Performance Testing Final Closure report Phase 1.1

Vodafone Oman

Version: 1.0

Template History

Version	Date	Role	Name	Comment
1.0	17 Dec 2020	VFO Test & QA Manager	Sivaranjini Saravanan	Standard final test report template for VFO projects

Document History

Version	Date	Role	Name	Comment
0.1	07 Dec 2021	Performance Test Manager	Mareeswaran Balaji	Draft version
1.0	08 Dec 2021	Performance Test Manager	Mareeswaran Balaji	Final Version

Document Approval

Version	Date	Role	Name	Approval Status
1.0	08 Dec 2021	QA Manager	Sivaranjini Saravanan	

Document Distribution

Date	Role	Name
08 Dec 2021	CIO & Head of IT	Mihir Oza
08 Dec 2021	Project Director	Paul Booth
08 Dec 2021	QA Manger	Sivaranjini Saravanan
08 Dec 2021	Programme Manager, Zentity	Vojtech Litavsky
08 Dec 2021	Programme Manager, Openet	Dolly Alexis Leong

08 Dec 2021	Programme Manager, API GW / ERP	Russel Inc
08 Dec 2021	Programme Manager, Netcracker	Tatiana Golovacheva

Acronyms

Term	Definition
PT	Performance Testing
SIT	System Integration Testing
SGW	Security Gateway
BSS	Business Support System
OCS	Online Charging System
MVA	My Vodafone Application
CGW	Communication Gateway
NFR	Non-Functional Requirement

Programme Overview

Programme Name	3 to 1
SI Partner	Maveric
Key Contacts	Mareeswaran Balaji
Programme overview	Launch of Mobile Telecom Services in Oman

Document Details

Document Id	Vodafone Oman Performance Testing Closure Report
Document Name	Performance Testing Final Closure report Phase 1.1
Version	1.0
Owner	Mareeswaran Balaji
Date released	08 Dec 2021

Table of Contents

Key References

Performance Testing NFR	Outcome of the NFR Assessment are captured	[Performance Testing - NFR](#)

Performance Testing Strategy	Overall PT strategy	[Performance Test Strategy Walkthrough - To all Partners](#)
Performance Testing Execution Reports	Detailed artefacts of all rounds of execution	[Performance Test Execution Reports](#)
Performance Testing Defect Dashboard	PT defect details	[Xray Defects-PT](#)
Performance Testing Execution Summary Dashboard	PT test execution summary	[Xray Summary - PT](#)

Overview

Performance testing aims to highlight the system performances before rolling out the new application in production environment. As defined in the Program level Test Strategy [Performance Testing (PT)](#), the PT was categorize into two phases,

- Standalone/Internal PT - this will be conducted by each partner as described in their SOW. Each partner to submit their internal PT plan and completion report for Vodafone review. Becomes the entry criteria for the E2E PT.
- E2E PT - Maveric has provided the performance testing services to conduct the E2E performance testing with primary focus on MVA as source channel

Performance Testing Goals Vs Status

To measure load handling capacity of MVA application under increased load and volume with all the surrounding systems / interfaces connected	COMPLETED
To measure the E2E response time of all the in-scope MVA transactions and benchmark in production environment	COMPLETED
To monitor the relevant server metrics (not limited to CPU & Memory) during execution & ensure the resources utilization are under threshold limits	COMPLETED
To measure the key performance indicators under stress conditions	COMPLETED

Test Progress

Schedule Planed Vs Actual

Key Milestone	Planned Start Date	Planned End date	Actual Start Date	Actual End date
NFR Assessment	13-Jun-21	24-Jun-21	13-Jun-21	18-Jul-21
Tool Setup & Feasibility Study	20-Jun-21	24-Jun-21	14-Jun-21	25-Jun-21
Performance Test Strategy	20-Jun-21	24-Jun-21	20-Jun-21	18-Jul-21
Performance Test Script Design	27-Jun-21	15-Jul-21	27-Jun-21	31-Aug-21
Performance Test Execution	18-Jul-21	07-Sep-21	09-Sep-21	03-Dec-21

Changes which impacted the Schedule

- The NFR assessment & Test strategy phase were commenced in parallel as they had dependent deliverables. The delay was experienced to finalize the traffic requirements/ Platform dimensioning from Business team and also the extended period of review sessions on NFR misalignment between Business & Partner's NFR
- The Script design completion extended due to open functional defects in E2E environment as well as in PROD - 12 out of 16 UJ (initial scope were completed on 15-July) the other UJ related to Add-on & Voucher redemption had functional issues that impacted the design completion. Further there were functional issues identified in PROD caused the script maintenance until 31-Aug-21.
- The PROD environment were not fully functional until 23-Aug and the workarounds for the PT SMTP server to handle Magic links during on-boarding were implemented in parallel by ZE.
- The other key issues experienced in PROD related to Payment not authorized by Bank error (PROD3TO1-2) & KYC internal server error (VFOMOP-676), SIM activation failure errors (PT3TO1-39) and Mail server issue (PT3TO1-40) further delayed the start date of Performance test execution to 09-Sep-21.

Performance Test Design Summary

The primary/ Source channel for e2e Performance testing was MVA. The transactions in-scope are derived based on the Business Priority & the weightage when compared with all the UJ's involved in the Phase 1.1

Transaction In-scope

- US-OBG- I Already Have a SIM
- US-OBG- I need New SIM

- US- ADO-1, Add One Time (Add-On)
- US- ADO-3, Remove (Add-On)
- US- CPL-1, Upgrade Plan
- US- CPL-2, Downgrade Plan
- US-CPL-4, Cancel Plan
- US- PAY-9, Top Up Someone else
- US- PRE-2, Quick Recharge
- US-CDA-4: My Account
- US-PRE-1 - Dashboard (Pre-Paid)
- US-PRE-1 - Detailed View (Pre-Paid)

Transaction Descoped

The below transactions were descoped during the course of execution due to respective justifications,

- US-POS-1 - Dashboard (Post-Paid) - descoped as Postpaid were not released as part of 1.1
- US-POS-2 - Detailed View (Post-Paid) - descoped as Postpaid were not released as part of 1.1
- US-DSB-8, Win Back - descoped as the feature is moved to 1.2
- US-PAY-5, Voucher redemption - descoped as the feature were not released as part of 1.1

Note: The other MVA UJ's classified as P3 & P4 were not included in Performance testing scope and the respective justification were provided in the performance test strategy

Test Design Approach

The test design was collectively performed on both the SIT and E2E environments. The scripts developed in lowered environment were validated/ periodically maintained in production environment in order to accommodate the code changes. The script were developed based on the API sequence gathered from the ZDS logs for each user action as part of the e2e user journey.

Key Script design Challenges & Mitigations

Magic Link - The OTP generated as part of the magic link during on-boarding were handled using the Mail reader samplers in Jmeter to bring in the real time scenario as well as extending coverage to the magic link generation & OTP validation

HMAC-SHA256 algorithm - MVA uses the HMA-SHA256 algorithm during the customer login the same were implemented in the PT script instead of requesting dev team to disable the encryption logics.

