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# Low Latency, High Availability and Fault Tolerance Using Cloud

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**ABSTRACT***:* With the changing need in the domain of web development nowadays, many of the web developers have been using a plethora of functionalities related to cloud computing in order to make the user experience smooth and wholesome.

One of the greatest problems faced by the users is the crashing of web applications, which create a lot of nuisance in the present day scenario. In the present times of ever more connected world every second of being connected to the web matters, and when your favourite website crashes down even for a second it is highly irritating, for this reason we plan to incorporate backup of all the resources including the code of the website, so that we can totally eliminate the problem of downtime. Majority of the users regularly use some specific features of a website, and so we plan to incorporate caching which would collect and store the contents of the website locally, in order to highly fasten the access of contents and produce lesser latency. The usage of websites depend on a number of factors and there is a huge variation in the number of users of a particular website at any particular time, and hence we plan to balance the load over the website for a preventive stance to this issue.

**KEYWORDS**: Latency, Availability, Fault Tolerance, Cloud, Resilience

## I. INTRODUCTION

In this research, we built a fault tolerant Word press site in which we will use the concepts of cloud computing. The basic features of the project that we wish to incorporate in this website are summarized in the following section which includes that the website will be resilient in nature i.e. their will be a backup for code, media assets which would be resorted to when the site crashes. The website will make the users use the Cloud-Front in order to speed up the access to the contents of the website thus less latency. To prevent the overloading of any of the virtual machines, we would include load balancers to ensure that none of the virtual machines in use would be overloaded. We would incorporate various health checks and according to the results we would incorporate auto-scaling. We would use Bootstrap scripts for the entire project, and we would use it to create Amazon Machine Images and we would conclude the paper with results and future scope.

## II. RELATED WORKS

In paper [1] Taskeen Zaidi et.al. Tolerance of faults in the cloud computing environment. The issues occur due to overlooking of various traditional aspects of computing with the cloud computing environment. The paper talks about the various fault tolerance methodologies fallowed in modern computing. The techniques are studied and compared using various UML and state diagrams. The changing attribute of cloud computing can lead to a number of unpredicted faults and defects. The methods are compared for best results on these faults. The preferred technique here is that of round robin. This model updates at the local and global checkpoints.

The paper [2] by Rajesh.S et.al. Discusses the importance of fault tolerance and techniques for better working and overall functioning of the cloud computing systems. The paper here introduces a model which checks the model's trust ability based on the Virtual Machines. The time limit corresponding to the virtual machine gives the reliability of the

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system. A backward recovery is performed in case the system is not up to the level. The paper has focused on the forward recovery mechanism. The results of the system can be applied in case of real time cloud computing environment. The method is also seen to quite fault tolerant. The method here is great for enhancing the quality of Service for the cloud.

Paper [3] by Chetan M Bulla et.al. Studies the Cloud Computing environment and developments with the usage of other areas in computing like SOA, Utility computing, grid computing etc. The paper studies the techniques and developments along with the challenges faced by the cloud computing. Various technologies have been seen along with their challenges. Challenges in the face of protection, Authentication, Access control, Trust Management, Policy Integration, Secure-Service Management, Privacy and resource Management have been identified. Further challenges include workload prediction as well as Dynamic allocation. It can be concluded that a lot of research scope rests for overcoming these challenges.

In the paper [4] Jasbir Kaur et.al. Discusses fault tolerance in Cloud computing environment. The paper discusses the initial methods of fault tolerance like check pointing, Job Migration, Replication, S-Guard, Retry etc. being a few. The method introduced here tries to make sure that faults do not occur in future as well. The system schedules the jobs and then applies the MPI on it post which the compatibility check is performed. After this step we implement MPIL. The paper sees that the results and performance achieved in case of application of MPIL is superior to that seen in case of using MPI. This is calculated both in terms of the number of checkpoints needed as well as the energy used.

The paper [5] has writer Salma M. A. Ataallah et.al Talk about and compare the various cloud computing techniques used nowadays. The comparison has been done on the basis of MTTF, MTTR, MTBF, Reliability, Availability, Safety and Maintainability. The strategies for fault tolerance are proactive fault tolerance and reactive fault tolerance. The AFTRC Model for fault tolerance gives reliability. The techniques have been compared based on resource, Distributed environment, Policies, Reliability and availability. The paper concludes with adding that new fault tolerance mechanisms are also coming up with this new age technology.

