MAVERIC
Transforming Assurance

Automatic Account Opening
Performance Test Closure Report

Version 1.0

بنك مسقط
BankMuscat

Maveric Systems

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Revision History

Author	Date	Version	Comments
Vimal Raj	18-Jan-21	0.1	Baseline version
Vimal Raj	20-Jun-22	0.2	Updated Management Summary and Branch Testing results
Vimal Raj	23-Jun-22	1.0	Updated Defect Tracker

Approved By

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1. Background

Bank Muscat (hereafter referred as BM) has intended to develop a new age centralized solution for Account Opening that would reduce the overall operational processes of Branches. In this process, Bank Muscat has planned for Performance testing of the Automatic Account Opening Application. In line to the requirements & expectations of BM IT Management, Maveric has extended their Non-functional testing (Performance testing) service to simulate the test scenarios and measure the key performance indicators for various load conditions.

1. Performance Test Objective

The objective and scope of the performance testing are provided below

Objective	Completion Status
To Measure the End to End response time while handling 150 concurrent user load	
To measure the performance of the Automatic Account Opening application while handling 50% user load for a prolonged duration of 6 hours	
To measure the performance of the Automatic Account Opening application under stress condition and to determine the breakpoint of the application in UAT environment	
To measure the performance of the Automatic Account Opening application when accessed by the users from branch in UAT environment	
To monitor the server metrics not limited to CPU, Memory, Disk I/O & Network during execution and ensure the resources utilization are under threshold limits of 75%.	

2. Management Summary

- Automatic Account Opening application were performance tested post deploying the on demand loading for the derived peak concurrent user load of 150 users and peak hour volume of 1200 transactions were able to handle 100% of 2026 concurrent user load with all 100% of the transactions response time under SLA and achieved 88 % of expected volume (Achieved: 1058 transactions | Expected: 1200 transactions)
- Endurance test were performed for a duration of 6 hours with 98.4% transactions had response time below SLA and achieved 90% of expected volume were achieved. No memory related issues were observed for the period of the run (Achieved: 3154 transactions | Expected: 3488 transactions)
- Observed the breakpoint of the application during the ramp-up stage on increasing the concurrent users from 178 and above by keeping the ramp up time as 1 user in 1 second. However, the application was able to handle 2.89 times the peak volume of 2026 volume in one hour with a maximum user concurrency of 178 users in the application which consumed 100% of CPU in Application server 2 and a peak of 93 % of CPU in Application server 1 during the run

- Application were able to handle the 100% of expected branch volume from both 1 Mbps and 2 Mbps branch, however only 33% and 75% of transactions had response time below SLA for 1 Mbps and 2 Mbps respectively (Achieved: 10 transactions | Expected: 10)
- Newgen confirmed no further optimisation were possible in the application to fix the high response time issues raised in branch network and BM Management agreed to go live in pilot branch with the existing configuration and requested Newgen to monitor the application Performance during the period
- Resource utilization were observed under acceptable threshold (<60%) in terms of CPU & memory for both Load and Endurance execution
- Load Balancer and Application server compression was enabled for *.css, *.js, .png, .jpg, .jpeg, *.txt, *.xml, *.html, *.xhtml files to reduce the data transfer over the network and Least Connection First and Affinity Param algorithm was enabled in LB, which reduced the data size drastically and improved the response times as well
- During Branch PT execution on demand loading was implemented in the application to reduce the data getting populated in “Click New” and “Open Workitem” user actions
- Query indexing and optimization were provided by the application team to reduce the DB response times which in turn reduced the front end response times for submit transactions

3. Performance Test Scope

3.1. Transaction in Scope

The below mentioned are the transactions finalized for the performance testing of Automatic Account Opening application,

- Account Opening for an Excising Customer
- Account Opening for a New Customer
- Editing the Excising Account Opening Request

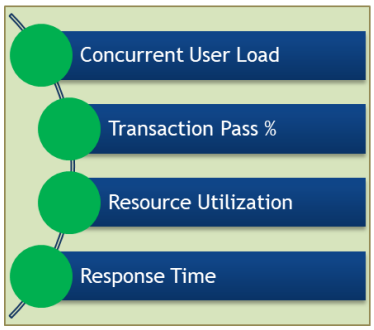
3.2. Out of Scope

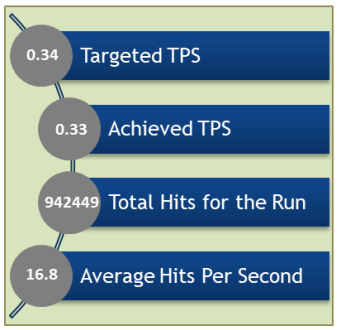
- Transactions apart from the agreed profile/modules in iBPS were not performance tested
- Performance execution will not cover any testing types other than agreed scope (Load /Volume & Breakpoint, Endurance and Branch). Also, any metrics related to UI of Automatic Account Opening application
- Any form of functional testing including field level validations, systems testing & integration testing are not in scope
- Client-side encryption, NID Validation using thumb impression, Email / SMS alerts, OTP, and any other security level challenges were not simulated as part of performance testing
- Signature capture and Debit card assignation were not in scope of performance testing
- Backend validation to check if Accounts and CIF are created in backed systems (T24) were not in scope of performance testing