KYC - The KYC Oman ID scanning and the Liveliness check features requires a real device during load generation and it is practically impossible. Hence KYC were mocked during PT as

agreed during the strategy. However the image uploads that happens at Scan Oman ID & Liveliness check along with the respective FE API calls has been incorporated in PT (approx. 140 KB of files were uploaded for 1 customer on-boarding)

JSON file - The /numberData API requires an JSON file to be uploaded based on the chosen MSISDN during on-boarding. The same were handled within the PT script using the Bean Shell sampler. We created the JSON file in runtime to simulate the real time behavior of the app.

Payment Status - A work around to retrieve the payment status from the Thawani gateway were implemented by ZDS (try until the status is obtained as processed) the same logic were handled in the PT script to retry the payment status API until the status in response is received as "PROCESSED"

Performance Test Execution Summary

All Performance test execution were executed in PROD Environment. The load were simulated from VF Office network for the On-Boarding scenario & 10% load scenarios for the 30% & 60% load scenarios the load were simulated from the Jump server resides within IT cloud to eliminate the external network latency.

Test Environment

The source channel for e2e performance testing was MVA.

Zentity	As defined in this page- Production Communications Matrix

Execution Approach

Approach adopted during strategy

The below profiling approach were recommended by Maveric during the performance test strategy to have maximum coverage and to have a detailed visibility of the application performance under various load scenarios.
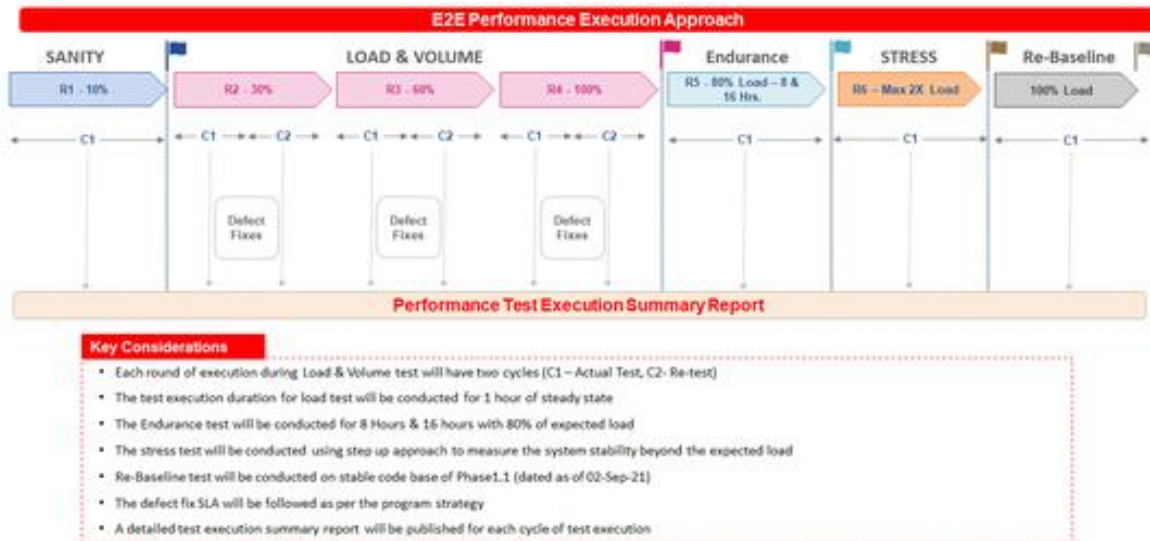
Approach adopted to accommodate multiple code drops

The recommended profiling base approach were modified to multiple cycles in order to align with the code release planed in PROD during the re-planning exercise carried on 15 Jul 2021 due to the unavailability of PROD environment with stable code base to carry out performance testing

10%		
30%	C1	Wk 1
60%		
Defect Fix		Wk 2
30%		
60%	C2	Wk 3
Network		
Defect Fix		Wk 4
100%	C3	Wk 5
Network		
Endu & Stress	C1	Wk 6
Regression	C1	Wk 7
Fix & retest	C2	Wk 8

Final approach

The below approach were adopted to overcome the timeline challenges and to provide more performance insights for the Day 0 scenarios covering the exclusive customer on-boarding & all UJ's under the category of BAU.

Scenario	Scenario Description	Kind of Test	User Journey	Customer Base	User	Volume	Test Objective	Test Duration	Load Distribution	Entry Criteria	Exit Criteria
Scenario 1	2k Customer On-boarding in 1 Hour	Load Test	I Already Have SIM_Customer On-Boarding	~ 75K	200	2000	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 2K customer onboarding	1 Hour (Steady State) + Ramp up (max. 20 mins)	Transaction volume is distributed over the test duration	Stable Environment + UJ Should be functionally stable	Key NFR's Meet - 95% of Transaction volume should be achieved, 5% of error rate are acceptable, Resource utilization under threshold <50% (across memory usage & CPU usage), Response time under SLA as defined in the NFR when compared to 90 Percentile of operations
Scenario 2	6k Customer On-boarding in 1 Hour	Load Test	I Already Have SIM_Customer On-Boarding	~ 80K	600	6000	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 6K customer onboarding	1 Hour (Steady State) + Ramp up (max. 20 mins)	Transaction volume is distributed over the test duration	Successful completion of Scenario 1 + Test Results Sign-off Stable Environment + UJ Should be functionally stable	Key NFR's Meet - 95% of Transaction volume should be achieved, 5% of error rate are acceptable, Resource utilization under threshold <50% (across memory usage & CPU usage), Response time under SLA as defined in the NFR when compared to 90 Percentile of operations
Scenario 3	10% Load Test	Load Test	All UJ mentioned in the Work Load Sheet	~ 90K to 200K	542	3898	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 10% Load Test across all the UJ mentioned in the work load	1 Hour (Steady State) + Ramp up (max. 20 mins)	Transaction volume is distributed over the test duration	Successful completion of Scenario 2 + Test Results Sign-off Stable Environment + UJ Should be functionally stable	Key NFR's Meet - 95% of Transaction volume should be achieved, 5% of error rate are acceptable, Resource utilization under threshold <50% (across memory usage & CPU usage), Response time under SLA as defined in the NFR when compared to 90 Percentile of operations
Scenario 4	30% Load Test	Load Test	All UJ mentioned in the Work Load Sheet	~ 90K to 200K	1637	11768	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 30% Load Test across all the UJ mentioned in the work load	1 Hour (Steady State) + Ramp up (max. 20 mins)	Transaction volume is distributed over the test duration	Successful completion of Scenario 3 + Test Results Sign-off Stable Environment + UJ Should be functionally stable	Key NFR's Meet - 95% of Transaction volume should be achieved, 5% of error rate are acceptable, Resource utilization under threshold <50% (across memory usage & CPU usage), Response time under SLA as defined in the NFR when compared to 90 Percentile of operations
Scenario 5	60% Load Test	Load Test	All UJ mentioned in the Work Load Sheet	~ 90K to 200K	3275	23574	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 60% Load Test across all the UJ mentioned in the work load	1 Hour (Steady State) + Ramp up (max. 20 mins)	Transaction volume is distributed over the test duration	Successful completion of Scenario 4 + Test Results Sign-off Stable Environment + UJ Should be functionally stable	Key NFR's Meet - 95% of Transaction volume should be achieved, 5% of error rate are acceptable, Resource utilization under threshold <50% (across memory usage & CPU usage), Response time under SLA as defined in the NFR when compared to 90 Percentile of operations
Scenario 6	100% Load Test	Load Test	All UJ mentioned in the Work Load Sheet	~ 90K to 200K	5460	39286	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 100% Load Test across all the UJ mentioned in the work load	1 Hour (Steady State) + Ramp up (max. 20 mins)	Transaction volume is distributed over the test duration	Successful completion of Scenario 5 + Test Results Sign-off Stable Environment + UJ Should be functionally stable	Key NFR's Meet - 95% of Transaction volume should be achieved, 5% of error rate are acceptable, Resource utilization under threshold <50% (across memory usage & CPU usage), Response time under SLA as defined in the NFR when compared to 90 Percentile of operations