The paper [6] by Jeffery C. Mogul talks about the reliance of Iaas and Paas users on cloud service providers. This article discusses several options for cloud provider concludes that there is network latency requirements of tenants. A compromise between the different requirements of the lesser Participation, accuracy and output devices overhead. The paper talks of overcoming challenges of measurement of network latency, application level performance effects and perturbing network latency. It is affirmed that the cloud platform should conclude, as a tenant applications depend on network latency, as part of "Undifferentiated heavy lifting" that makes the cloud valuable for enterprises, and that the PN codes can includes it.

The paper [7] by Seyyed Mansur Hosseini et. al reviews the various FT techniques used with cloud computing. In this paper, Ault tolerance has been introduced in the context of cloud computing, and fault-tolerant technology has been proposed. After introducing some measures, a comparative analysis given. The models have been compared on the basis of proactivity, reactivity, performance, adaptive, response time etc.

The paper [8] by Patricia T. Endo et.al. Discusses and reviews the various problems that turn up for providers due to high availability with the cloud environment. The paper discusses the various HA solving techniques and gives a comparative evaluation of those fallowing. The authors segregate the methods for HA into middleware and visualization based. The results are classified to form 3 layers while keeping in mind the SAF Framework. The paper considers portability, safety and reliability as important measures for this problems solution.

Paper [9] by R. Jhawar focuses and analyses the repeating issues with cloud computing. The fault characteristics of typical clouds are discussed Based on service and analyzed the impact each failure types of in the user's application. The paper came up with an Innovation and Take advantage of existing solutions for delivery solutions and their use performance to provide a high level of fault tolerance based on a given set of desired attributes distribution plan.

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Paper [10] by Chunye Gong et.al. Talks about the various characteristics possessed by the Cloud Computing. The paper provides the distinguishing aspects of cloud computing like being service oriented, loose coupling, fault tolerance etc. This article attempts to summarize the general characteristics of Cloud computing, which will promote the adoption of this rapidly developing technology. The office oriented conceptual characteristic abstracted detail internal implementation. The paper finally focuses on cloud computing characteristics that differentiate it from the other forms of computing that have been present in time like grid computing, utility computing to name a few.

The paper [11] specified here by B.P. Rimal talks about the cloud computing technology and infrastructure. The various cloud platforms like Amazon web services, GoGrid etc. have been compared and contrasted on the basis of their architecture, Services, Virtualization Management, Fault tolerance, storage, security, framework etc. to name a few. The open source cloud platforms are also compared on similar grounds like Nimbus, OpenNebula etc. The paper gives the main comparison of the various platforms for a user to choose and compare between.

The paper [12] by A. Bala discusses about the fault tolerance based issues and solutions faced by the Cloud Computing framework. The various fault tolerance techniques like Self-healing, Check pointing, Job Migration and replication have been compared and contrasted based on policies, systems, Programming framework, Environment detection and application type. They have further proposed a virtualized cloud system which has its basis on HAProxy. The benefit is that failure of one server does not lead to fall down of the whole system but actually leads to redirection to a working server system.

The paper [13] by M.A. ALZain et.al gives an idea of the issues that come up with multi user cloud environment. The paper aims to draw awareness to the security issues faced by multi user cloud backgrounds. The paper discusses the issues that come with multi user environments like privacy loss, Virtualization vulnerability, privacy loss, integrity and confidentiality based issues, data storage security issues etc. The Byzantine protocols related are introduced. The DepSky system has been talked about in the paper which takes into consideration data confidentiality and security. The authors overall support change to multi user cloud systems to reduce the security risks seen by the cloud framework.

In paper [14] authors L. Youseff et.al. Tries to give a highly descriptive idea of the cloud computing ontology. The best advantage of the paper would be in its capability to help the acceptance of this scientific technology for the use by this generation. The layers of cloud computing can be divided into a total of five and the paper examines their advantages and disadvantages. The paper compares the models based on the various layers in cloud computing and gives a detailed description of the cloud computing ontology.