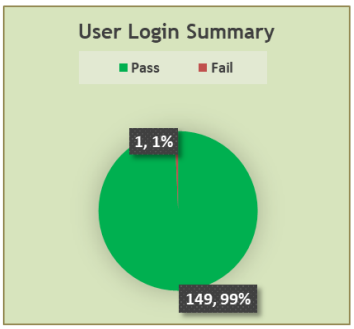
4. Performance Result Summary

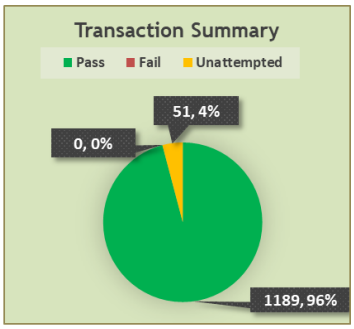
4.1. 100% Load Test

4.1.1. Key Performance Indicators:

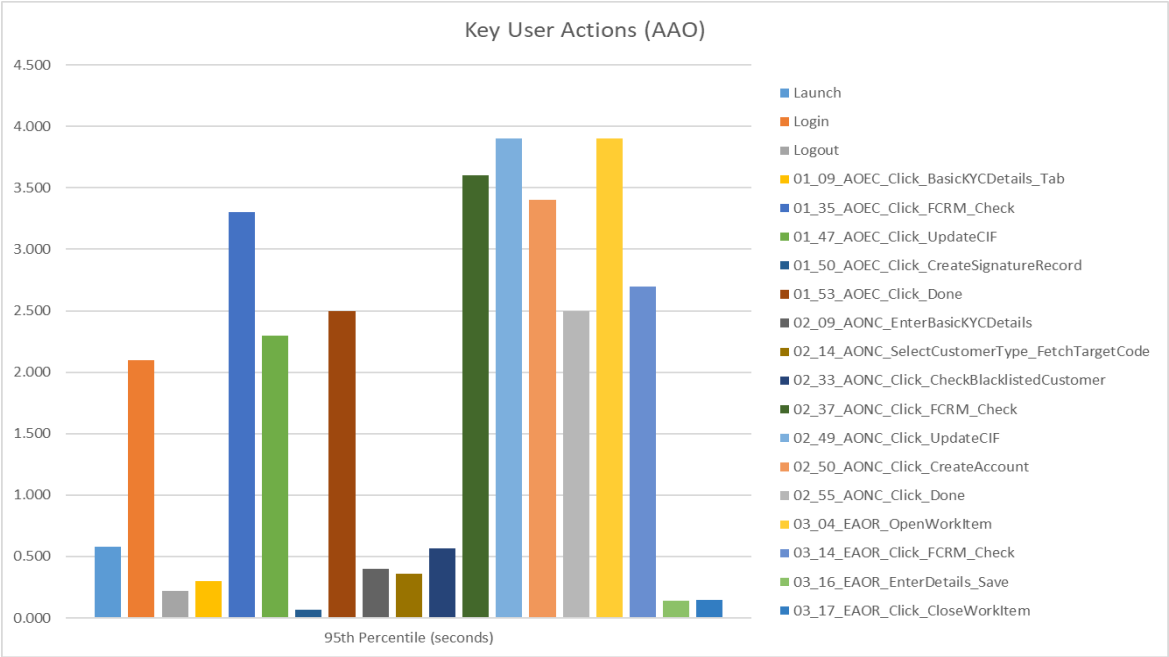








4.1.2. Response Time Analysis for Key User Actions:

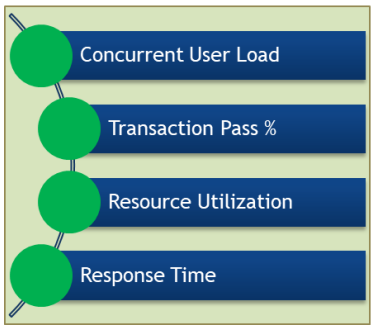


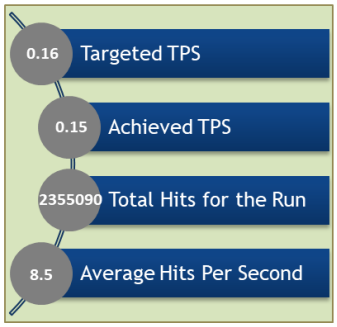
4.1.3. Resource Utilization:

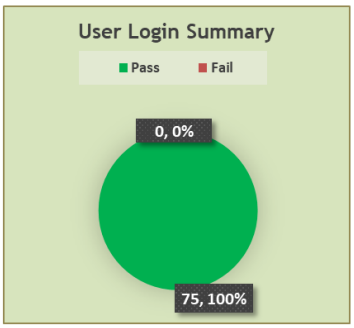
Category	CPU		Memory	
	Avg. CPU%	Max CPU%	Avg. Memory%	Max Memory %
Application Server 1	30	55	29	32
Application Server 2	31	68	23	30
Utility Server	7	13	44	27
Database Server Node 1	3	6	31	28
Database Server Node 2	18	29	79	29

