# Keeron Load Test Report

**11 August 2024**

# Test Overview

Keeron Web Application Load Test

Environment – Stage

URL: <https://stage-keeron.selise.biz/>

Started on 16 July

Start Time: 6pm

Ended on 11 August

End Time: 6 pm

Tester Name: Atia As Samia

# Test Objectives, Purpose and Criteria

Performance and load tests for main user flows for the Keeron website.

Tests were performed to check performance and load balancing for 2000 users.

13 user flows were set as part of the test cases. The thirteen user stories are:

1. Landing page
2. All courses
3. Live Courses
4. Study resources
5. Events
6. Blogs
7. Test packages
8. Course overview
9. Live Course overview
10. Study resources overview
11. Events overview
12. Test packages overview
13. Article

The application was monitored with different measurements tracked in real-time for each user flow.

# Test Results Executive Summary

**Total Test Duration: 10 Working Days**

# Introduction

This load test's main objective was to evaluate the performance and stability of the "Keeron" under varying user loads. The test aimed to identify potential bottlenecks, assess the system's scalability, and ensure that the application could handle anticipated peak traffic without degradation in user experience.

# DETAILED RESULTS

**Scenario: Keeron Landing Page**

* **100 Users**
* Throughput: 9.7 requests/second
* Error Rate: 0.06%
* Status Codes: 200 OK
* Observations: The system handled the load efficiently with a very low error rate and consistent throughput. All API requests returned a successful response (200 OK).
* **500 Users**
* Throughput: 10.5 requests/second
* Error Rate: 0.8874%
* Status Codes: 401 UNAUTHORIZED
* Observations: As the load increased to 500 users, the throughput slightly improved, but the error rate also rose. The system began to return unauthorized access errors, indicating a potential issue with the authentication process under heavier loads.
* **700 Users**
* Throughput: 45.6 requests/second
* Error Rate: 0.9257%
* Status Codes: 401 UNAUTHORIZED
* Observations: At 700 users, the system's throughput saw a significant increase, but this was accompanied by a higher error rate. The continued presence of 401 UNAUTHORIZED errors suggests that the system's authentication mechanisms may be struggling to cope with the increased load.
* **1000 Users**
* Throughput: 67.3 requests/second
* Error Rate: 0.9478%
* Status Codes: 401 UNAUTHORIZED
* Observations: At 1000 users, the system's throughput increased significantly to 67.3 requests/second. However, the error rate also rose to 0.9478%, with a high occurrence of 401 UNAUTHORIZED errors. This indicates that while the system can handle a large number of requests, there are issues with maintaining correct authentication under this load.
* **1500 Users**
* Throughput: 95.6 requests/second
* Error Rate: 1.0875%
* Status Codes: 401 UNAUTHORIZED
* Observations: As the load increased to 1500 users, throughput continued to improve, reaching 95.6 requests/second. However, the error rate further increased to 1.0875%, with persistent 401 UNAUTHORIZED errors. The system is showing signs of strain, particularly in managing user authentication efficiently under heavy load.
* **1900 Users**
* Throughput: 123.9 requests/second
* Error Rate: 1.1543%
* Status Codes: 401 UNAUTHORIZED
* Observations: At 1900 users, the system achieved a throughput of 123.9 requests/second, but the error rate also climbed to 1.1543%. The continued presence of 401 UNAUTHORIZED errors suggests a critical bottleneck in the authentication process, indicating that the system is struggling to handle the user load at this level.

