

G Cloud 14- Framework Service Definition

Cloud Migration Testing Services

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1. Overview

Infosys is working towards redesigning enterprises for the future through **Infosys Cobalt** ecosystem, with the objective to expand innovation, speed to the market and secure the enterprise. Infosys cobalt is a set of services, solutions, and platforms for enterprises to accelerate their cloud journey. Every enterprise today would like to mark its presence in the cloud to be part of their digital transformation journey and exploit the features of the cloud. However, cloud transformation journeys can have multiple points of failure across the technology stack of infrastructure, data and application.

Infosys cloud testing offers end-to-end validation of cloud migration transformation as well as cloud native build, with a shift-left cloud-first and gen ai (artificial intelligence) test approach. Testing consumes a significant portion of the time and effort in any cloud implementation. Also, post go-live scheduled (mandatory) upgrades require that we revalidate and retest the application at regular intervals. Infosys cloud validation services bring in the required domain knowledge along with the automated tools / pre-built test scripts to ensure that the business impact is kept to the minimum.

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2. Key Pillars

Below are the 3 key pillars on which Infosys Cloud ecosystem is built on.

Expand Innovation with the Cloud community

The Infosys Cobalt Cloud community focuses on expanding the store of cloud assets. Enterprises can leverage the full potential of the cloud ecosystem.

- Cloud agnostic Engineering Assets, domain specific Business Assets and reusable Knowledge Assets
- Reference Validation Case Studies across Cloud deployment model and Cloud service models

Speed-to-market with multiple Engineering Assets

With Infosys Cobalt, enterprises can have ready access to a growing portfolio of various Technical and Business Solutions and Tools. Below are the key validation tools that are Cloud ready and part of the Hyperscaler marketplace:

Infosys Cloud Infrastructure Validation (ICIV):

A platform to conduct cloud readiness and non-functional validation for cloud platform build. Key benefits:

- **100% Coverage** and Complete Traceability.
- Lower TCO and cycle time improvement of up to 50%

Infosys Cloud Data Validation Solution (ICDVS)

Cloud Native data validation automation solution to accelerate testing of Data Integration / Data Analytics platforms. Key benefits:

- Reduction in Test execution by 50%
- Ensures 100% data validation coverage.

Infosys Cloud Quality Assessment and Transformation (ICQAT)

Helps customers assess the quality risks in cloud implementations and enables building of a comprehensive test strategy to validate such cloud implementations. Key benefits:

- 100% Test Coverage Assurance with a clear test plan and strategy
- At least 40% faster test cycles through Machine first approach.

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Infosys Performance testing Platform

A platform for Load ingestion, Network bandwidth simulation, monitoring and performance assurance. Elastic LG is an interesting module that spins on/ off new load generators based on test need. Key benefits:

- 70% Effort Savings by API performance test at key integration points.
- E2E RT improvisation from 40 min to <60seconds.

Infosys LegMAP

Test Workbench for Cloud Modernisation and Microservices Test automation. Key benefits:

- 100% test coverage with benefits of 100% Test process standardisation
- 40-50% Test cycle time reduction and up to 40% cost savings.

Reusable Test Components

 500+ Test cases specific to validation of Cloud components such as landing zone, Resources such as storage, Network and Monitoring of Active directory supporting AWS, Azure, GCP and other cloud implementations.

Gen Al Validation Solutions

- Generate test scenarios from requirement and design documents.
- Generate test cases from test scenarios.
- · Generate automated test scripts.

Securing the Enterprise:

Infosys Cloud Security Quality Assurance Service offer comprehensive validation solution through discovery of critical assets, review of cloud migration readiness, cloud configuration review, validation of security strategies, policies and controls against industry standards and benchmarks, security assessment for cloud applications, remediation of identified threats.

We help our clients validate security of their cloud migration and transformation journey to build a cyber resilient and compliant cloud eco-system. Our suite of Cloud Security Validation services mainly covers

- · Cloud Configuration Review and Recommendations
- Vulnerability Assessment and Management
- Identity Access and Management Validation

- Infrastructure Security Validation
- Data Privacy and Protection Controls Validation

3. Test Strategy

A cloud migration test strategy is developed in 3 phases, as below

- Infrastructure and Application Discovery based on discussions and workshops with the development team and business application owners of the existing architecture.
- Risk Assessment which involves identifying the risks, dependencies, and mitigation plans.
- QA Strategy and Roadmap which includes Test Strategy and Planning, testing
 recommendations, test Automation Tooling and defining Quality Benchmarks. Key metrics
 including OLAs, and transformation KPIs are highlighted and aligned to quality engineering
 practice.