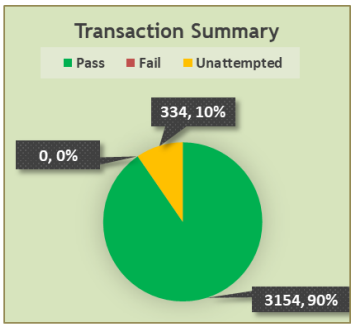
4.2. Endurance Test

4.2.1. Key Performance Indicators:

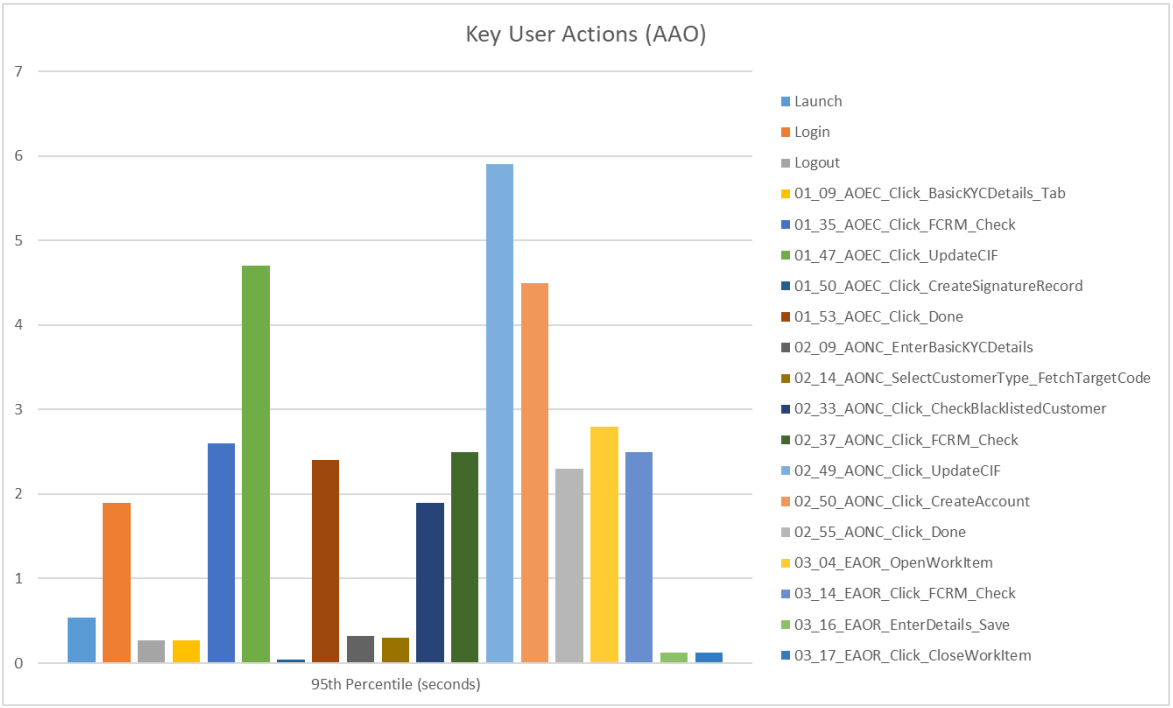








4.2.2. Response Time Analysis:

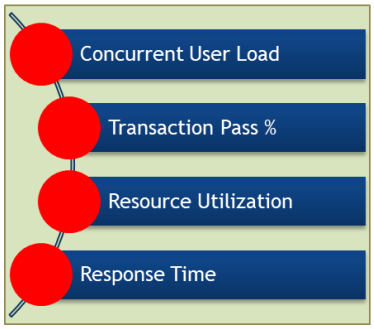


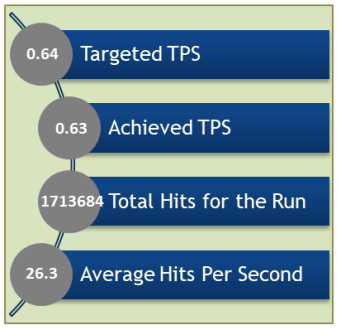
4.2.3. Resource Utilization:

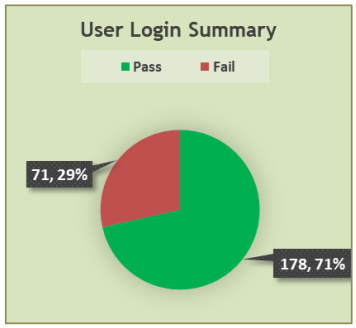
Category	CPU		Memory	
	Avg. CPU%	Max CPU%	Avg. Memory%	Max Memory %
Application Server 1	23	36	33	35
Application Server 2	33	64	28	30
Utility Server	6	30	26	27
Database Server Node 1	1	2	11	28
Database Server Node 2	15	24	58	29

