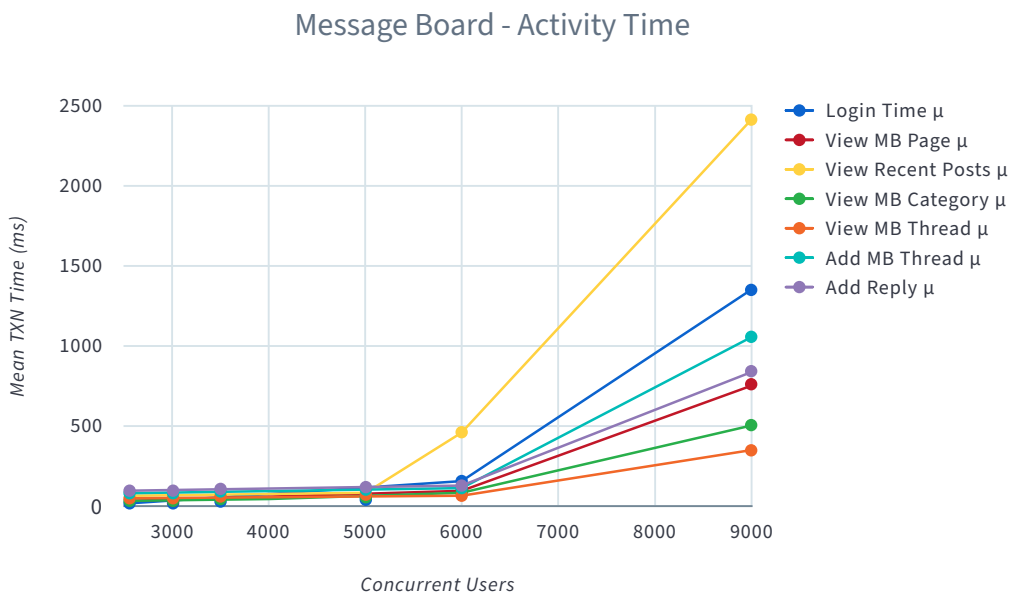

Figure 3: Message Board - Activity Time

In the Message Board scenario, the ideal performance point is based on all seven transactions having a total meantime of under two seconds (2,000 ms). In Figure 3, the statistics show that the inflection point is surpassed at 6,000 virtual users, where the total meantime for all tests is 8,420 ms, far over the acceptable value. The most stable performance point is around 5,000 users where we see a two sigma (2σ) value of 716.24 ms, indicating that 95% of all users would record total testing times under one second.

2.2.2 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.

Virtual Users	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)	Add Blog Reply μ(ms)
2000	90.70	27.70	68.00	33.00	141.00	25.40	157.00
2500	88.40	28.00	55.50	15.30	137.00	28.10	107.00
3000	86.20	27.10	56.40	15.90	127.00	24.10	101.00
3500	90.70	27.70	59.10	20.70	134.00	34.20	107.00
4000	97.50	39.60	60.20	27.50	136.00	33.20	111.00
4500	108.00	58.00	63.30	29.50	144.00	52.30	116.00
5000	1310.00	4650.00	690.00	3270.00	2190.00	7560.00	1440.00

Table 4 - Blogging Part 1

Virtual Users	Add Blog Reply σ(ms)	Total μ(ms)	Total σ(ms)	Total 2σ(ms)	Instance 1 Max CPU Utilization	Instance 2 Max CPU Utilization
2000	28.30	456.70	114.40	685.50	75.80%	57.60%
2500	23.30	387.90	94.70	577.30	86.90%	77.30%
3000	22.90	370.60	90.00	550.60	77.30%	61.60%
3500	29.80	390.80	112.40	615.60	83.60%	80.70%
4000	31.40	404.70	131.70	668.10	99.90%	92.70%
4500	45.50	431.30	185.30	810.90	96.40%	93.70%
5000	5870.00	5630.00	21350.00	48330.00	109.50%	87.50%

Table 5 - Blogging Part 2

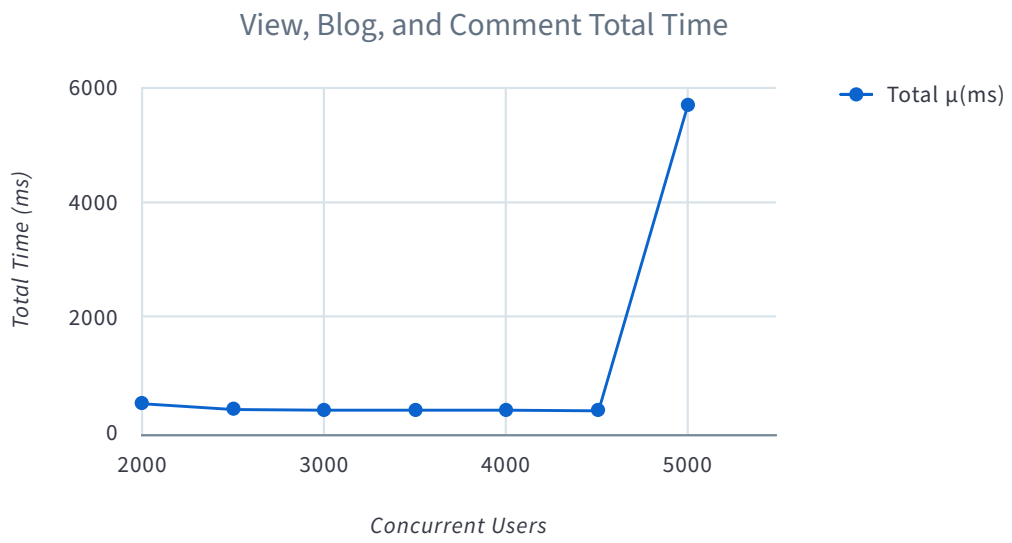

Figure 4: Blogging | All Tests - Total Time

As shown in Figure 4, the statistics point to a performance inflection point of between 4,500 and 5,000 virtual users. At 5,000 users the CPU utilization has a max value of over 100% for the first time and the total meantime for all tests is over 21 seconds. The optimal performance point is determined to be 4,500 virtual users, here we see the meantime for all tests at 431.30 ms and 95% of all users completing the tests under one second.