3.1 Cloud Migration Dispositions

Cloud Migration Disposition Type	Definition	Description
Re-Host (Lift and Shift)	Redeploying an application to a different hardware environment, then changing the application's infrastructure configuration to support the Cloud	laaS (Infrastructure as a Service) is the most flexible cloud computing model and allows for automated deployment of servers, processing power, storage, and networking. EXAMPLE: Application migration to target Cloud Minimal effort to make the application work on the target cloud infrastructure Storage migration will be needed
Re-Mediate	Remediate means version upgrade of programming languages, frameworks, Operating Systems, Databases	SaaS (Software as a Service) providers host an application and make it available to users through the internet, usually a browser-based interface. As the most familiar category of cloud computing, users most commonly interact with SaaS applications such as Gmail, Dropbox, Salesforce, or Netflix.

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Re-Platform	Re-Platform is defined as application requiring platform changes for Operating system or Databases or middleware frameworks for cloud migration	PaaS (Platform as a Service) solutions appeal to developers who want to spend more time coding, testing, and deploying their applications instead of dealing with hardware-oriented tasks such as managing security patches and operating system updates. EXAMPLE:	
		Up-version of the OS and/or database on to the target cloud	
		Some level of application changes	
		Application reinstallation on the target	
	Re-designing how the application is architected and developed, typically using cloud-native features.	Re-designing how the application is architected and developed, typically using cloud-native features.	
		EVANDI E.	
Re-Factor		EXAMPLE:	
		OS and /or database porting	
		Middleware and application change to cloudify an application	
		Data conversion; database to AWS RDS	

3.2 Testing Applicability for each Disposition

Disposition Type	Cloud Infra Testing	Data Services Testing	Performance Testing	Security Testing	Functional Testing
Re-Host (Lift and Shift)	High	High	High	Medium	Low
Re-Mediate	Medium	Medium	High	Medium	High
Re-Platform	Medium	Medium	High	Medium	High
Re-Factor	Medium	Medium	Medium	Medium	High

3.3 Types of Testing for Cloud Migration

Infosys has a layered approach to cover quality across the Cloud deployment models and the service models. Our assessment framework provides a strategy to determine the scope of testing (type and coverage) based on the disposition type. As an example, the emphasis will be to do higher degree of Infrastructure testing and minimal Functional / Sanity tests for a Rehost disposition.

Type of Testing	Description
Infrastructure & Platform	 Cloud Platform Validation – Validation of landing zones as well as foundation for desired state configurations through Operational. Acceptance Testing, Operational Reediness Testing Operational Readiness – Testing of Disaster Recovery, Fail-over, High availability and Resiliency
Data	 Data Migration Testing – Testing for Datacenter migration frompremise source to cloud target. Data Lake Validation – Validation of Data Lake being setup on Cloud, Data ingestion test, Test Data Management. End to End Solutions on Databases like DW, BI, Kafka, BLOB, PowerBI, Tableau, Qlik, ADW, ADLS, SQL DB, Delphix, IBM Broadcom, Informatica, Kinesis, Firehose, S3, Glue, Athena, S3, Redshift, RDS, Snowflake.
Non- Functional	 Performance – Reliability, Resiliency and Scalability of Applications on Cloud. Chaos engineering can be used to achieve resilience against infrastructure failures, network failures, and application failures. Security Vulnerability – Validation on Cloud across IaaS, PaaS and SaaS - OWASP, Penetration, Encryption and IAM tests.
Functional	 Validation of Cloud Native Microservices and Containerised Applications on Cloud Testing of Legacy applications being modernised and migrated to Cloud. System Integration Testing (SIT), End to End Testing, User Acceptance Testing (UAT) support, Sanity/Smoke Testing, API Testing

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3.4 Infosys Cloud Performance Testing Service Capabilities

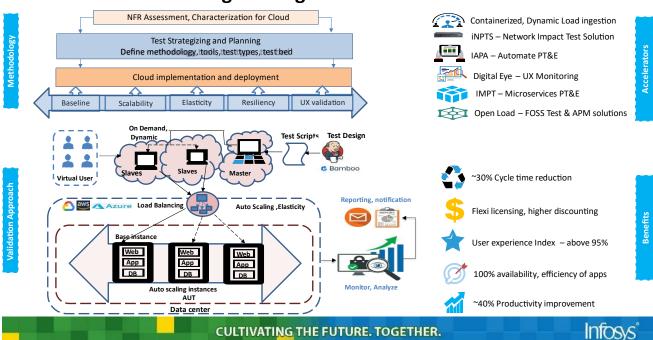
Infosys Cloud Performance Testing Services, help clients secure their cloud migration and transformation journey to simulate real-world conditions to help you understand how your application behaves under various levels of demand. Cloud performance testing services are essential tools for identifying bottlenecks, ensuring scalability, and providing a smooth user experience.