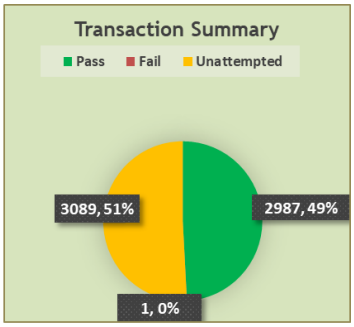
4.3. Breakpoint Test

4.3.1. Key Performance Indicators:

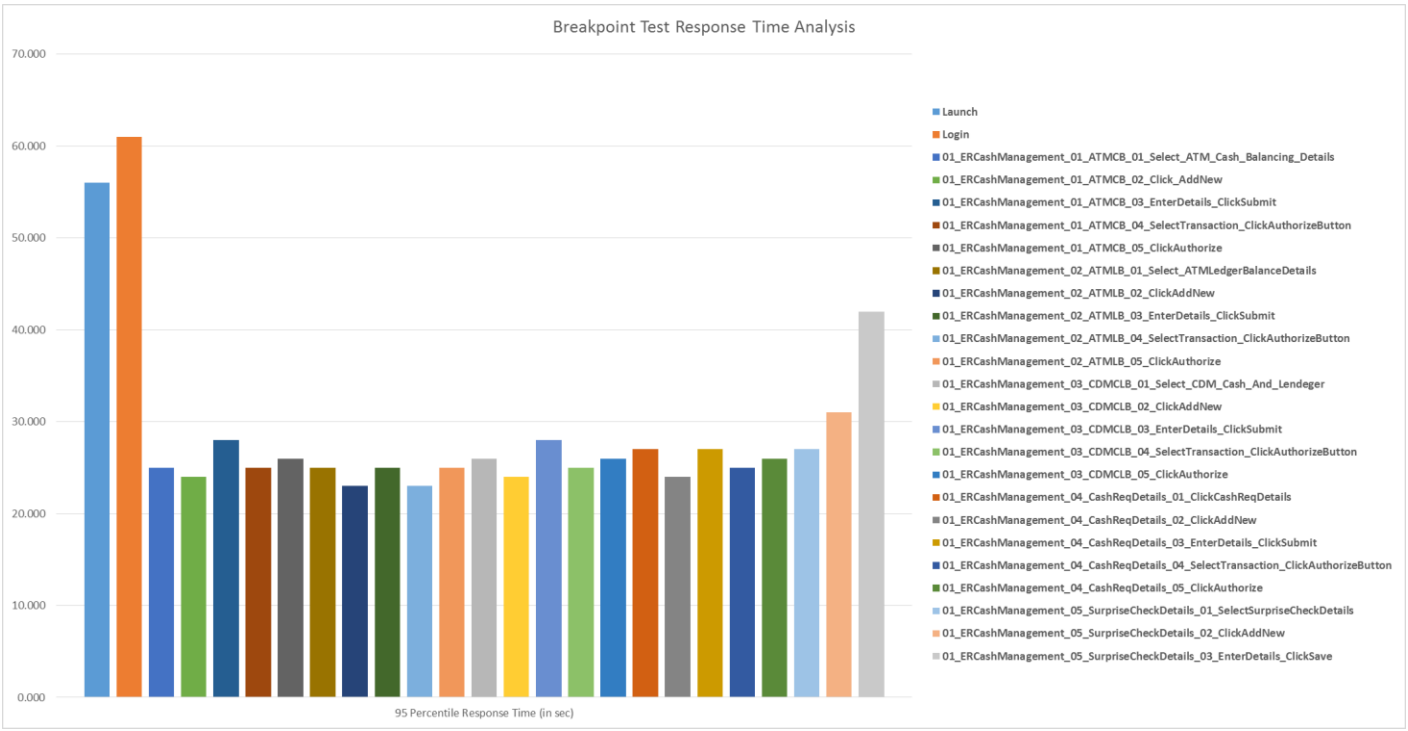








4.3.2. Response Time Analysis:

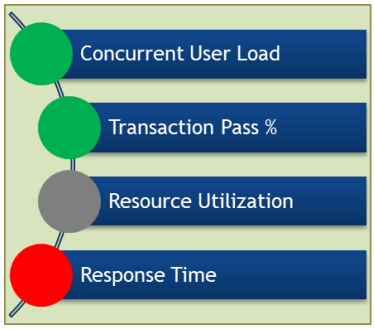


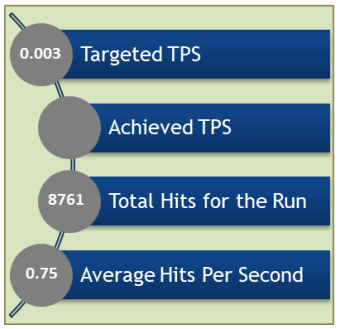
4.3.3. Resource Utilization:

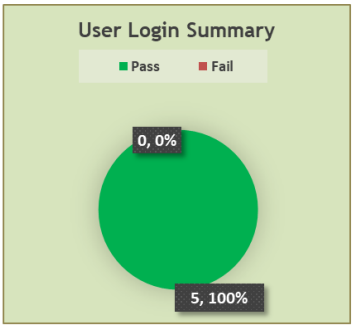
Category	CPU		Memory	
	Avg. CPU%	Max CPU%	Avg. Memory%	Max Memory %
Application Server 1	55	93	44	47
Application Server 2	66	100	36	30
Utility Server	7	9	43	27
Database Server Node 1	2	16	33	28
Database Server Node 2	22	29	80	29