**Scenario: Keeron All Courses Page**

* **100 Users**
  + **Throughput:** 10.7 requests/second
  + **Error Rate:** 0.0589%
  + **Status Codes:** 200 OK
  + **Observations:** The system handled the load efficiently with minimal errors, maintaining steady throughput. All API requests returned successful responses.
* **500 Users**
  + **Throughput:** 55.4 requests/second
  + **Error Rate:** 0.9475%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 500 users, throughput improved, but the error rate increased, with unauthorized access errors indicating potential issues in handling higher loads.
* **700 Users**
  + **Throughput:** 82.9 requests/second
  + **Error Rate:** 1.0153%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** Under 700 users, the system showed further improvement in throughput, but the error rate remained high, with continued 401 errors.
* **1000 Users**
  + **Throughput:** 102.5 requests/second
  + **Error Rate:** 1.0756%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 1000 users, the system continued to handle more requests but struggled with maintaining a low error rate, particularly with authentication errors.
* **1500 Users**
  + **Throughput:** 142.8 requests/second
  + **Error Rate:** 1.1598%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1500 users, the throughput increased significantly, but the system's error rate also rose, indicating that it's reaching its performance limits.
* **1900 Users**
  + **Throughput:** 178.3 requests/second
  + **Error Rate:** 1.2375%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** The system showed a strong throughput but a high error rate, suggesting that further optimization is needed to handle such high loads effectively.

**Scenario: Keeron Article Page**

* **100 Users**
  + **Throughput:** 15.2 requests/second
  + **Error Rate:** 0.0456%
  + **Status Codes:** 200 OK
  + **Observations:** The article page handled 100 users without significant issues, maintaining excellent performance with negligible errors.
* **500 Users**
  + **Throughput:** 48.9 requests/second
  + **Error Rate:** 0.8545%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 500 users, there was a slight increase in throughput, but the error rate increased due to unauthorized access issues.
* **700 Users**
  + **Throughput:** 67.3 requests/second
  + **Error Rate:** 0.9478%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** The system handled 700 users with increased throughput, but with a noticeable rise in the error rate and 401 errors continued.
* **1000 Users**
  + **Throughput:** 83.2 requests/second
  + **Error Rate:** 1.0224%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 1000 users, the system's performance began to strain, as indicated by the higher error rate, particularly in authentication.
* **1500 Users**
  + **Throughput:** 112.7 requests/second
  + **Error Rate:** 1.0934%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** The system's throughput improved with 1500 users, but the error rate also increased, indicating potential bottlenecks in handling this load.
* **1900 Users**
  + **Throughput:** 139.8 requests/second
  + **Error Rate:** 1.1687%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1900 users, the system maintained high throughput, but with a further increase in the error rate, highlighting the need for further optimization.

**Scenario: Keeron Blogs Page**

* **100 Users**
  + **Throughput:** 12.5 requests/second
  + **Error Rate:** 0.0678%
  + **Status Codes:** 200 OK
  + **Observations:** The blogs page performed well with 100 users, showing low error rates and consistent throughput.
* **500 Users**
  + **Throughput:** 40.3 requests/second
  + **Error Rate:** 0.7924%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** The system managed 500 users with a moderate increase in throughput but faced authentication issues, as reflected in the error rate.
* **700 Users**
  + **Throughput:** 61.5 requests/second
  + **Error Rate:** 0.9115%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** The throughput increased with 700 users, but the system continued to struggle with a rising error rate, particularly unauthorized access errors.
* **1000 Users**
  + **Throughput:** 74.9 requests/second
  + **Error Rate:** 1.0295%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1000 users, the system's performance began to decline, with higher error rates, indicating challenges in handling the increased load.
* **1500 Users**
  + **Throughput:** 98.2 requests/second
  + **Error Rate:** 1.1027%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** The error rate increased further with 1500 users, despite the improved throughput, showing the system's struggle to maintain stability under heavy load.
* **1900 Users**
  + **Throughput:** 121.3 requests/second
  + **Error Rate:** 1.1923%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1900 users, while the throughput remained high, the error rate continued to increase, highlighting significant performance challenges under extreme loads.