2.3 Content and Document Management Scenario

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.

At 11,000 virtual users, we see a total meantime of 2,606.20 ms and a standard deviation of 3,280.50 ms. At this point the standard deviation value is larger than the mean value, indicating that the inflection point has been passed and performance is not stable. Therefore, the optimal performance point is at 10,000 users where a meantime of 379.20 ms is recorded.

Virtual Users	View Folder μ(ms)	View Folder σ(ms)	View File μ(ms)	View File σ(ms)	Download File μ(ms)	Download File σ(ms)
5000	71.40	23.80	45.40	19.60	11.80	15.80
5500	62.70	15.40	44.30	11.40	11.60	11.20
6000	79.70	33.90	44.50	13.00	11.60	12.10
7000	83.00	40.00	45.10	12.50	11.70	11.80
8000	67.60	18.80	45.50	12.20	11.70	11.40
9000	78.80	19.40	46.70	12.80	11.80	11.20
10000	83.60	40.40	48.20	24.40	12.40	16.00
11000	373.00	808.00	113.00	130.00	50.20	92.50
12000	343.00	817.00	181.00	596.00	85.50	443.00
13000	450.00	1500.00	314.00	1290.00	172.00	1040.00
14000	333.00	950.00	225.00	836.00	116.00	630.00

Table 6 - Document Management Part 1

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
5000	170.00	29.10	298.60	88.30	475.20	42%	48%
5500	175.00	18.50	293.60	56.50	406.60	48%	48%
6000	259.00	37.40	394.80	96.40	587.60	53%	51%
7000	276.00	64.10	415.80	128.40	672.60	65%	60%
8000	193.00	25.40	317.80	67.80	453.40	74%	75%
9000	211.00	30.30	348.30	73.70	495.70	79%	82%
10000	235.00	68.80	379.20	149.60	678.40	92%	83%
11000	2070.00	2250.00	2606.20	3280.50	9167.20	93%	114%
12000	1640.00	2110.00	2249.50	3966.00	10181.50	94%	114%
13000	2230.00	5200.00	3166.00	9030.00	21226.00	86%	111%
14000	1310.00	2060.00	1984.00	4476.00	10936.00	98%	106%

Table 7 - Document Management Part 2

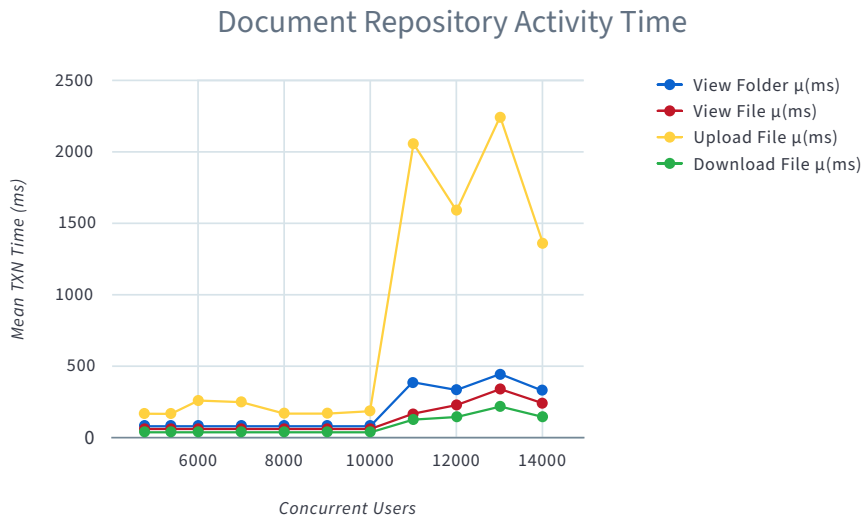

Figure 5: Document Management - Activity Time

3. Summary

In collaboration with various clients and partners, Liferay commissioned this benchmark study to demonstrate the performance of Liferay Experience Cloud SM in a typical High Availability configuration (Sizing S) and to provide statistics for future capacity planning.

Based on the results of this study, Liferay determined that Liferay Experience Cloud SM provides a high-performance environment for building out digital solutions for any combination of transaction, collaboration, and content-centric scenarios now and in the future. Additionally, with Liferay DXP 7.3's added feature-rich capabilities, Liferay Experience Cloud SM continued to deliver robust functionality and performance.

Liferay Experience Cloud SM also offers the Auto Scaling feature which allows customers to handle unexpected peak traffic volumes, leading to a more seamless experience when these scenarios occur. Using Auto Scaling, Liferay Experience Cloud SM adds capacity when workloads exceed user-defined thresholds, providing a balance between cost and scalability. Liferay believes that Liferay Experience Cloud SM is uniquely positioned to help enterprises successfully achieve digital transformation.

4. Moving Forward

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

Liferay makes software that helps companies create digital experiences on web, mobile and connected devices. Our platform is open source, which makes it more reliable, innovative and secure. We try to leave a positive mark on the world through business and technology. Hundreds of organizations in financial services, healthcare, government, insurance, retail, manufacturing and multiple other industries use Liferay. Visit us at liferay.com.