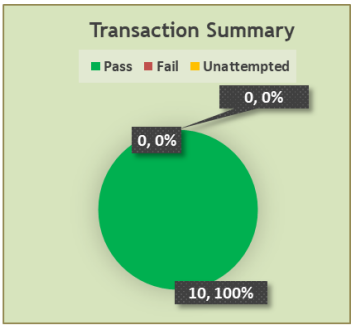
4.4. Branch Test

4.4.1. Key Performance Indicators for 1 Mbps Branch:

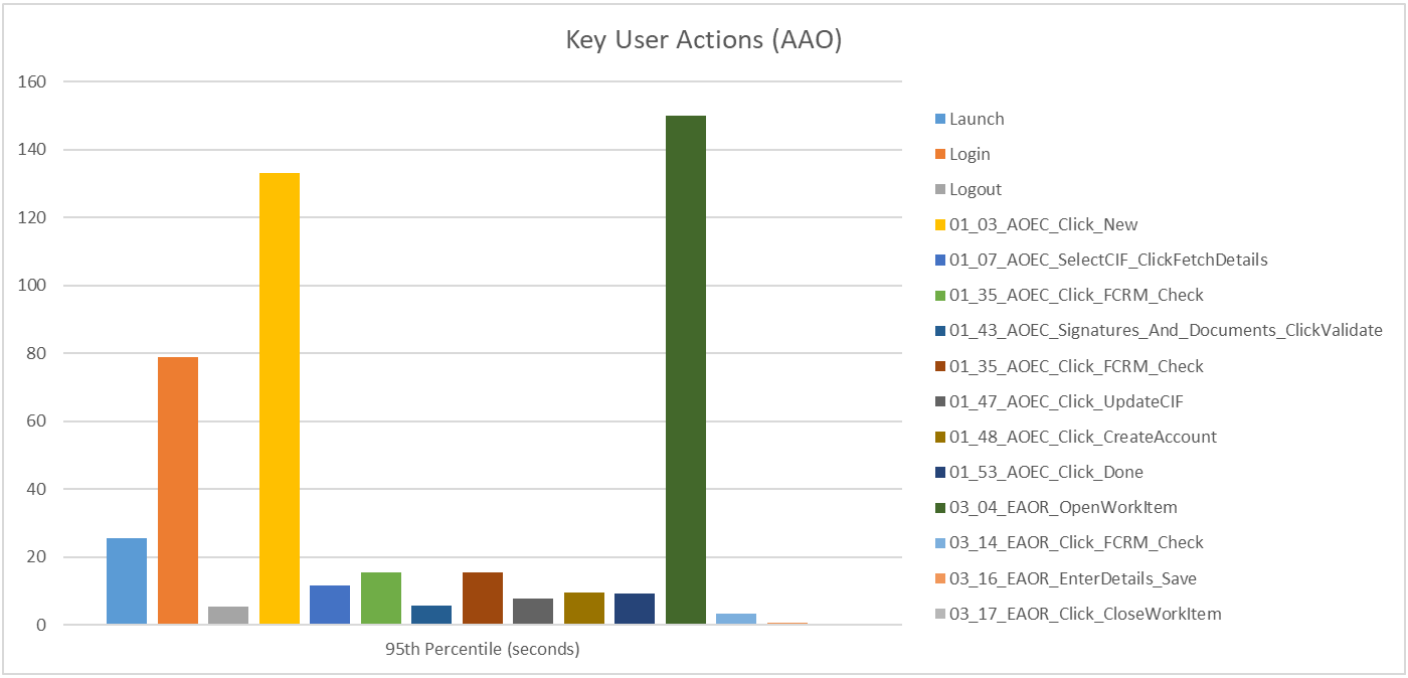








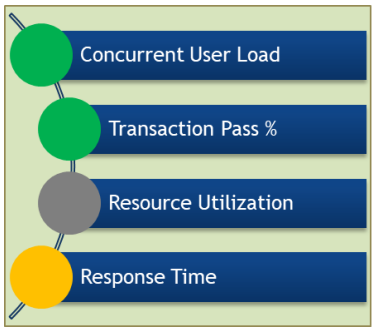
4.4.2. Response Time Analysis:

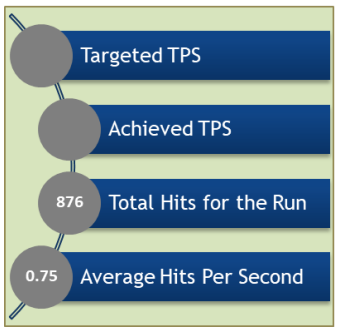


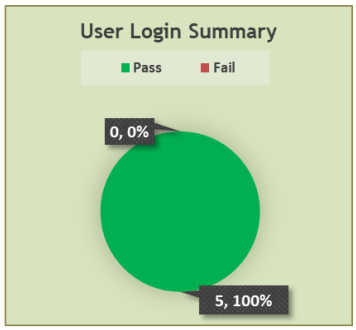
4.4.3. Network Utilization:

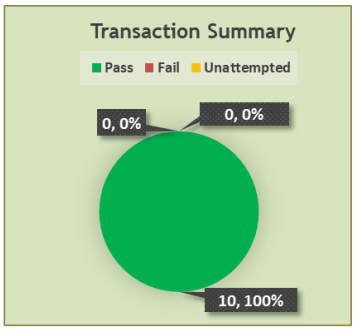
- During the execution observed a maximum of 0.3 Mbps and an average of 0.13 Mbps bandwidth utilization, however the branch maximum utilization was 0.7 Mbps
- Out of 71 MB of total data transferred 18 MB of data was transferred over network during the execution period