**Scenario: Keeron Events Page**

* **100 Users**
  + **Throughput:** 11.4 requests/second
  + **Error Rate:** 0.0489%
  + **Status Codes:** 200 OK
  + **Observations:** The events page handled 100 users effectively, maintaining low error rates and stable performance.
* **500 Users**
  + **Throughput:** 38.6 requests/second
  + **Error Rate:** 0.8074%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 500 users, the throughput increased, but the error rate also rose, with unauthorized access errors being the primary issue.
* **700 Users**
  + **Throughput:** 56.4 requests/second
  + **Error Rate:** 0.9234%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** The system showed a further increase in throughput with 700 users but continued to experience high error rates, particularly with authentication.
* **1000 Users**
  + **Throughput:** 69.3 requests/second
  + **Error Rate:** 1.0345%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1000 users, the error rate increased significantly, despite the higher throughput, indicating issues in managing the load effectively.
* **1500 Users**
  + **Throughput:** 93.4 requests/second
  + **Error Rate:** 1.1167%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** The error rate continued to rise with 1500 users, suggesting that the system is struggling to handle the increased load.
* **1900 Users**
  + **Throughput:** 116.5 requests/second
  + **Error Rate:** 1.2043%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1900 users, the system maintained high throughput but continued to experience high error rates, indicating a need for optimization.

**Scenario: Keeron Live Courses Page**

* **100 Users**
  + **Throughput:** 10.9 requests/second
  + **Error Rate:** 0.0543%
  + **Status Codes:** 200 OK
  + **Observations:** The Live Courses page effectively managed 100 users with a throughput of 10.9 requests/second. The error rate was minimal, and all requests returned successful 200 OK responses, indicating smooth operation under this load.
* **500 Users**
  + **Throughput:** 42.7 requests/second
  + **Error Rate:** 0.8378%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** When the load increased to 500 users, the throughput improved to 42.7 requests/second. However, the error rate rose to 0.8378%, with a noticeable occurrence of 401 UNAUTHORIZED errors. This suggests that while the system can handle more users, the authentication process might need optimization to reduce errors.
* **700 Users**
  + **Throughput:** 63.4 requests/second
  + **Error Rate:** 0.9256%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 700 users, the throughput increased further to 63.4 requests/second. However, the error rate also rose to 0.9256%, with a continued prevalence of 401 UNAUTHORIZED errors. The system appears to be reaching its threshold, particularly in terms of authentication handling.
* **1000 Users**
  + **Throughput:** 87.9 requests/second
  + **Error Rate:** 1.0034%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** Under the load of 1000 users, the throughput increased to 87.9 requests/second, but the error rate exceeded 1%, indicating significant strain. The persistent 401 UNAUTHORIZED errors suggest a bottleneck in the authentication system that requires immediate attention.
* **1500 Users**
  + **Throughput:** 112.6 requests/second
  + **Error Rate:** 1.1197%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 1500 users, the system's throughput reached 112.6 requests/second, but the error rate continued to rise to 1.1197%. The high rate of 401 errors indicates that the system is struggling to manage this level of user load, particularly in maintaining secure access.
* **1900 Users**
  + **Throughput:** 135.2 requests/second
  + **Error Rate:** 1.2153%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1900 users, throughput increased to 135.2 requests/second, but the error rate rose to 1.2153%. The continued high occurrence of 401 errors highlights the need for urgent improvements in the system’s capacity to handle high-volume authentication requests.

**Scenario: Keeron Study Resources Page**

* **100 Users**
  + **Throughput:** 11.3 requests/second
  + **Error Rate:** 0.0498%
  + **Status Codes:** 200 OK
  + **Observations:** The Study Resources page efficiently managed 100 users with a throughput of 11.3 requests/second and a very low error rate. All requests were successful, indicating strong performance under this load.
* **500 Users**
  + **Throughput:** 40.9 requests/second
  + **Error Rate:** 0.8457%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 500 users, throughput increased to 40.9 requests/second, but the error rate rose to 0.8457%, with frequent 401 UNAUTHORIZED errors. The increase in errors suggests a strain on the authentication process as the load grows.
* **700 Users**
  + **Throughput:** 59.7 requests/second
  + **Error Rate:** 0.9183%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 700 users, the system managed a throughput of 59.7 requests/second, but the error rate increased to 0.9183%. The continued 401 UNAUTHORIZED errors indicate that the system is nearing its capacity in terms of user authentication management.
* **1000 Users**
  + **Throughput:** 82.4 requests/second
  + **Error Rate:** 1.0297%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1000 users, the system's throughput was 82.4 requests/second, but the error rate exceeded 1%. The consistent 401 errors suggest that the system is struggling to manage user access effectively at this level of load.
* **1500 Users**
  + **Throughput:** 107.5 requests/second
  + **Error Rate:** 1.1078%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 1500 users, the throughput increased to 107.5 requests/second, but the error rate also rose to 1.1078%. The high error rate indicates that the system's ability to manage user load and secure access is compromised.
* **1900 Users**
  + **Throughput:** 130.4 requests/second
  + **Error Rate:** 1.2013%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1900 users, the system managed a throughput of 130.4 requests/second, but the error rate further increased to 1.2013%. The persistent high error rate suggests that the system is operating at or beyond its optimal capacity.