Scenario Coverage

Scenario Description	Kind of Test	User Journey	Customer Base	User	Volume	Test Objective	Status
2k Customer On-boarding in 1 Hour	Load Test	I Already Have SIM_Customer On-Boarding	~ 75K	250	2000	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 2K customer onboarding	TESTED
10% Load Test	Load Test	All UJ mentioned in Scope for PT	~ 90K to 200K	542	3898	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 10% Load Test across all the UJ mentioned in scope for PT	TESTED

30% Load Test	Load Test	All UJ mentioned in Scope for PT	~ 90K to 200K	1637	11768	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 30% Load Test across all the UJ mentioned in scope for PT	TESTED
60% Load Test	Load Test	All UJ mentioned in Scope for PT	~ 90K to 200K	3275	23574	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 60% Load Test across all the UJ mentioned in scope for PT	TESTED

The below scenarios were descoped from Performance testing execution,

Scenario Description	Kind of Test	User Journey	Customer Base	User	Volume	Test Objective	Status	Reason

6k Customer On-boarding in 1 Hour	Load Test	I Already Have SIM_Customer On-Boarding	~ 80K	600	6000	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 6K customer onboarding	DE-SCOPED	Due to revised consideration of NFR's from VF Business (1860 sales order per hour). The higher throughput scenarios were de-scoped
100% Load Test	Load Test	All UJ mentioned in Scope for PT	~ 90K to 200K	5460	39286	The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 100% Load Test across all the UJ mentioned in scope for PT	DE-SCOPED	

| 8 Hours & 16 Hours test | Endurance Test | All UJ mentioned in Scope for PT | ~ 90K to 200K | 4368 | 8 Hours - 2514448 16 Hours - 502896 | The objective is to measure KPI's over a prolonged duration across all the UJ mentioned in scope for PT | DEFERRED | Tracked under [RAID3TO1-1158](#). |

Scenario Vs Detailed Test Result Summary

All detailed execution summary report all published in the confluence page

[Performance Test Execution Reports](#)

On-boarding Scenario

- Overall 12 cycles of 2K on-boarding were executed Vs planned 2 cycles (excluding the ad-hoc run executed to support the iRule implementation in Load Balancer & the Load distribution across TOMS servers)
- The concurrent users were increased from 200 to 250 for the on-boarding scenario to increase the throughput attempt rate
- The final cycle - C18 were executed on 15 Nov 2021 and below are the high level stats across the key performance indicators (**Run Status : Conditional Pass**)

Detailed Report:

VFOMAN_Perform...ing_15Nov.XLSX
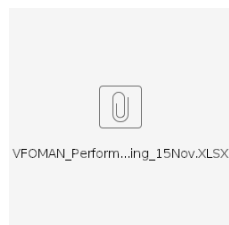
Scenario Details:

- Concurrent Users - 250
- Transaction Volume - 2000
- Ramp up Rate - ~5 sec/user
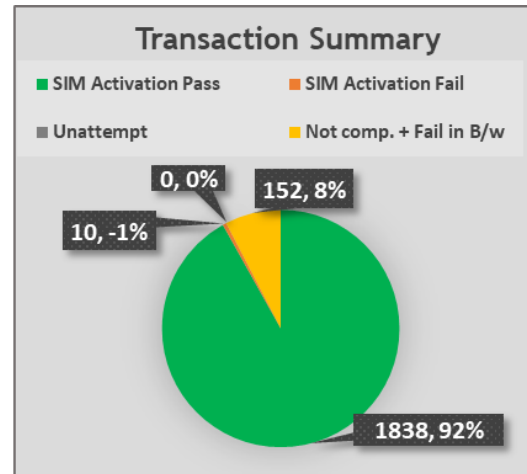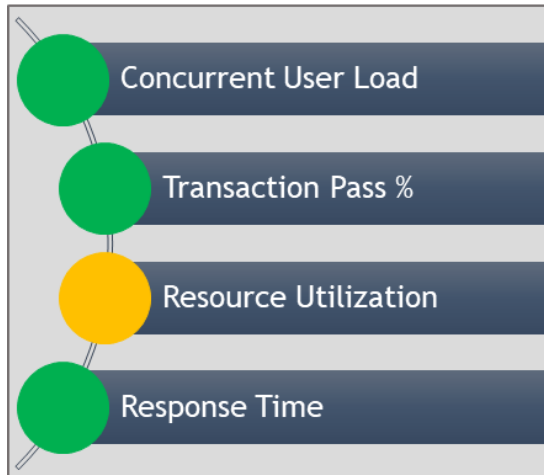
Response Time

- observation against 90th percentile - 2 out 36 calls breached response time SLA (95% under SLA)
- observation against 95th percentile - 4 out 36 calls breached response time SLA (92% under SLA)
- observation against 99th percentile - 15 out 36 calls breached response time SLA (58% under SLA)
- The response times has been improved when compared to the previous high throughput run (R1C17, 14-Nov) – Refer run comparison sheet in the attached report

Throughput

The expectation is to on-board 2000 customers within 1 hour of steady state & ramp up of 20 minutes

- 1838 successful e2e on-boarding were achieved (92% of throughput were achieved; expected was 95%)
- Overall 163 failures were observed
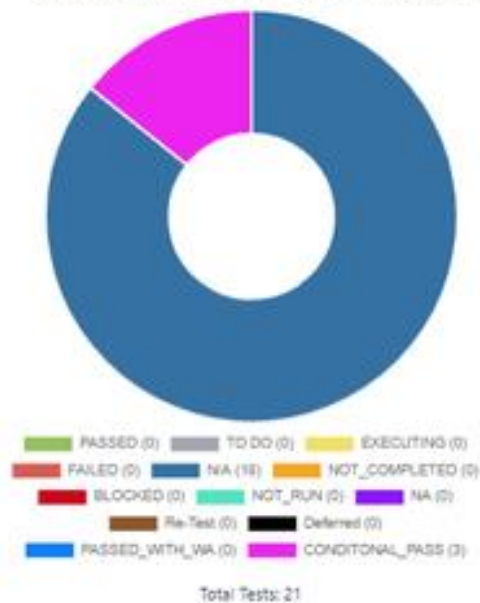
Error Analysis