4.4.4. Key Performance Indicators for 2 Mbps Branch:

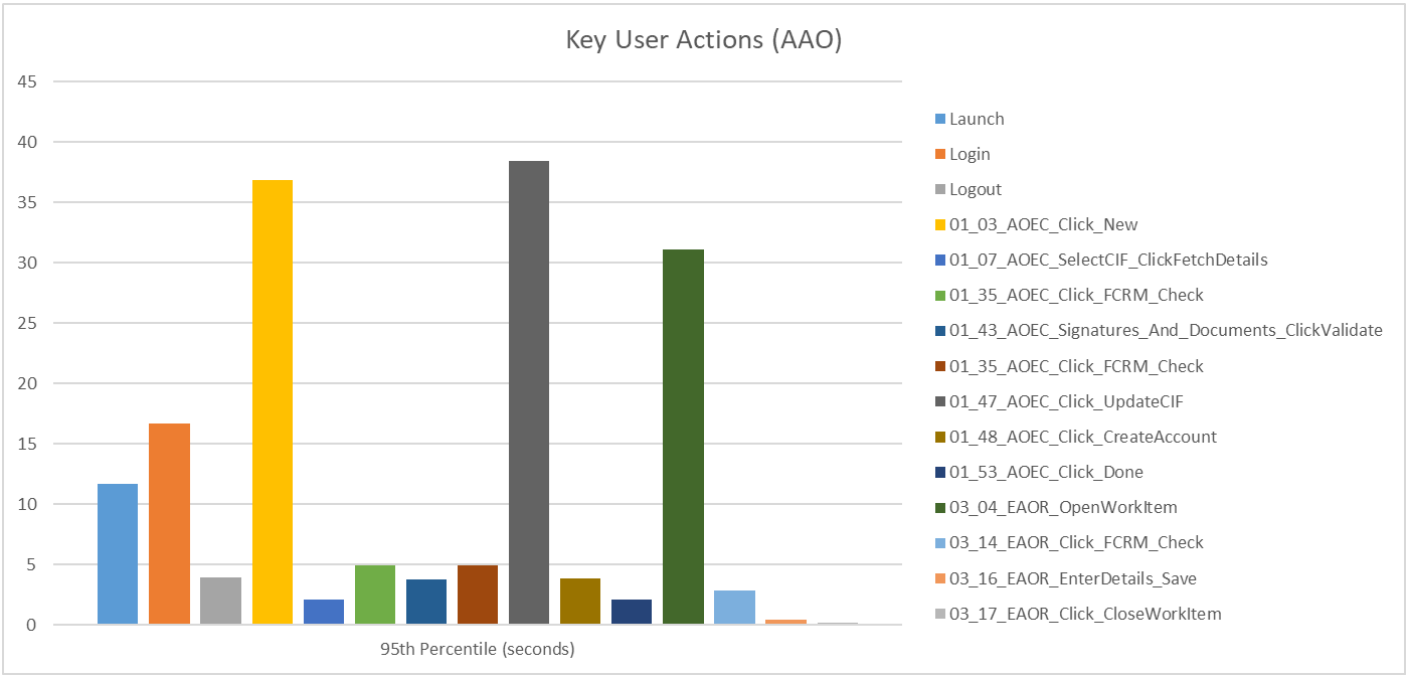




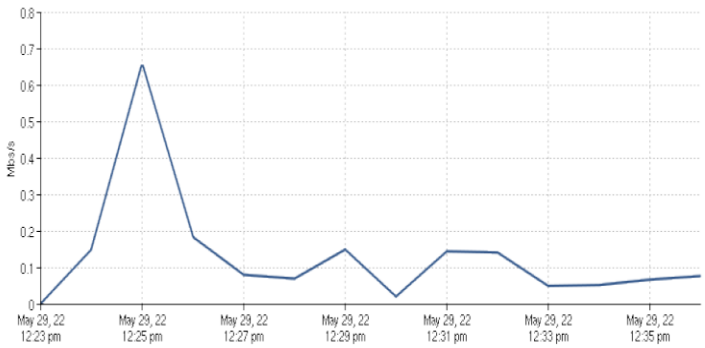




4.4.5. Response Time Analysis:



4.4.6. Network Utilization:



- During the execution observed a maximum of 0.7 Mbps and an average of 0.18 Mbps bandwidth utilization
- 14 MB of data was transferred over network during the execution period

5. Performance Test Execution

The below mentioned are the Performance test execution scenarios executed to measure the Electronic Replacement Cash Management application.

5.1. Performance Test Scenarios and Status

Test Round	Load Scenario	Actual Date	Response Time	Volume Achieved	RAG	Comments
Round 1 Cycle 1	50% Load Test	24-Nov-2021	99% < SLA	53%		▶ Out of 131 user action/pages, only 1 user action were not under agreed SLA (99.2% of under SLA of 5 sec) ▶ 309 successful E2E Transactions were achieved during the test run wherein the expected volume was 582 transactions (53% of Volume Achieved)
Round 1 Cycle 2	50% Load Test	05-Dec-2021	78.6% < SLA	92.6%		▶ Out of 131 user action/pages, 28 user action were not under agreed SLA (78.6% of under SLA of 5 sec) ▶ 392 successful E2E Transactions were achieved during the test run wherein the expected volume was 621 transactions (63% of Volume Achieved)