**Scenario: Keeron Course Overview**

* **100 Users**
  + **Throughput:** 12.1 requests/second
  + **Error Rate:** 0.0467%
  + **Status Codes:** 200 OK
  + **Observations:** The Course Overview page handled 100 users smoothly with a throughput of 12.1 requests/second. The error rate was minimal, and all requests returned successful responses, indicating efficient performance under this load.
* **500 Users**
  + **Throughput:** 44.3 requests/second
  + **Error Rate:** 0.8567%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 500 users, the system's throughput improved to 44.3 requests/second, but the error rate rose to 0.8567%. The frequent 401 UNAUTHORIZED errors suggest challenges in handling user authentication under this increased load.
* **700 Users**
  + **Throughput:** 64.1 requests/second
  + **Error Rate:** 0.9278%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 700 users, the throughput increased to 64.1 requests/second, but the error rate also rose to 0.9278%, indicating that the system is facing difficulties in maintaining secure access as the load increases.
* **1000 Users**
  + **Throughput:** 89.2 requests/second
  + **Error Rate:** 1.0347%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** Under the load of 1000 users, the system's throughput increased to 89.2 requests/second, but the error rate exceeded 1%. The persistent 401 errors suggest a significant strain on the system's ability to manage user access at this load level.
* **1500 Users**
  + **Throughput:** 114.5 requests/second
  + **Error Rate:** 1.1098%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 1500 users, the throughput increased to 114.5 requests/second, but the error rate continued to rise to 1.1098%. The system is showing signs of strain, particularly in handling secure user access under heavy load.
* **1900 Users**
  + **Throughput:** 138.7 requests/second
  + **Error Rate:** 1.2097%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1900 users, the system managed a throughput of 138.7 requests/second, but the error rate further increased to 1.2097%. The persistent high error rate indicates that the system is operating at or near its limit, particularly in terms of user authentication and access management.

**Scenario: Keeron Test Packages Page**

* **100 Users**
  + **Throughput:** 11.5 requests/second
  + **Error Rate:** 0.0491%
  + **Status Codes:** 200 OK
  + **Observations:** The Test Packages Page handled the load of 100 users efficiently, maintaining a steady throughput of 11.5 requests/second. The error rate was negligible, and all responses were successful (200 OK), indicating robust performance at this level.
* **500 Users**
  + **Throughput:** 41.7 requests/second
  + **Error Rate:** 0.8295%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** As the load increased to 500 users, the throughput improved to 41.7 requests/second. However, the error rate also increased to 0.8295%, with unauthorized access errors (401) being the primary issue. This indicates potential bottlenecks in the authentication process under moderate load.
* **700 Users**
  + **Throughput:** 62.8 requests/second
  + **Error Rate:** 0.9218%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 700 users, the throughput increased to 62.8 requests/second, but the error rate rose to 0.9218%, with continued 401 errors. The system shows signs of strain as it attempts to handle the increased user load, particularly in managing secure access.
* **1000 Users**
  + **Throughput:** 86.7 requests/second
  + **Error Rate:** 1.0349%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 1000 users, the throughput further improved to 86.7 requests/second, but the error rate exceeded 1%, indicating significant challenges in handling authentication under heavy load. The consistent occurrence of 401 errors suggests that the system is nearing its capacity for secure user management.
* **1500 Users**
  + **Throughput:** 110.3 requests/second
  + **Error Rate:** 1.1182%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1500 users, the throughput reached 110.3 requests/second, but the error rate continued to increase to 1.1182%. The system is clearly struggling to manage user load effectively, particularly in terms of secure access.
* **1900 Users**
  + **Throughput:** 133.6 requests/second
  + **Error Rate:** 1.2094%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** Under the load of 1900 users, the throughput reached 133.6 requests/second, but the error rate further increased to 1.2094%. The persistent 401 errors highlight the need for improvements in the system's capacity to handle high user loads while maintaining secure access.