We, Infosys Performance Testing team, determine what controls can be leveraged for cloud subscriptions. We also perform manual/automated assessments to help customers decide their cloud strategy.

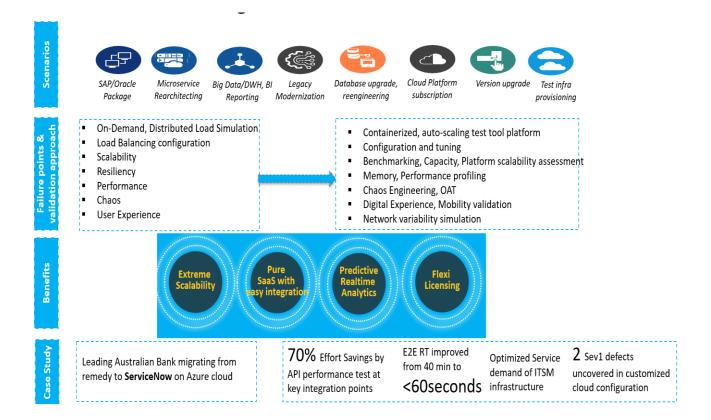
The Significance of Infosys Cloud Performance Testing Services:

- We conduct Performance assessment for applications hosted on cloud, APIs and integrations.
- We conduct Performance review of cloud migration readiness.
- We apply Performance strategy and Continuous monitoring to identify, detect, and prevent performance bottlenecks in the cloud ecosystem for assured performance of the applications.

Cloud Performance Engineering Solution

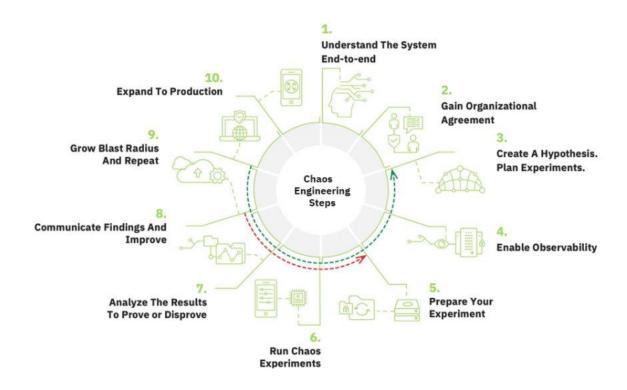


3.4.1 Infosys Cloud Performance Testing Approach



3.4.2 Chaos Engineering

Chaos Engineering is the practice of intentionally introducing controlled disruptions or failures into a software system to test its resilience and identify weaknesses, with the aim of improving overall reliability.



Chaos Engineering Process and Setup

Prepare for Chaos Engineering process	 Understanding the end-to-end application architecture, Isolate all the third-party calls and implement stubs Inform stakeholders of the Chaos engineering implementations and get necessary approvals before conducting chaos experiments. Build Hypothesis based on the system understanding, debate and finalise expectations with stakeholders, plan experiments.
Tools setup	 Setup following tools for monitoring and alerting: Honeycomb and New relic for service monitoring and
	 alerting, Prometheus and Grafana for resource monitoring and alerting, AWS cloud watch for monitoring logs.

Run Chaos test	 Setup Performance test tool(K6\Neoload\JMeter\LoadRunner) to generate peak load on the system under attack. Setup and enable Gremlin tool on the servers to run chaos test attacks. Setup Jenkins CICD pipeline to automate the chaos tests. Execute different kinds of attacks on the system to cause failures. Ensure proper alerts are generated for the failures and sent to the relevant teams to take actions.
Analyze results	 Analyze the test results and compare if it matched the expectations set while designing hypothesis. Communicate the findings to relevant stakeholders and development teams to fix any deviation from expectations. Analyze results
Run Regression Tests	 Repeat the tests once the issues are fixed. Increase the blast radius to uncover further failures.