The paper [15] by D. Mani et.al. Gives a brief description of the Fault tolerant computing systems. The paper basically tries to show how the Markov Based model attempts to solve the client issues. The markovian and non- markovian models are also compared here. The best model for average time eliminates the time spent waiting. Repair is a CTMC, with reduced risk of potential speed. Repair periods significantly improved and demonstrated lognormal assignment than Exponential transmission. This technique in paper sees Hardware, software as well as network related failures.

## III. PROPOSED METHODOLOGY

The network diagram has been created with the help of website draw.io; it summaries and correlates all the features and functionalities of our website which have been described below:

- **Cloud Front**: We will be using the services of the CloudFront in order to speed up the usage of the contents of the website. It uses the concept of caching which stores the con- tent in edge locations.

- **Route 53**: We plan to use Route 53 for health checks and the visualisation of various metrics using CloudWatch.

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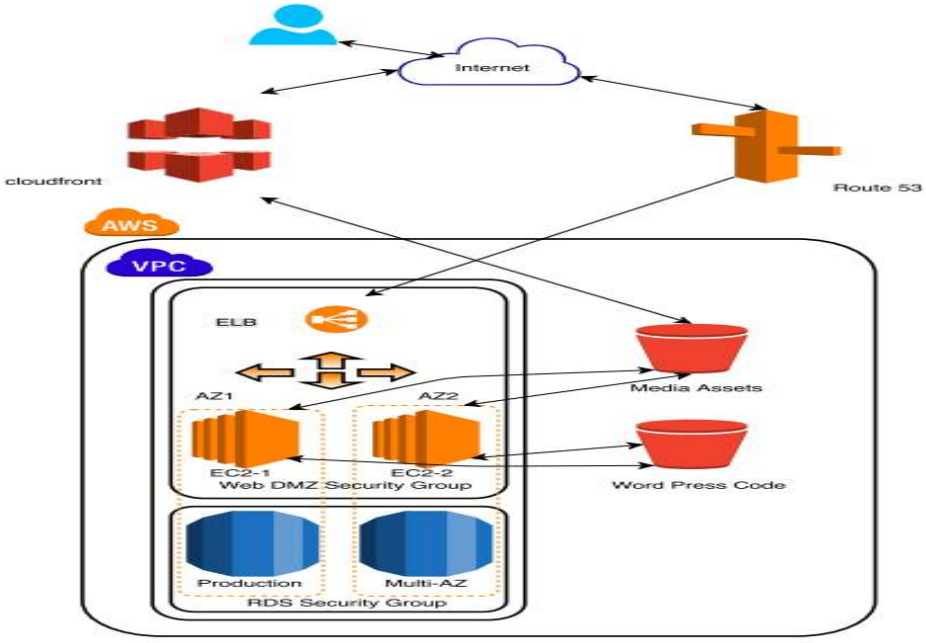
- **VPC (Virtual Private Cloud)**: In this we plan to have two subnets: public and private. The public subnet would be for casual users who can view content over the website, while the private sub- net can be used for the purpose of editing or maintaining the website.

- **S3 Buckets**: We will use two buckets: one would be containing the entire backup including the code, and the other buckets would contain only the media assets.

- **ELB**: Elastic Load Balancers which would be used in the process of load balancing.

- **EC2 Instances**: We will be using two EC2 instances: one would be used in the public domain while the other would be used for the purposes of content writing etc.

- **RDS Instances**: We would be using two RDS instances in which we will be installing SQL servers.




**STEP 1**: We create a new Amazon Web Services account and set up the Identity Access Management portal to secure our root device access. Then we create a role for S3 Full Access so that we can manage the various S3 services through our account. Then, we create two security groups one for RDS instance access and the other for Web DMZ access. Within these two security groups we would further place our instances for the production and the content management teams working on the Word press Site. These groups would provide common privileges and security access to the users.