**Scenario: Keeron Live Course Overview**

* **100 Users**
  + **Throughput:** 12.4 requests/second
  + **Error Rate:** 0.0487%
  + **Status Codes:** 200 OK
  + **Observations:** The Live Course Overview page managed 100 users with ease, maintaining a throughput of 12.4 requests/second and a very low error rate. All responses were successful (200 OK), indicating strong performance at this load level.
* **500 Users**
  + **Throughput:** 45.6 requests/second
  + **Error Rate:** 0.8541%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 500 users, the throughput increased to 45.6 requests/second, but the error rate also rose to 0.8541%, with 401 UNAUTHORIZED errors being the primary issue. This suggests challenges in handling user authentication under a moderate load.
* **700 Users**
  + **Throughput:** 65.8 requests/second
  + **Error Rate:** 0.9362%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 700 users, the throughput improved to 65.8 requests/second, but the error rate increased to 0.9362%. The system appears to be facing challenges in maintaining secure access as the load increases, with a continued occurrence of 401 errors.
* **1000 Users**
  + **Throughput:** 88.7 requests/second
  + **Error Rate:** 1.0451%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1000 users, the system's throughput reached 88.7 requests/second, but the error rate exceeded 1%. The persistent 401 errors indicate that the system is struggling to handle the load effectively, particularly in terms of user authentication.
* **1500 Users**
  + **Throughput:** 114.1 requests/second
  + **Error Rate:** 1.1218%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** The system's throughput increased to 114.1 requests/second at 1500 users, but the error rate also rose to 1.1218%. The high error rate suggests that the system is under significant strain, particularly in managing secure user access under heavy load.
* **1900 Users**
  + **Throughput:** 139.3 requests/second
  + **Error Rate:** 1.2135%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** Under the load of 1900 users, the throughput reached 139.3 requests/second, but the error rate further increased to 1.2135%. The consistent 401 errors highlight the need for optimization in the system's authentication process to better manage high user loads.

**Scenario: Keeron Test Packages Overview**

* **100 Users**
  + **Throughput:** 11.8 requests/second
  + **Error Rate:** 0.0454%
  + **Status Codes:** 200 OK
  + **Observations:** The Test Packages Overview page managed 100 users efficiently, with a throughput of 11.8 requests/second and a very low error rate. All responses were successful (200 OK), indicating that the system is performing well at this load level.
* **500 Users**
  + **Throughput:** 43.2 requests/second
  + **Error Rate:** 0.8694%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 500 users, the throughput increased to 43.2 requests/second, but the error rate rose to 0.8694%. The increase in 401 UNAUTHORIZED errors suggests challenges in handling user authentication under a moderate load.
* **700 Users**
  + **Throughput:** 66.1 requests/second
  + **Error Rate:** 0.9497%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 700 users, the throughput improved to 66.1 requests/second, but the error rate also rose to 0.9497%. The system is starting to show signs of strain, particularly in managing secure access as the user load increases.
* **1000 Users**
  + **Throughput:** 90.4 requests/second
  + **Error Rate:** 1.0643%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1000 users, the system's throughput reached 90.4 requests/second, but the error rate exceeded 1%, indicating challenges in handling the increased load. The persistent 401 errors highlight the need for improvements in the authentication process.
* **1500 Users**
  + **Throughput:** 115.8 requests/second
  + **Error Rate:** 1.1432%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 1500 users, the throughput reached 115.8 requests/second, but the error rate continued to rise to 1.1432%. The system is showing signs of significant strain, particularly in managing secure user access under heavy load.
* **1900 Users**
  + **Throughput:** 141.7 requests/second
  + **Error Rate:** 1.2289%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** Under the load of 1900 users, the throughput reached 141.7 requests/second, but the error rate further increased to 1.2289%. The consistent 401 errors highlight the need for urgent optimization to improve the system's capacity to handle high user loads while maintaining secure access.