3.4.3 Resiliency Testing

Resiliency testing shows how well a programme operates under stress before it malfunctions. It is a type of software testing performed to evaluate how an application will perform under stress, or in "chaotic" circumstances. Key features being observed are how well the programme can keep on performing core functions and preserve data integrity during these chaotic conditions.

How to Do Resilience Testing

Resilience testing is part of the SDLC and starts with setting up a test environment for the application to perform in. Here are the steps of a resilience test.

1. Determine metrics.

Developers need to pick out which metrics should be monitored to show how well the software is performing. For example, metrics could be input and output times, throughput, time to recovery, and latency. Metrics could also include the relationship between metrics.

2. Identify baseline performance.

Now establish a baseline for the maximum load that the software can experience and still perform adequately. You need this base to help establish other variables seen in the testing.

Introduce and evaluate disruptions.

Next, it's time to try and break your application. There are a variety of ways to do this, including communication disruption with external dependencies, inserting malicious input, turning off interfacing systems, etc. The information being gathered during these disruptions is what's important.

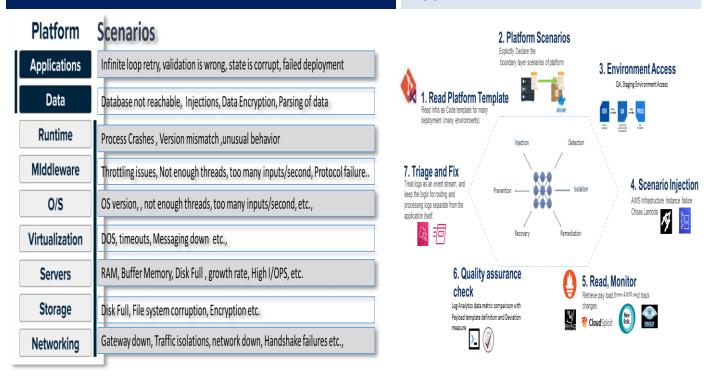
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4. Come to conclusions and decide how to respond to the test results. It's now time to use the data you just gathered to make informed improvements to your software. This data can also inform future testing.

Cloud Resiliency Testing Approach:

Resilience is ability to handle failure and recover from chaos failure injections. It is critical in Cloud context, as resources are dynamic aggregated, pooled and dropped. Since in Apple we have AWS and Hybrid cloud, Resiliency becomes very much valid to be considered.

Resiliency Testing Execution Approach



Benefit Platform Stability Robustness Zero Downtime Fail Proof

Site reliability engineering (SRE) is a discipline used for solving the challenges faced in running large-scale, highly distributed systems. SRE applies software engineering practices to operations and infrastructure, aiming to improve the system's reliability and reduce the time needed in detecting and recovering from outages.

SRE majorly focuses on the following activities:

- Monitoring systems to collect data on performance, availability, and user experience
- Reducing the latency for users in accessing systems
- Planning capacity to meet future growth and demand
- Incident management to efficiently respond to emergencies and resolve issues quickly
- Root cause analysis of incidents to identify the cause of failures and discover improvement areas

- Change management to ensure changes to systems are done safely and reliably
- Automate repetitive tasks and write tools to streamline operations, reduce manual tasks, and improve efficiency

3.4.5 Infosys Microservices Performance Testing – Key Capabilities

Our Value Adds for E2E Microservices Performance Testing



Rapid coverage of Microservices Development framework:

· Automatic Jmeter script creation for Open APIs: POSTMAN/Swagger



Technology Agnostic:

 Easily integrated and supports leading Monitoring tools like AppDynamics, Dynatrace, Kibana, Grafana



Seamless CI/CD Integration:

· Single click DvOps solution for implementing shift left strategy



Realtime performance monitoring

· Intuitive dashboard to get real time metrics



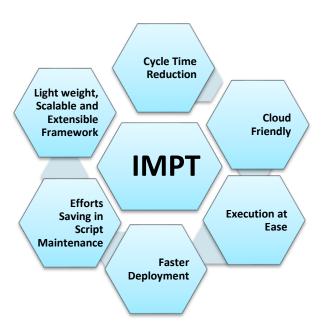
Enablement of holistic performance dashboard