Round 1 Cycle 3	50% Load Test	20-Dec-2021	98.5% < SLA	95%		▶ Out of 131 user action/pages, 2 user action were not under agreed SLA (98.47% of under SLA of 5 sec) ▶ 587 successful E2E Transactions were achieved during the test run wherein the expected volume was 621 transactions (95% of Volume Achieved)
Round 2 Cycle 1	100% Load Test	21-Dec-2021	93.1%<SLA	81%		▶ Out of 131 user action/pages, 9 user action were not under agreed SLA (93.12% of under SLA of 5 sec) ▶ 1010 successful E2E Transactions were achieved during the test run wherein the expected volume was 1240 transactions (81% of Volume Achieved)
Round 2 Cycle 2	100% Load Test	23-Dec-2021	96.9%<SLA	96%		▶ Out of 131 user action/pages, 4 user action were not under agreed SLA (96.94% of under SLA of 5 sec) ▶ 1189 successful E2E Transactions were achieved during the test run wherein the expected volume was 1240 transactions (96% of Volume Achieved) ▶ Resources utilizations of both the application servers were not within the

						permissible limits during execution, Application 1 utilized an average of 75% of CPU and during the peak time the CPU utilization reached 100% of CPU and similarly during the ramp up period the application server 2 utilized 80% of CPU post which it reduced to an average of 40% CPU
Round 2 Cycle 3	100% Load Test	10-Jan-2022	77.8%<SLA	97%		▶ Out of 131 user action/pages, all user action were not under agreed SLA (100% of under SLA of 5 sec) ▶ 1189 successful E2E Transactions were achieved during the test run wherein the expected volume was 1240 transactions (96% of Volume Achieved)
Round 3 Cycle 1	Breakpoint Test	12-Jan-2022	20.6%<SLA	47%		▶ Out of 131 user action/pages, 104 user action were not under agreed SLA (20.6% of under SLA of 5 sec) ▶ 2989 successful E2E Transactions were achieved during the test run which is 2.8 times the 100% Load Test volume ▶ 2989 successful E2E Transactions were achieved during the test run

						which is 2.8 times the 100% Load Test volume
Round 4 Cycle 1	Endurance Test	18-Dec-2021	100%<SLA	29%		▶ Out of 131 user action/pages, all user action were not under agreed SLA (100% of under SLA of 5 sec) ▶ 1005 successful E2E Transactions were achieved during the test run wherein the expected volume was 3488 transactions (29% of Volume Achieved)
Round 4 Cycle 2	Endurance Test	28-Dec-2021	98.4%<SLA	90%		▶ Out of 131 user action/pages, 2 user action were not under agreed SLA (98.4% of under SLA of 5 sec) ▶ 3154 successful E2E Transactions were achieved during the test run wherein the expected volume was 3488 transactions (90% of Volume Achieved)
Round 2 Cycle 4 **(Post implementing on demand loading)**	100% Load Test	22-May-2022	83%<SLA	92%		▶ Out of 131 user action/pages, 13 user action were not under agreed SLA (83% of under SLA of 5 sec) ▶ 1142 successful E2E Transactions were achieved during the test run wherein the expected volume was 1240 transactions (92% of Volume Achieved)

Round 2 Cycle 5 **(Post removing redundant save servlet request)**	100% Load Test	28-May-2022	100%<SLA	88%		▶ Out of 70 user action/pages, all user action were not under agreed SLA (100% of under SLA of 5 sec) ▶ 1031 successful E2E Transactions were achieved during the test run wherein the expected volume was 1200 transactions (88% of Volume Achieved)
Round 5 Cycle 1	Branch Test – 1Mbps Branch	29-May-2022	35%<SLA	100%		▶ Out of 70 user action/pages, 46 user action were not under agreed SLA of 5 sec(35% of under SLA of 5 sec) ▶ 10 successful E2E Transactions were achieved during the test run (100% of Volume Achieved) ▶ Observed maximum of 0.3 Mbps network utilisation during the run
Round 5 Cycle 2	Branch Test – 1Mbps Branch	29-May-2022	75%<SLA	100%		▶ Out of 70 user action/pages, 11 user action were not under agreed SLA of 5 sec(75% of under SLA of 5 sec) ▶ 10 successful E2E Transactions were achieved during the test run (100% of Volume Achieved) ▶ Observed maximum of 0.7 Mbps network utilisation during the run

Note: The above RAG (Red, Amber & Green) status are denoted based on the test results, the major counters that were taken into consideration are Response Time, Throughput, Resource Utilization and Hits per Second.

6. Performance Tuning

S.No	Performance Tuning
1	Duplicate RRN, issue is resolved by implementing the RRN with micro seconds
2	Static references within the code was removed which was picking incorrect NID on triggering multiple request to the backend systems
3	Configuration level changes were implemented to restrict the loading of all documents at once on opening workitem
4	DB level indexing were done in below mentioned transaction tables, • NG_AOR_PR_AC_G_DEDUPE • NG_AOR_PR_AUTHENTICATE_CUSTOMER • NG_AOR_PR_CIF_ACC_DEBIT_CARD • NG_AOR_PR_DECISION_HISTORY • NG_AOR_PR_DH_G_AUDIT_LOG • NG_AOR_PR_DH_G_NOTIFICATION_LOG • NG_AOR_PR_DH_G_SENDBACK_REASONS • NG_AOR_PR_INPUT_ACCOUNT_DETAILS • NG_AOR_PR_KYC_VERIFICATION • NG_AOR_PR_SAD_G_CUST_PROVIDED_DOC • NG_AOR_PR_SAD_G_SYS_GENERATED_DOC • NG_AOR_PR_SIGNATURE_CAPTURE • NG_AOR_PR_SIGNATURES_AND_DOCUMENTS • NG_AOR_PR_UCP_BASIC • NG_AOR_PR_UCP_CONTACT • NG_AOR_PR_UCP_EMPLOYMENT • NG_AOR_PR_UCP_OTHERS • NG_AOR_PR_UCP_OTHERS_G_TIN_DTLS • NG_AOR_PR_VALIDATE_FOR_EXCEPTION
5	Disabled loading of "My Queue" workitems on Login to optimize the login touch point response time
6	"Application level logs configuration were changed as below to reduce the logging mechanism • Combined Result=Y • ShowQueryListOnLogin=N"
7	Enabled compression at load balancer to 6 for *.css, *.js, .png, .jpg, .jpeg, *.txt, *.xml, *.html, *.xhtml files to reduce the data transfer over the network
8	Configured LB Algorithm - Least Connection First and Affinity Param - cookie
9	User level batching reduced at Application Level
10	Logging mechanism were changed from Debug to Error mode to reduce the logging
11	On demand loading was implemented in the application to reduce the data getting populated in Click New and Open Workitem
12	setFocus points was earlier pointing to Click Validate button and its moved to TAB click to reduce the validate button response times
13	Removed redundant save servlet calls to server, which in turn reduced the number of hits to server