**Scenario: Keeron Study Resources Overview**

* **100 Users**
  + **Throughput:** 12.6 requests/second
  + **Error Rate:** 0.0463%
  + **Status Codes:** 200 OK
  + **Observations:** At 100 users, the Study Resources Overview page performed efficiently with a throughput of 12.6 requests/second. The error rate was very low, and all requests were successful, indicating strong system performance at this user load.
* **500 Users**
  + **Throughput:** 46.8 requests/second
  + **Error Rate:** 0.8752%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 500 users, the throughput increased significantly to 46.8 requests/second. However, the error rate also rose to 0.8752%, with a noticeable number of 401 UNAUTHORIZED errors. This suggests the system is starting to experience strain, particularly in handling user authentication under moderate load.
* **700 Users**
  + **Throughput:** 68.4 requests/second
  + **Error Rate:** 0.9534%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 700 users, the system managed a throughput of 68.4 requests/second, but the error rate rose to 0.9534%. The continued occurrence of 401 errors indicates that the system is reaching its threshold in managing secure access as the user load increases.
* **1000 Users**
  + **Throughput:** 92.5 requests/second
  + **Error Rate:** 1.0756%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 1000 users, the throughput reached 92.5 requests/second, but the error rate exceeded 1%, indicating significant strain. The high rate of 401 errors suggests the system is struggling to manage user authentication effectively at this load level.
* **1500 Users**
  + **Throughput:** 117.9 requests/second
  + **Error Rate:** 1.1529%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1500 users, the system’s throughput increased to 117.9 requests/second, but the error rate also rose to 1.1529%. The system is clearly under stress, particularly in managing secure access, which could affect overall user experience.
* **1900 Users**
  + **Throughput:** 144.2 requests/second
  + **Error Rate:** 1.2384%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At the highest load of 1900 users, the system achieved a throughput of 144.2 requests/second, but the error rate further increased to 1.2384%. The persistent 401 errors suggest that the system is operating beyond its optimal capacity, especially in managing authentication requests, and may require optimization to handle such high user loads effectively.

**Scenario: Keeron Events Overview**

* **100 Users**
  + **Throughput:** 12.8 requests/second
  + **Error Rate:** 0.0471%
  + **Status Codes:** 200 OK
  + **Observations:** The Events Overview page handled the load of 100 users effectively, maintaining a throughput of 12.8 requests/second with a very low error rate. All responses were successful, indicating strong system performance at this user level.
* **500 Users**
  + **Throughput:** 48.1 requests/second
  + **Error Rate:** 0.8691%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** As the user load increased to 500, the throughput improved to 48.1 requests/second. However, the error rate also increased to 0.8691%, with a significant number of 401 UNAUTHORIZED errors. This suggests the system is beginning to experience stress, particularly in managing secure user access.
* **700 Users**
  + **Throughput:** 69.7 requests/second
  + **Error Rate:** 0.9478%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 700 users, the throughput increased to 69.7 requests/second, but the error rate rose to 0.9478%. 401 errors indicate the system is approaching its capacity in handling secure access as the load increases.
* **1000 Users**
  + **Throughput:** 94.3 requests/second
  + **Error Rate:** 1.0863%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** With 1000 users, the throughput reached 94.3 requests/second, but the error rate exceeded 1%. The system is showing signs of strain, particularly in managing user authentication, with a high occurrence of 401 errors under this load.
* **1500 Users**
  + **Throughput:** 120.6 requests/second
  + **Error Rate:** 1.1691%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At 1500 users, the throughput increased to 120.6 requests/second, but the error rate also rose to 1.1691%. The system is clearly under significant strain, particularly in handling secure user access, which could impact overall performance and user experience.
* **1900 Users**
  + **Throughput:** 146.3 requests/second
  + **Error Rate:** 1.2537%
  + **Status Codes:** 401 UNAUTHORIZED
  + **Observations:** At the highest load of 1900 users, the system achieved a throughput of 146.3 requests/second, but the error rate further increased to 1.2537%. The persistent 401 errors suggest that the system is operating beyond its optimal capacity, especially in managing authentication requests, and may require immediate optimization to handle such high user loads effectively.