**STEP 2**: We launch an Application Load Balancer which would monitor the use of resources on the site and act in accordance with the usage. We assign this load balancer to the Web-DMZ group so that it performs regular health checks on the target group instances. Now, we deploy two S3 buckets one specifically for the media contents on the website and the other for the code running on the site and the media objects. The first would be used to provide speedy access to the users because it would store the media contents which would be made available to the users by routing them to use Cloud-Front instead. The second bucket is merely for the backup of the site and its contents.

**STEP 3**: Now we create a content distribution network using Cloud-Front which will the cache the most frequently used contents and blogs over the website. For loading the SQL-server we create a RDS instance so that we can load

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images and contents in the Word press site. We here use a instance that will support Multi AZ Development and is a t2.micro instance class. We grant the full S3 Admin Access to this RDS instance. Now, we create an Amazon Linux t2.micro AMI for the creation of web server through EC2 console and grant it Full S3 Admin Access. Now, we with the help of scripting we create a server and with the help of the permissions certificate log into the EC2 instance. We load into the root access to make further changes and install the amazon security updates. Then, we create an html file for health checks. Also, we install the Word press code from the site, with the help of Tar. Now, we edit the setting of health checks so that on every 6 seconds a health check is initiated. Now, we go to the Word press site, in order to complete its installation and link it to the RDS instance. Now, in order to store and sync the media contents on the Word press site, we recursively store all the data in the S3 bucket and on syncing, each time the previous data is deleted and the new one is loaded in the bucket for a consistent data repository. As, now each image will be displayed through the Cloud Front when being accessed from the website. This has been shown in the image below. Now, in order to sync this into our media bucket automatically we edit the crontab file, and edit it so that after every 5 minutes the S3 bucket is synced back after deleting the previous contents. Now first, we create and deploy two EC2 instances separately for the Production Team and for normal Content Surfing and we create images for these instances.

**STEP 4:** We create an Auto Scaling group, deciding the initial group size- the number of instances the group starts with and the subnets over which the Auto Scaling group would function. We set the health check grace period as 10 seconds for deploying quick health checks, also we set the threshold to deploy commence two new instances in case the load crosses 75% for a simultaneous of five minutes, and to terminate one instance when the load comes down below 25% on a similar cycle of five minutes. We set up notifications to be sent in case of launch, termination, failure of launch or termination of launch of EC2 instances to the Administrator email id. Now, on termination of two instances, two new EC2 instances are generated automatically and deployed. Screenshots of the following are attached. We then stress tested the EC2 instances by logging into them, and then with the help of Stress application that we installed in the Review 2, we dispatch 100 threads from two terminal windows to load up both the EC2 instances. As soon as the health check occurs and load is detected, two more EC2 instances are launched**.**

## V. RESULTS

We obtained a highly available, fault tolerant and low latency system and it can be seen in the following figures.

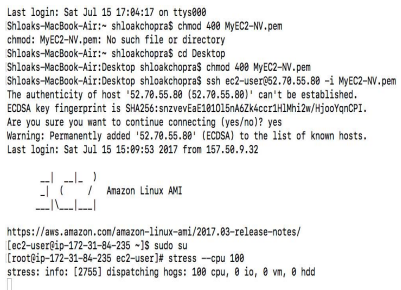


Fig.1. Fault Tolerance

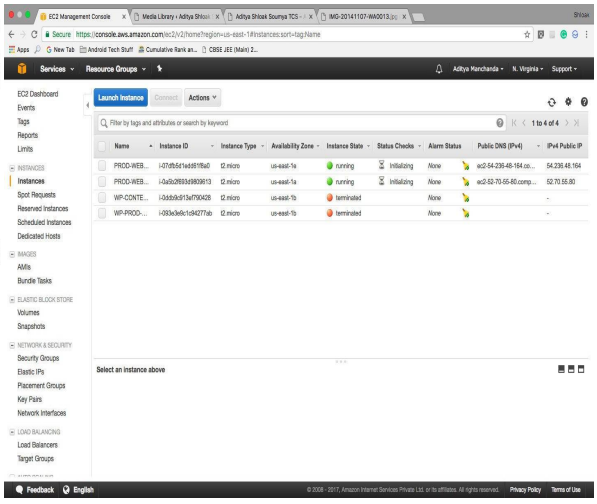


Fig. 2. Auto Scaling

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Fig.3. Improved result in speed