- Majority of the transaction failures are due to the below error
  • 504 Gateway Time-out, "The server didn't respond in time"
  • 500 Timeout Exception
  • 424 FAILED_DEPENDENCY
- Apart from the above mentioned errors there were
  - 10 failures in SIM activation occurred due to failures in EIO notification
  - 3 failures in Thawani payment gateway calls were observed
  - 76 failures in search of MSISDN (searched number were not found in the system under standard segment hence a valid business error)

Resource Utilization

- BSS:
    - TBAPI CPU ~12% average utilized
    - TOMS CPU ~20% average utilized (some peaks to 30%)
- APIGW:
    - Almost all the APIGW pods were consuming more than 60% of memory usage (note: pre-occupancy were significantly higher for all apigw pods)
- MVA-ZDS:
    - Memory usage (avg.)
    vfo-zds-mva-64cd5b8f6b-jtfff - 64%, vfo-zds-mva-64cd5b8f6b-9lvmr - 72%, vfo-zds-mva-64cd5b8f6b-wx7hn - 64%
    - CPU usage (Avg) :
    vfo-zds-mva-64cd5b8f6b-jtfff - 0.6%, vfo-zds-mva-64cd5b8f6b-9lvmr - 0.5%, vfo-zds-mva-64cd5b8f6b-wx7hn - 0.6%
- MVA-ZPP:
    - Memory usage (avg.)
    vfo-zds-zpp-f6b7766bb-6v5h7- 31%, vfo-zds-zpp-f6b7766bb-kwsmv - 31%, vfo-zds-zpp-f6b7766bb-4k9kc - 28%
    - CPU usage (Avg)
    vfo-zds-zpp-f6b7766bb-6v5h7 - 0%, vfo-zds-zpp-f6b7766bb-kwsmv - 1.0%, vfo-zds-zpp-f6b7766bb-4k9kc - 1.0%
- ZDS - SGW:
    - Memory usage (avg.)
    vfo-zds-sgw-isgw-77fcd65f6c-4pslq - 95%, vfo-zds-sgw-isgw-77fcd65f6c-bfhsx - 96%, vfo-zds-sgw-esgw-7f44d6985f-xjg48 - 86%
    vfo-zds-sgw-isgw-77fcd65f6c-8k29q- 86%, vfo-zds-sgw-esgw-7f44d6985f-hcjrk - 74%, vfo-zds-sgw-esgw-7f44d6985f-2pfhw- 72%
- ZDS-CGW:
    - vfo-zds-cgw-8648c65b54-5lfzk - 39%, vfo-zds-cgw-8648c65b54-m2sx9 - 38%, vfo-zds-cgw-8648c65b54-xh2cd - 37%

Xray Execution Summary

Overall Test Results: PT Summary Filter1 - (PT3TO1-115)

PASSED (0) TO DO (0) EXECUTING (0)
FAILED (0) NA (18) NOT_COMPLETED (0)
BLOCKED (0) NOT_RUN (0) NA (0)
Re-Test (0) Deferred (0)
PASSED_WITH_WA (0) CONDITONAL_PASS (3)

Total Tests: 21

18 NA Cases - As onboarding scenario includes only the UJ of I Already have SIM, the test cases of other UJ and unexpected load test cases were marked as NOT APPLICABLE under Onboarding scenario test plan PT3TO1-155.

Load Scenario

The 10% load scenario & the 30% load scenario were executed as part of performance testing. Below are the detailed performance observations.

10% Load

- Overall 2 cycles of 10% load were executed
- The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 10% Load Test across all the UJ in scope for PT
- The final cycle (10% Load - C2) were executed on 15 Nov 2021 and below are the high level stats across the key performance indicators (***Run Status : Conditional Pass***)

Detailed Report:

VFOMAN_Perform...est_15Nov.xlsx
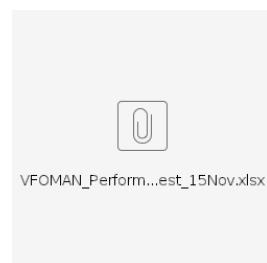
Scenario Details:

- Concurrent Users - 542
- Transaction Volume - 3902
- Volume Split up :
- Sales orders - 804, Non-Sales order - 3098
- Ramp up Rate - ~3 sec/user
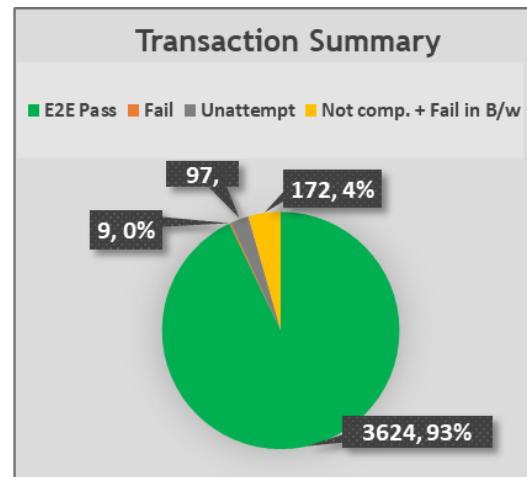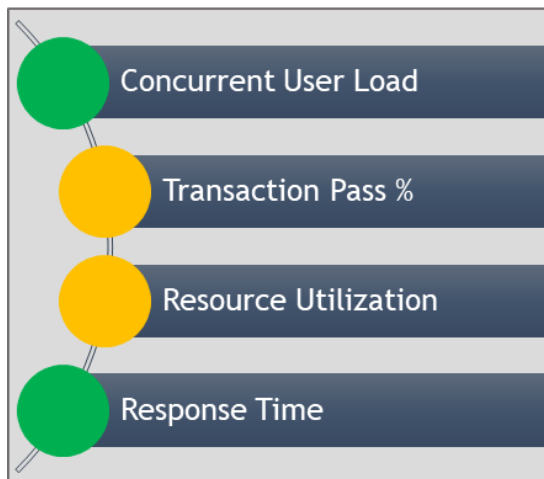
Response Time

- In total there are 150 API calls for the 12 UJ's and out of which 57 FE API's are unique
- Observation against 90th percentile – 12 out 150 API calls breached response time SLA (90% under SLA; expected is 95%), below are the unique API Calls that breached Response time SLA
    - api/public/numbers/v1/[phonenumber]/plans
    - api/public/numbers/v1/[phonenumber]/plans/[planId]
    - api/public/orders/v1/[orderId]/numberData
    - api/public/orders/v1/[orderId]/kyc/identityDocumentData
    - api/public/orders/v1/[orderId]
    - api/public/numbers/v1/[phonenumber]/addOns/[addonId]