# ANALYSIS

1. **Bottlenecks Identified**

* **Authentication Issues**: Across all scenarios and pages, the system consistently struggled with authentication under increased loads. This is evidenced by the frequent occurrence of 401 UNAUTHORIZED errors, which appeared as early as 500 users and escalated as the load increased. The authentication mechanism seems to be the primary bottleneck, limiting the system's ability to handle higher user volumes effectively.
* **Error Rate Increases**: As the number of users increased, there was a noticeable rise in the error rate across all scenarios. This trend suggests that while the system's throughput improved with more users, it came at the cost of reliability and stability. The error rates reached over 1% at the highest loads (1500-1900 users), indicating that the system is operating beyond its optimal capacity.
* **Throughput vs. Error Rate Trade-off**: There is a clear trade-off between throughput and error rates. While the system can handle a significant number of requests per second as user load increases, this is coupled with a rise in errors, particularly unauthorized access errors. This indicates that while the backend can process requests quickly, it is not effectively managing user authentication and access control under heavy load.

**2. System Behavior Under Load**

* **Initial Performance (100 Users)**: At 100 users, the system performed exceptionally well across all scenarios, with low error rates (ranging from 0.0456% to 0.0678%) and stable throughput. All API requests returned successful responses (200 OK), indicating that the system is well-tuned for light loads.
* **Moderate Load (500-700 Users)**: As the user load increased to 500 users, the throughput improved across all pages (ranging from 40.3 to 63.4 requests/second). However, the error rate also began to rise significantly, with 401 UNAUTHORIZED and 502 OR 504 BAD GATEWAY errors becoming prevalent. This suggests that the system's ability to manage user authentication starts to degrade at this level.
* **High Load (1000 Users)**: At 1000 users, the system showed further improvements in throughput, with some scenarios reaching up to 89.2 requests/second. However, the error rate consistently exceeded 1%, indicating that the system is under significant strain. The persistent 401 UNAUTHORIZED errors point to serious challenges in maintaining secure user access under this load.
* **Maximum Load (1500-1900 Users)**: At the highest loads tested (1500-1900 users), the system achieved its peak throughput (up to 178.3 requests/second). However, this came with a significant increase in the error rate, which reached up to 1.2375%. The continued occurrence of 401 UNAUTHORIZED and 502 OR 504 BAD GATEWAY errors suggests that the system is struggling to manage user authentication and access control at these levels, indicating a critical need for optimization.

# RECOMMENDATION

* **Optimize Authentication Mechanisms:** Given that authentication errors were the most common issue, focusing on improving the efficiency and scalability of the authentication process is crucial. This could involve optimizing database queries related to authentication, implementing caching strategies, or introducing more robust load balancing for authentication services.
* **Enhance Error Handling**: To improve the system's stability under load, better error handling and retry mechanisms could be implemented. This would help mitigate the impact of temporary issues, reducing the overall error rate.
* **Load Balancing and Scaling**: Consider implementing advanced load balancing techniques and auto-scaling for both the web server and authentication services. This would help distribute the load more evenly and prevent the bottlenecks that are currently occurring under heavy user traffic.
* **Stress Testing and Capacity Planning**: Further stress testing should be conducted, focusing on the authentication services, to identify the exact load point at which the system begins to fail. This information can be used for more accurate capacity planning and to ensure the system can handle expected peak loads without significant performance degradation.

# CONCLUSION

The performance analysis of the Keeron system under varying loads has revealed critical bottlenecks, particularly in its authentication processes. As the user load increased, the system demonstrated a trade-off between higher throughput and increased error rates, with significant issues arising at 1000 users and beyond. The persistent 401 UNAUTHORIZED errors highlight the need for urgent optimization of the authentication mechanisms. To ensure scalability and reliability, it is recommended to enhance error handling, optimize load balancing, and conduct further stress testing focused on the authentication services.