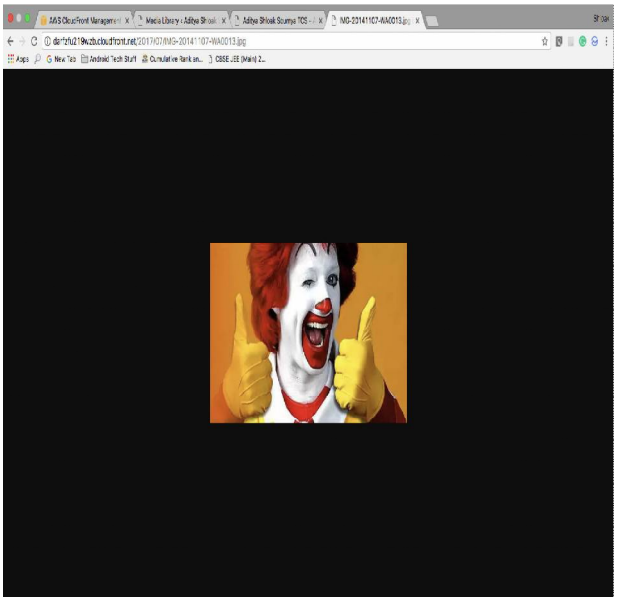

Fig. 4. Low latency using cloudfront

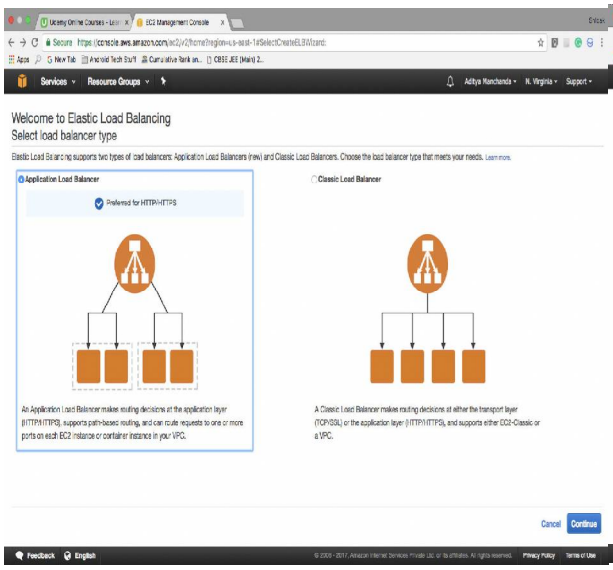


Fig.5. Load Balancing.

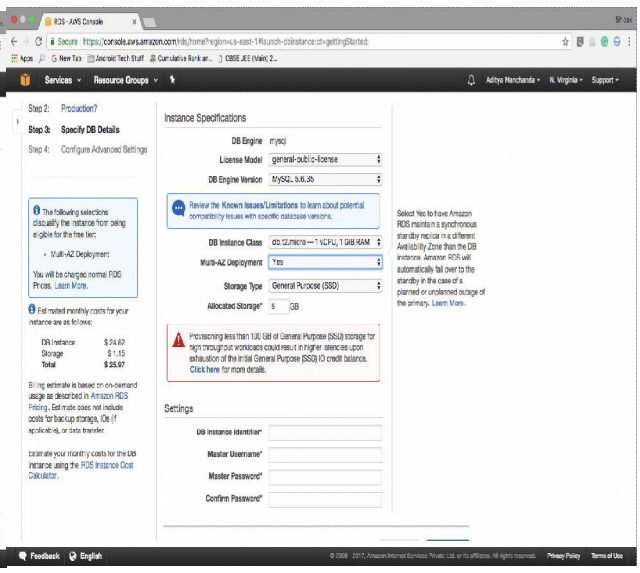


Fig. 6. Highly Available.

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## VI. CONCLUSION AND FUTURE WORK

Thus, with the successful deployment of Auto Scaling groups, Load Balancing, Cloud Front Networks, Automated backups, Virtual Machines we made a highly available, fully fault tolerant and low latency system.
In future maybe more latency can be reduced using more efficient algorithms and networks

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