Throughput

- The expected throughput is 3902 out of which 3624 were achieved (93% of throughput is achieved; expected is 95%) and the transaction volumes were not achieved for the below UJ's,
    - On-boarding --> ~ 140 (majorly due to 424 & 504 errors)
    - Upgrade Plan --> ~ 60 (unattempt)
    - Detailed View --> ~ 25 (unattempt)
    - Downgrade plan--> ~ 8 (unattempt)
    - Quick Recharge --> ~ 4 (unattempt)

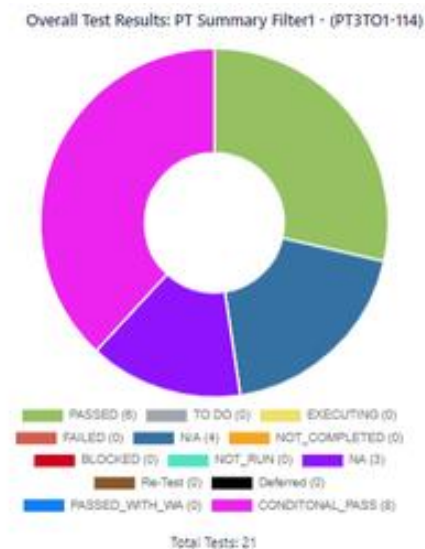Note: For rest of the 7 UJ's 100% throughput has been achieved.

Error Analysis

- 424 Errors - 44 of such failures (PT3T)1-63)
- 500 TimeoutException – 4 (PT3TO1-63)
- 404 Bad Request – 16 (PT3TO1-96)
- Sim Activation failure – 2 (PT3TO1-71)

Resource Utilization

- BSS:
    - TBAPI CPU ~8% average utilized
    - TOMS CPU ~15-18% average utilized
- APIGW:
    - Almost all the APIGW pods were consuming more than 60% of memory usage (note: pre-occupancy were significantly higher for all apigw pods)
- ZE Components:
    - Except CGW & ZPP Pods all other ZE Pods memory usage were > 50% - Refer the ZE Resource utilization details for the MVA-ZDS, SGW, ZPP & CGW

Xray Execution Summary

Overall Test Results: PT Summary Filter1 - (PT3TO1-114)

PASSED (8)   TO DO (0)   EXECUTING (0)
FAILED (0)   N/A (4)   NOT_COMPLETED (0)
BLOCKED (0)   NOT_RUN (0)   NA (3)
Re-Test (2)   Deferred (0)
PASSED_WITH_WA (0)   CONDITONAL_PASS (8)

Total Tests: 21

5 NA Cases - 3 test cases (PT3TO1-24, 23, 22) relates to higher volume scenarios (Endurance & Stress) and 1 test case (PT3TO1-20) relates to MVA APP size. All of the above 4 test cases are "NOT APPLICABLE" for 10% load test scenario. 1 test case (PT3TO1-18) relates to voucher Redemption & 2 Test Cases - (PT3TO1-12 & 15) relates to Postpaid UJ as it was not part of 1.1 Launch it was deferred.

30% Load

- Overall 9 cycles of 30% load were executed Vs planned 2 cycles
- The objective is to measure KPI's (Response Time, Throughput, Error rate, Resource utilization etc.) during 30% Load Test across all the UJ in scope for PT
- The final cycle (30% Load - C9) were executed on 03 Dec 2021 and below are the high level stats across the key performance indicators (***Run Status : Conditional Pass***)

Detailed Report:

VFOMAN_Perform...le7_03Dec.xlsx
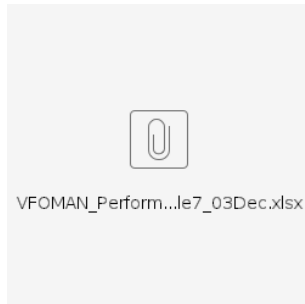
Scenario Details:

- Concurrent Users - 1636
- Transaction Volume - 11768
- Volume Split up : Sales orders - 2434, Non-Sales order - 9334
- Ramp up Rate - ~3 sec/user
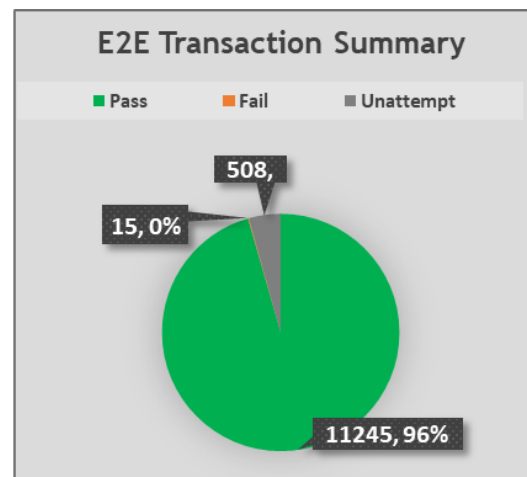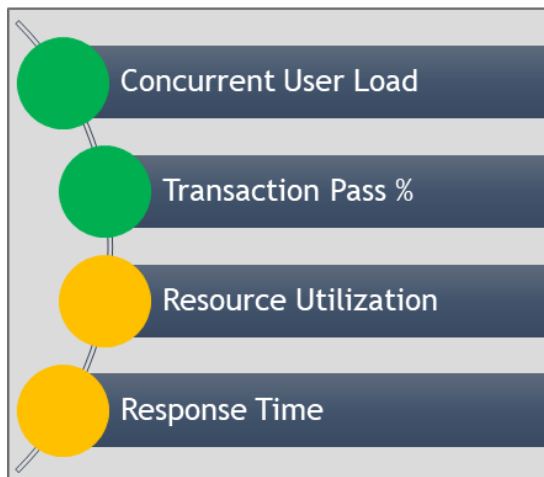
E2E Throughput Stats:

- Expected: 11768
- Attempted: 11237
- Unattempt: 508
- Total Pass: 11222

- o On-boarding achieved:1459
- o Other Sales order achieved: 532
- o Browsing traffic achieved: 9231
- Fail: 15
- **95%** of throughput were achieved
- Overall 144 errors were observed at the FE API level during the test duration out of the attempted 99912 MVA FE API calls

Response Time Stats:

- 87% of API calls met response time SLA (35 out of 148 API calls did not meet response time SLA)
- Below is the split-up of response time range;
  - o 2-3 Sec : 10 calls
  - o 3-4 sec : 7 calls
  - o 4-6.5 sec : 3 calls
  - o 1.1 sec to 2 (that had SLA as 1 sec): 15 calls
  - o Rest of the 113 API calls met their respective response time SLA
- Below are the 9 unique API's that did not meet response time SLA against 90th Percentile
  - o api/public/numbers/v1/[phonenumber]/addOns/[addonId]
  - o api/public/orders/v1/[orderId]
  - o api/public/numbers/v1/[phonenumber]/dashboard/primaryTile
  - o api/public/numbers/v1/[phonenumber]/plans
  - o api/public/numbers/v1//[phonenumber]/plans/[planId]
  - o api/public/numbers/v1/[phonenumber]/currentBalance
  - o api/public/numbers/v1/[phonenumber]/addOns
  - o api/public/orders/v1/[orderId]/deliveryData
  - o api/public/orders/v1/[orderId]/numberData
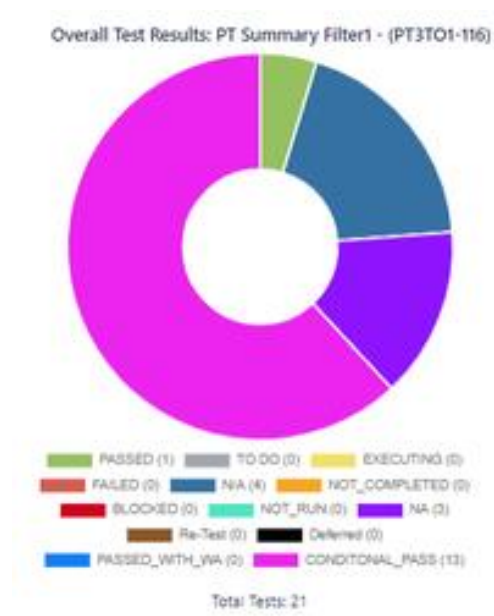
Error Stats:

- 424 Error - 121 Errors (due to timeouts within APIGW)
- 500 Timeout Exception- 3 Errors (due to the delay within APIGW leading to timeout for BSS request to SGW post On-boarding submit)
- 400 Bad_Request - 45 Errors (Additional characters added X-forwarder header by APIMAN leading to failure)
- 403 Forbidden - 7 errors (in relation to PT3TO1-64)
- SIM activation Failure (due to notification failure) - 2 Errors (EIO notification failure/ communication API failure via APIGW)

Resource Utilization:

- mva-ZDS Pods memory were utilized in the range of 50% to 65%
- mva-iSGW Pods memory were 99% utilized, however the preoccupancy was 95%
- mva-esgw Pods memory were utilized >85%, however preoccupancy was >80%

- Almost all the APIGW pods requested for more memory within the available limits
- OCS Provisioning pod memory were utilized <50%
- TBAPI CPU ~12% average utilized
- TOMS CPU ~18% average utilized but few peaks of 25-30%

Xray Execution Summary

Overall Test Results: PT Summary Filter1 - (PT3TO1-116)

Legend: PASSED (1), TO DO (0), EXECUTING (0), FAILED (0), N/A (4), NOT_COMPLETED (0), BLOCKED (0), NOT_RUN (0), NA (3), Re-Test (0), Deferred (0), PASSED_WITH_WA (0), CONDITIONAL_PASS (13)

Total Tests: 21

5 NA Cases - 3 test cases (PT3TO1-24, 23, 22) relates to higher volume scenarios (Endurance & Stress) and 1 test case (PT3TO1-20) relates to MVA APP size. All of the above 4 test cases are "NOT APPLICABLE" for 10% load test scenario. 1 test case (PT3TO1-18) relates to voucher Redemption & 2 Test Cases - (PT3TO1-12 & 15) relates to Postpaid UJ as it was not part of 1.1 Launch it was deferred.

Stress Scenario

Based on the test results of load test scenarios, the 60% load were considered as the stress condition and it was executed on 02 Dec 2021.

VFOMAN_Perform...ats_02Dec.xlsx
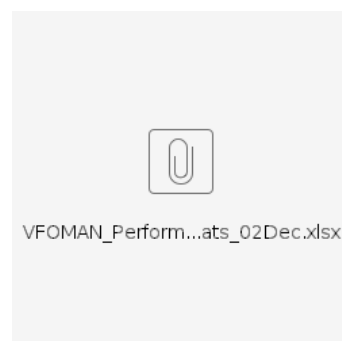
Below are the performance observation,

Scenario Details:

- Concurrent Users - 3275
- Transaction Volume - 23573
- Volume Split up :
- Sales orders - 4900, Non-Sales order - 18673
- Ramp up Rate - ~3 sec/user

Response Time Stats:

- 47% of the API calls met the response time SLA; 93 out of 148 API calls breached response time SLA.
- Out of that >20 Sec: 20 calls, 14-20 Sec: 13 calls, 7- 13 Sec: 21 call when compared against the 90th percentile.

Error Stats:

- 30 Sec timeouts - 571 Errors
- 424 Error - 302 Errors
- 500 Internal server error - 74 Errors
- 504 Error - 4 Errors
- 400 Bad_Request - 34 Errors
- 403 Forbidden - 21 errors
- SIM activation Failure (due to notification failure) - 42 Errors
- Overall 4255 errors were observed (at API level) and out of that,
    - 2182 errors were returned with 503 (service unavailable error) for the FE API's to ZDS between 12:13 to 12:26 GST (ZDS pods went down for about 10 mins.
    - 1048 errors were due the various errors due to APIGW (30 sec timeouts, 424, 500 timeout exception, notification failures, 403, 400 Bad Request)
    - 7 errors with 504 error for the FE API's
    - 375 errors were due to the non-http response code error that we were seeing for last two rounds testing)
    - 155 errors were valid business errors the MSISDN were not found in standard segment.

E2E Throughput stats:

- Expected: 23573
- Attempted: 14375
- Pass: 13648
- Fail: 727
- Throughput achieved % - 58%

The above stats from the 60% load run indicates that the current PROD landscape cannot withhold the load beyond the throughput achieved in 30% load run dated 03-Dec-21. However the BSS NFR on the number of TBAPI calls has been covered as during the 60% load test the BSS component were able to process 122K of TBAPI calls (Total calls: 122736, less than 1 sec: 121504, 1-3 sec: 1013, 3-5 sec:58, >5 sec: 161). The potential bottleneck were observed at the APIGW (higher error rates) & the ZE MVA ZDS Pod (Pod went down as all the 600 threads were consumed for the simulated load leading to 504 error and 503 (service unavailable error)

Ad-hoc Scenarios/ Execution Support

Ad-hoc scenarios were mainly executed for the Load Balancer issue & to validate the temporary fix provided for APIGW. Below are the details,

- 2 cycles of 30% load covering the browsing UJ's (My Profile, Dashboard, Detailed View) and 1 cycle of 60% load were executed to validate the APIGW fixes
- Overall 15+ ad-hoc runs were executed to support ODP & NC BSS to identify the root cause for Load balancer issue/ iRule implementation reported in the tickets
    - https://vodafoneoman.atlassian.net/browse/PT3TO1-44
    - https://vodafoneoman.atlassian.net/browse/VFOMOP-916
    - https://vodafoneoman.atlassian.net/browse/VFOMOP-915
- Apart from the above ad-hoc runs extended support were provided to VF OPS team to aid OAT by simulating 2 rounds of 100 thread load simulation in parallel to HA scenario

Test Acceptance Criteria and Results

Exit Acceptance Criteria

Criterion	Remarks
All **PT test Scenarios have been 100%** successfully executed.	- Yes - No 95% of the scenarios has been executed. As per programme suggestion, Current SIT environment to uplifted and to be benchmarked to continue PT to test Endurance Scenarios as a mitigation