Holistic view of the performance Test Results

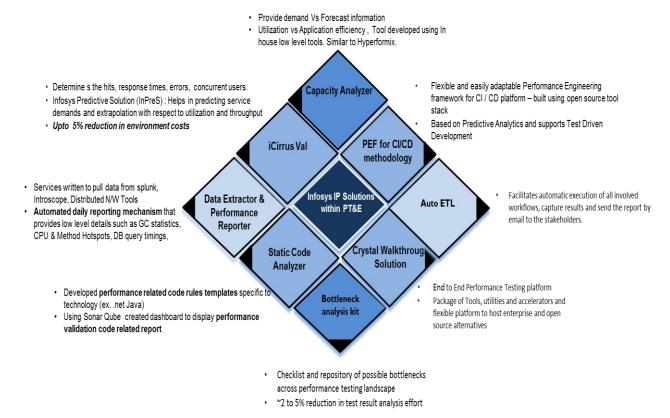


Easy Portability, Creation & Maintenance

· Easy maintenance of Scripts and Multiple environment support with simple configuration changes



3.4.6 Infosys IP Solutions within performance testing



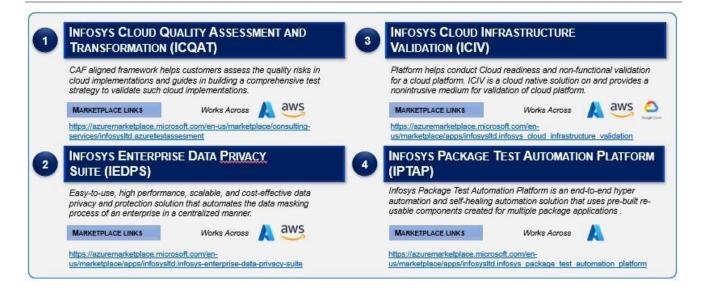
3.5 Infosys Accelerators on Cloud Marketplace

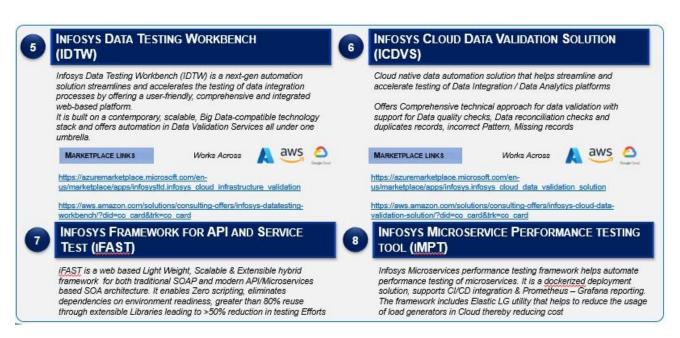
Below are the Infosys IP accelerators which help in accelerating the QA. These tools support most of the Public and Private cloud environments.

In addition to leveraging the infrastructure provided by the partners for testing, we contribute to their enhancement of the marketplace through our solutions.

- Infosys Cloud Quality Assessment and Transformation (ICQAT) is on Azure Marketplace
- Infosys Cloud Infrastructure Validation (ICIV) is on Azure and AWS Marketplace
- Infosys Cloud Data Validation Solution (ICDVS) is on Azure and AWS Marketplace
- Infosys Data Testing Workbench (IDTW) is on Azure and AWS Marketplace
- Infosys Package Test Automation Platform (IPTAP) is on Azure
- Infosys Enterprise Data Privacy Suite (IEDPS) is on Azure
- Infosys Framework for API and Service Test (iFAST)
- Infosys Microservice Performance testing tool (iMPT)

High level purpose for each of these tools is mentioned below





4. Credentials

4.1 Key Benefits

Below are the key benefits of implementing Infosys Cloud Migration Testing Service for any cloud migration programmes.

- 100% QA Coverage Assurance with a clear validation plan and strategy covering functional, data, platform and non-functional (security and performance) validations on cloud.
- Right Fit QA Methodology and recommendation on industry best practices for ensuring test maturity elevation and driven through a shift left approach.
- With at least 40% faster automated validation cycles through Machine first approach and right fitment on Marketplace tooling for automation on cloud
- 50% reduction in Testing cycle time and 70% increased productivity
- 5x Accelerated Cloud transformation.
- Next Gen engagement model, Optimised QA operations reduces the TCO by > 30%
- Solution enabled testing of Poly Cloud, Hybrid Cloud and for laaS, PaaS and SaaS service models.
- **7000+ Reusable assets**, 27 QA Solutions with 8+ available on Hyperscaler marketplace.
- Strategic partnership with Hyperscalers (AWS, Azure, GCP, OCI) and SaaS service providers (SAP, SFDC, PEGA, Oracle Fusion).
- 1700+ externally certified talents on GCP, Azure and AWS.