Note: All the performance Tunings are to be deployed and confirmed before go live to maintain the best performance in production

7. Defect Summery

Defect ID	Defect Name	Defect Description	Defect Status
Bug 870818	Duplicate RRN issue | AAO PT | 50% Load Test	RRN were duplicated for same services triggered from the host systems.	Resolved
Bug 873109	High Response Times for ESB Services | 50% Load Test	AccountCreation, CustCreationOrLongUpdate, CustProflValidtn and FinTxnStatusInquiry ESB services took more than 2 secs to respond (95th Percentile)	Resolved
Bug 873313	T24 Account Creation Issue | 50% Load Test	Create Account services were failing	Resolved
Bug 873339	CIF Id not getting appended in CustInquiryService | PT 50% Load Test	CIF Id was not dynamically passing in the request and all the request sent to T24 was passing the same number over time (hard coding the CIF)	Resolved
Bug 874063	High Response Time | Done User Action | 50% Load Test	Out of 131 user action/pages, done user action were not under agreed SLA. It responded in 11 and 8 secs for New to Bank and Excising Customers respectively	Resolved
Bug 874793	High Resources Utilization in Application Servers | 100% Load Test	Resources utilizations of both the application servers were not within the permissible limits during execution, Application 1 utilized an average of 75% of CPU and during the peak time the CPU utilization reached 100% of CPU and similarly during the ramp up period the application server 2 utilized 80% of CPU post which it reduced to an average of 40% CPU	Resolved
Bug 883118	TWS Error | Endurance Test	Login transactions failed due to backend errors from T24 which lead to high failure rates	Resolved
Bug 892425	High response time for Open Workitem and Click New Workitem | Branch Performance Testing	Click New and Open Workitem user actions took 133 and 15 seconds when tested in 1 Mbps branch and 36 and 31 seconds when tested in 2 Mbps branch	Open
Bug 892426	Launch and Login high response times | Branch Performance Testing	Launch and Login user actions took 26 and 79 seconds when tested in 1 Mbps branch and 11 and 17 seconds when tested in 2 Mbps branch	Open

Note: All the performance Tunings are to be deployed and confirmed before go live to maintain the best performance in production

7.1. Observations, Known Issues and Accepted Risk

Below are the list of outstanding defects dated on 23rd June 2022 that were tracked under performance testing.

Defect ID	Description	Mitigation Plan	Accepted by
Bug 892425	Click New and Open Workitem user actions took 133 and 150 seconds when tested in 1 Mbps branch and 36 and 31 seconds when tested in 2 Mbps branch	Newgen to monitor the performance of the application post pilot deployment and to fix the fix same if any bottlenecks identified	Steering Committee
Bug 892426	Launch and Login user actions took 26 and 79 seconds when tested in 1 Mbps branch and 11 and 17 seconds when tested in 2 Mbps branch	Newgen to monitor the performance of the application post pilot deployment and to fix the fix same if any bottlenecks identified	Steering Committee

Note: As per the PSC meeting held on 23rd June the mitigation plan was agreed for the open issues in PT

8. Annexures

Document Name	Attachment
50% Load Test Execution Summary Report	BM_AAO_R1C1_50% Load Test-Nov_24_2 BM_AAO_R1C2_50% Load Test-Dec_05_2 BM_AAO_R1C4_50% Load Test-Dec_20_2
100% Load Test Execution Summary Report	BM_AAO_R2C1_100 % Load Test-Dec_21_ BM_AAO_R2C2_100 % Load Test-Dec_23_ BM_AAO_R2C3_100 % Load Test-Jan_10_ BM_AAO_100% Load Test PT_Apr_1 BM_AAO_100% Load Test PT_May_2 BM_AAO_100% Load Test PT_May_2 BM_AAO_100% Load Test PT_May_2
Endurance Test Execution Summary Report	BM_AAO_R4C1_End urance Test-Jan_18_ BM_AAO_R4C2_End urance Test-Jan_28_
Breakpoint Test Execution Summary Report	BM_AAO_R3C1_Brea kpoint Test-Jan_12_
Branch Test Execution Summary Report	BM_AAO_Branch Test PT_May_29_202
Defect Tracker	DefectTracker_V1.xl sx

Note: The attached execution summary report is zipped and shared over mail