Test cycle execution is successfully completed with 95% pass and **no P1 & P2**. All P3 & P4 defects should have agreed resolution/workaround in place.	• Yes • No Open P1 Defects, PT3TO1- 63, PT3TO118, PT3TO1-94 Open P2 Defects, PT3TO1- 97, PT3TO1- 98, PT3TO1- 77 Open P3 Defects, PT3TO1- 71, PT3TO1- 96, PT3TO1- 60, PT3TO1- 58
There is a plan in place for all the outstanding items of PT Plan is reviewed & approved by Vodafone Quality Manager.	• Yes • No As per programme suggestion, Current SIT environment to uplifted and to be benchmarked to continue PT. Below dashboard reflects the progress of Benchmarking activity [Benchmarking Activity - SIT - Jira (atlassian.net)](atlassian.net)
PT Final test report is signed off by all relevant stakeholders.	• Yes • No

Test Run and Status description

Detail descriptions on category of test run status are described in the table below:

Test Run Status	Description
Passed	Test scenario which had met the expected results based on existing NFR requirements
Conditionally Passed	Conditional Pass status will be used in the event that expected result does not match the actual result but accepted by all stakeholders and test cases kept as observation.
Failed	Test scenario with status "Failed" indicate the scenario did not met NFR requirements
Blocked	Test scenario with status "Blocked" indicate the scenario could either be due to : Unable to proceed to the next steps due to blocking issues/defects

N/A	Invalid/wrong test cases
	Test cases that are de-scoped from this test phase.

Test Results Overview

Test Scenario	Status	Comments
2K on-boarding scenario	CONDITIONAL PASS	92% of throughput was achieved (expected was 95%) & 95% of API calls met response time SLA . Hence status is marked as conditional Pass.
10% Load Test	CONDITIONAL PASS	93% of throughput was achieved & 90% of API calls met response time SLA (expected was 95%). Hence status is marked as conditional Pass.
30% load test	CONDITIONAL PASS	95% of throughput was achieved, however only 87% of API calls met response time SLA (expected was 95%). Hence status is marked as conditional Pass.

Defect Management Summary

Defect status (Grouped by Partner)

The detail of all the defects were tracked in Jira under the Project Vodafone Oman X-ray - PT, Xray Defects-PT Dashboard Link. The below defect status are dated as of 03 Dec 2021 .

Status	KC-ZE	Kumoco	Maveric	Netcracker	ODP	Vodafone	Zentity	T:
CLOSED	1	17	0	4	2	2	11	37
REJECTED	0	1	1	0	0	1	2	5
UNDER INVESTIGATION	0	9	0	0	0	0	1	10
Total Unique Issues:	1	27	1	4	2	3	14	52

Grouped by: Service Provider   Showing **3** of **3** statistics.

Priority	KC-ZE	Kumoco	Maveric	Netcracker	ODP	Vodafone	Zentity	T:
⌃ Highest - P1	0	3	0	0	1	2	3	9
⌃ High - P2	1	18	1	2	1	0	7	30
= Medium - P3	0	6	0	1	0	1	4	12
⌄ Low - P4	0	0	0	1	0	0	0	1
Total Unique Issues:	1	27	1	4	2	3	14	52

Grouped by: Service Provider   Showing **4** of **4** statistics.

Status	⌃ Highest - P1	⌃ High - P2	= Medium - P3	⌄ Low - P4	T:
CLOSED	5	24	7	1	37
REJECTED	1	3	1	0	5
UNDER INVESTIGATION	3	3	4	0	10
Total Unique Issues:	9	30	12	1	52

Grouped by: Priority   Showing **3** of **3** statistics. Show less

Observations, Known Issues & Accepted Risks

Below are the list of outstanding defect/ RAIDS/ Actions/ Design tickets dated as of 07 Dec 2021 that were created/ tracked under performance testing.

Jira Ticket No.	Description	Mitigation plan / Acceptance	Accepted by

PT3TO1-63	424 Errors	APIGW team requires additional logging to analyze the 424 errors. No ETA for the permanent fix. In the event a fix is provided, the re-test result in lower environments will not assure that it will not happen in Production. The fixes to be delivered for 424 is planned to be tested in SIT environment post completion of Benchmarking activity.	Programme
PT3TO1-71	Failure of notifications to CGW via APIGW from BSS	As the number of such failures during the 30% load run were minimal the fixes for these issues to be deployed in PROD and monitored by Partners/ OPS team as part of live monitoring. This issue cannot be reproduced or re-tested in SIT Environment as it requires 1:1 as PROD environment	Mihir Oza
PT3TO1-77	Stripping request payloads leading to 424	As the number of such failures during the 30% load run were minimal the fixes for these issues to be deployed in PROD and monitored by Partners/ OPS team as part of live monitoring. This issue cannot be reproduced or re-tested in SIT Environment as it requires 1:1 as PROD environment	Mihir Oza
PT3TO1-96	400 Bad Request error due to special characters getting added to the X-forwarder for header within APIGW	As the number of such failures during the last 30% load run were minimal the fixes for these issues to be deployed in PROD and monitored by Partners/ OPS team as part of live monitoring	Mihir Oza
PT3TO1-60	500 Internal Server error, Timeout Exception caused due to failure for SGW call from BSS via APIGW triggered post successful submit in BSS during on-boarding	As the number of such failures during the last 30% load run were minimal the fixes for these issues to be deployed in PROD and monitored by Partners/ OPS team as part of live monitoring. This issue cannot be reproduced or re-tested in SIT Environment as it requires 1:1 as PROD environment	Mihir Oza

PT3TO1-94	Duplicate calls to BE	Optimization on usage consumption report FE API call and GET /product/0.1/ to OC to be delivered by ZE on 14 Dec 2021 and to be verified in SIT	Sivaranjini Saravanan
PT3TO1-58	Top Product offering called without Filters	Implementation is moved to Phase 1.2 and cannot be tested before 1.1 launch	Programme
PT3TO1-97	Remove (Add-On) - High Response Time	Can be assessed for 1 user 1 transaction in lower environment post relevant fix from Partners	Sivaranjini Saravanan
PT3TO1-98	Upgrade Plan, High Response Time	Can be assessed for 1 user 1 transaction in lower environment post relevant fix from Partners	Sivaranjini Saravanan
PT3TO1-118	High response time within APIGW	This defect cannot be tested in lower environment as a bare minimum 30% load is required to certify the fixes from KC-APIGW. A separate PT environment with similar Architecture setup of PROD would be required.	Mihir Oza
RAID3TO1-1158	Higher Load > 30% Load & Actual Endurance & Stress testing not been covered in E2E PT from MVA Channel before cutover	Business has given the latest forecast, therefore PT was closed based on the latest numbers provided by Business. 30% load met the criteria & 60% is the stress condition. All open defects & Endurance testing to be continued in non-prod environment as a mitigation for this risk.	Sivaranjini Saravanan
RAID3TO1-1029	Throttling on APIGW	POC in progress in APIGW using customer-info header	Mihir Oza
CR3TO1-414	DXL & Look-ahead cache for MVA. Umbrella API	The CR is moved to Phase 1.2	Programme
BD3TO1-1929	Performance Improvement suggestions on MVA API sequences	The duplicate calls identified as part of PT3TO1-94 would be delivered by ZE on 14 Dec 2021 and any logic changes were not recommended by ZE for Phase 1.1	Programme