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4.2 Case Studies

Case Study	Objective & Challenges	Approach Solution	Benefits
Client is a 200year-old Banking Financial institute in Australia. It provides services in Banking, Wealth advisory, Insurance, Trading, Ioans and Cards.	 Build multiple fabrics based on Azure cloud (laaS, PaaS) to be used by the different IT/Business applications. Hybrid Cloud: Modernise application taking full potential of On-premise and Multicloud environments. 	 Infosys customised its iCIVS solution (non-UI based) to meet the clients test automation requirements. Implemented Automated test cases generated by iCIVS tool for cloud pipeline validation. Test automation suite merged with Azure build pipeline for automated validation post env provisioning. 	• 80% Reduction in Test Cycle Time
Leading post trade financial services company	Customer has embarked on a Cloud Transformation journey and the Programme objective is to develop and mature the foundational capabilities for sustainable cloud adoption, ultimately resulting on organisations readiness to securely design, develop and sustain operations of systems in the Public Cloud.	Continuous Compliance assurance solution implemented using: Chef InSpec Framework Ruby scripting language AWS SDKs Capabilities: Performs compliance and configuration check for cloud infrastructure. Run within/outside the infrastructure provisioning pipeline Automated Defect Management in Jira using inhouse developed RubyGem Also run against already provisioned infrastructure	Compliance & control — Adherence to compliance and security best practices Reduced Costs — Prevents misconfigured infrastructure provisioning. Uncovered 3K defects across environments. Cloud Agnostic — Can be extended to other cloud Service providers and related services in addition to AWS.

Client is one of the leading investment management firms in US. The client is migrating legacy applications to with single platform using AWS cloud.

- Establish performance baseline of Microservice based system and compare the performance with legacy system.
- Understand if there is any impact on the user experience, query execution time, Batch job and MQ response time degradation due to the migration.
- · Carried out production log analysis and identified key transactions from premigrated application and derive peak production volume for post migrated application.
- · Analyzed the performance issues, exceptions, error, warning recorded during test run and monitor any functional / environmental issues with the help of Splunk, Dynatrace and Load Runner Analysis,

AWR report, Dynatrace and

Splunk log analysis

• 20-30% improvement in response time and throughput) improvement post tuning

Infosys's client is an international technical athletic apparel retailer.

- Migrate data from Netezza to Azure SQL Data warehouse, remove dependency on Netezza and sunset on-premise data management platform
- · Re-point the existing reports to Azure SQL data warehouse and create Power BI reports pointing to ADW
- Deployed IP tools IDTW and BIRT to support hosting on cloud and established connectivity to new data sources like Snowflake, ADW, and extended support for Reports QlikView, Power BI and SSRS respectively
- 50% effort saving in data validations with use of automation tools
- 30-40% reduced time to market

Infosys's client is a premier Health Care client in US

 Build Microservice wrappers to the existing SOAP Services to fulfill the business

requirements

- Stringent timelines as the existing application had to be transformed to new application within 4 months before the new enrollment season starts.
- Microservice component level testing, Integration level testing, Process level testing, System level testing using open-source tool (SOAP-UI tool and custom functions). Usage of JIRA tool for Test Management, Usage of Bit Bucket

Repository and Bamboo Dashboard as a part of CI/CD Setup

- 35% effort saving
- Zero defect leakage to production

Client is a multinational professional services network headquartered in London, United Kingdom. It is the second largest professional services firm in the world. and is one of the Big Four auditors in the

world.

- Performance testing for laaS cloud infrastructure for applications like Global Snapshot, CCH, ACC portal and EMT
- Performance testing for PaaS cloud implementation for application like Attend and Vantage.
 Performance testing for SaaS based Salesforce application.
- Performance benchmarking of integration infrastructure like IIB, Biztalk and BOS when

- Created
 performance test
 scripts for 200 +
 critical for 10
 different
 applications.
- Executed 300 +
 iterations multiple
 rounds of Load
 tests with VSTS
 online on cloud
 from different
 locations.
- Performance testing of cloud based applications from on premise load test tool.
- Used various
 APM tools like
 AppDynamics ,
 Azure insights to
 identify server
 level bottle necks.

- 15 + Applications successfully migrated to cloud
- 400% Improvement in response times.30+ Bottlenecks Performance bottlenecks identified
- 1 Million transaction throughput achieved for Snapshot application.
- 1800+ Pre and post tuning load tests.8000+ Vusers Concurrent users load



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