BD3TO1-1246	Timeouts and supported throughput for integrations	The exercise is currently with VF and the timeout settings needs to be finalized before 1.1 Go-live	Programme

Other Tickets

Below are the list of Risk/ Design/ Action tickets that were created/ tracked and brought to closure during performance testing life cycle,

https://vodafoneoman.atlassian.net/browse/RAID3TO1-1095

https://vodafoneoman.atlassian.net/browse/RAID3TO1-1145

https://vodafoneoman.atlassian.net/browse/RAID3TO1-1044

https://vodafoneoman.atlassian.net/browse/RAID3TO1-1012

https://vodafoneoman.atlassian.net/browse/RAID3TO1-1013

https://vodafoneoman.atlassian.net/browse/RAID3TO1-1014

https://vodafoneoman.atlassian.net/browse/CR3TO1-526

https://vodafoneoman.atlassian.net/browse/PT3TO1-81

https://vodafoneoman.atlassian.net/browse/PT3TO1-75

Key Performance Tuning

The performance tuning exercise were majorly focused on three layers MVA-ZDS, APIGW & BSS. Below are the key performance tuning implemented by Partners in respective system/ application based on the recommendations/ root cause analysis of the performance bottleneck raised out of each round of testing.

MVA-ZDS

Problem statement	Root cause analysis	Performance Tuning Details

Received 504 error for the MVA FE API calls	PMS cache did not work. Leading to repetitive calls to DB slowing process down, causing the error.	Configuration changes were released to fix the PMS cache
Time Lag in triggering the BE calls from ZDS leading to response time issues	The connections parameter from ZDS to APIGW were configured with default value 100 leading wait time	`shared.api.gw.connections.max=40` All 3 pods backed by <u>vfo-zds-mva</u> were updated
MVA FE API's were breaching response time SLA during the Baseline test (1 user 1 transaction)	Duplicate BE calls were identified and the same was contributing for the high response time	Refractor were applied by ZE for the below BE calls, usageConsumptionReport/0.1/ /product/0.1/
Higher number of BE calls were observed	The duplicate BE calls/ unwanted backend calls (among 12 UJ's in-scope for PT) were identified as the root cause for the higher number of BE calls from ZDS to APIGW	**Refractor** has been applied for BE call */product/0.1?offset=0&limit=20 (reduced ~10K of BE calls to APIGW during 30% load test)* **Cache filler** were applied to the BE call */userinfo/0.1/?sub* Additional optimization of **Suppressing** the BE call */productOrder/0.1/{orderID}* Pending Optimization as of 03 Dec 2021 • Suppression of GET /product/0.1/ call to OCS • Optimization of usageConsumption calls
High memory consumption & higher CG count were observed on ZDS PODS	JVM parameters & thread usage were identified as the root cause	Java Garbage Collector settings were optimized Resource optimization were implemented (thread usage) Memory optimization for REST Backend calls were provided

APIGW

Problem statement	Root cause analysis	Performance Tuning Details
Timeout errors were observed within APIGW leading to 424 Failed Dependency Error, 30 Sec read timeout errors, 504 Gateway timeout errors and leading to high processing time within APIGW	The resources for the API PODS, Worker PODS, APIMAN were not optimally sized and bottleneck were identified at code level that was causing the delay in API reaching the worker POD	API, Worker & APIMAN Pods were added with additional resources in terms of CPU & memory and auto scale up has been configured for the critical PODS like (Federated Identity, BSS, ZPP, UsageConsumption, Product, LogicalResources etc.) The code change were applied across all the POD to reduce the delay between the API & Worker

BSS

Problem statement	Root cause analysis	Performance Tuning Details
During the load run high CPU usage were observed for the received traffic to TOMS. TOMS CPU **~60**% average utilized but a multiple peaks of **78**%	The main CPU guzzlers were C2 compiler threads. The RC for this: reserved cache for compiled code was set to 256MB, which in presence of wide profile of APIs at this load proved to be not enough. This lead to constant recompilation and eviction leading to cyclically triggering more CPU usage	The reserved cache was increased to 512MB (from 256MB)

Management Summary

- The Primary source channel considered for Performance testing was MVA, covering 12 P1 & P2 Business critical transactions that touch bases key components MVA-ZDS, ZPP, CGW, SGW, APIGW, Payment Gateway, BSS TBAPI, BSS-TOMS, OCS, EDA, Mocked KYC & SMTP.
- The MVA application was benchmarked against 2K Customer On-boarding, 10% load & 30% load scenarios
- The MVA application was tested with max 1636 concurrent users & 11768 transaction volume under the expected load scenario and the outcome was 95% of throughput got achieved & the 87% of API call met response time SLA
- The 30% load test results was considered as 100% load for PROD when compared to the IT expectations in terms of number of sales order (1860) & browsing traffic
- The MVA application were subjected to a stress condition with the 60% load and the performance observation were published. (2689 concurrent users were into the system and due to the ZE POD failure & higher error rate the concurrency was not maintained for complete steady state)

- The worst case scenario of 60% load on browsing traffic were tested (Expected throughput: 18673, Achieved: 11034 (59%) & high response time were observed in 53% of API's
- Overall 52 issues was raised during the performance testing phase in Production covering Performance issues (41), functional issues (9) & Environment issues (2)
- Out of the 52 tickets 9 defects was unresolved as of 03 Dec 2021 - Refer the Outstanding Defects section for details
- The risk & customer impact due to the open issues were discussed with VF and the same has been taken up to Business team and the risk were accepted by both VF IT & Business
- The next steps and the plan to test the outstanding defects were taken up as an action item by Programme board
- The performance test results produced on PROD environment as part of 2K on-boarding scenario, 10% Load Test, 30% load test were accepted by Programme board & VF
- The final internal performance testing reports were received from NC BSS, NC AA, Opennet & Zentity. However, we have not received final report from key systems/ application KC - APIGW, Seamless - MEPOS (one of the key entry criteria for e2e Performance testing phase were not met)

Approval & Sign-off

Approver Name	Department	Date	Approval Signature
Mihir Oza	CIO & Head of IT		
Sivaranjini Saravanan	VF QA Manager		

Annexure

Name	Description	Attachment
NFR Review Log	Review comments on NFR and final agreement was captured in this page	NFR - Review Log
Test Strategy Review Log	Review comments on Test strategy and final agreement was captured in this page	Performance Test Strategy - Review Log

Programme Update to VF Management	Programme Update on Performance testing to VF Management based on the results from final PT run executed on 3-Dec.	20211205 Perfor...Update v02.pptx
Worst Case Scenario	Worst case scenario presented to VF Business	PT_Worstcase_Scenario.pptx