ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2015; 1(10): 538-542
www.allresearchjournal.com
Received: 12-07-2015
Accepted: 14-08-2015

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A comprehensive study on Microsoft azure cloud services, architecture and controls implementation

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Abstract
Microsoft Azure is one of leading public cloud service platform from Microsoft Corporation. It provides almost the entire cloud delivery model services (SaaS, IaaS and PaaS) deployed across different Microsoft and partner managed hosting data centers across the world. Azure provides a central interface called management portal for management of most of the azure services to consumers [1]. As we know industry still facing lots of cloud related challenges due to lack of standards, especially in the area of security where customers are still not confident to share their critical and confidential information and data with some third party service provider. Some concerns are truly valid but some concerns are there due to lack of knowledge and misconceptions. One of the best ways to understand all of the gaps and challenges is to first understand the cloud computing architecture and all related security implementations of any one of the leading cloud service provider, and then do a deep dive to understand all open gaps and challenges. In this paper I am going to explain the basic architecture and security implementations of the Microsoft Azure cloud delivery model. After reading this paper you would able to read and understand any of the cloud service provider cloud architecture and security implementations as all are running with some basic common architecture and service implementations.

Keywords: study, Microsoft azure cloud services, architecture, controls implementation

1. Introduction
Microsoft Azure services have been divided into four different layers as I have explained below. All these are some generic layers which you will see almost same in all cloud service providers cloud architecture [2].

- **Client Layer**

Client layer is the on premises cloud consumer layer who is actually using the cloud services from different sources like mobile, tablet, pc etc.

- **Integration Layer**

Integration layer is the mediator or first layer of interaction with the cloud services. It provides some generic security, access and performance related functionalities. For example, Active Directory provides first level of authentication to access applications, CDN used to increase the performance of website heavy contents like videos, images etc, Traffic Manager is used for load balancing the requests between multiple application instances.

- **Application Layer**

This is the actual middleware layer all of your applications deployed and executes the business logic and functionalities.

- **Data Layer**

All of your structured and non-structured data resides at this layer either in relational or non-relational database.
Please refer below Fig 1 to understand all layers and their major functionalities.

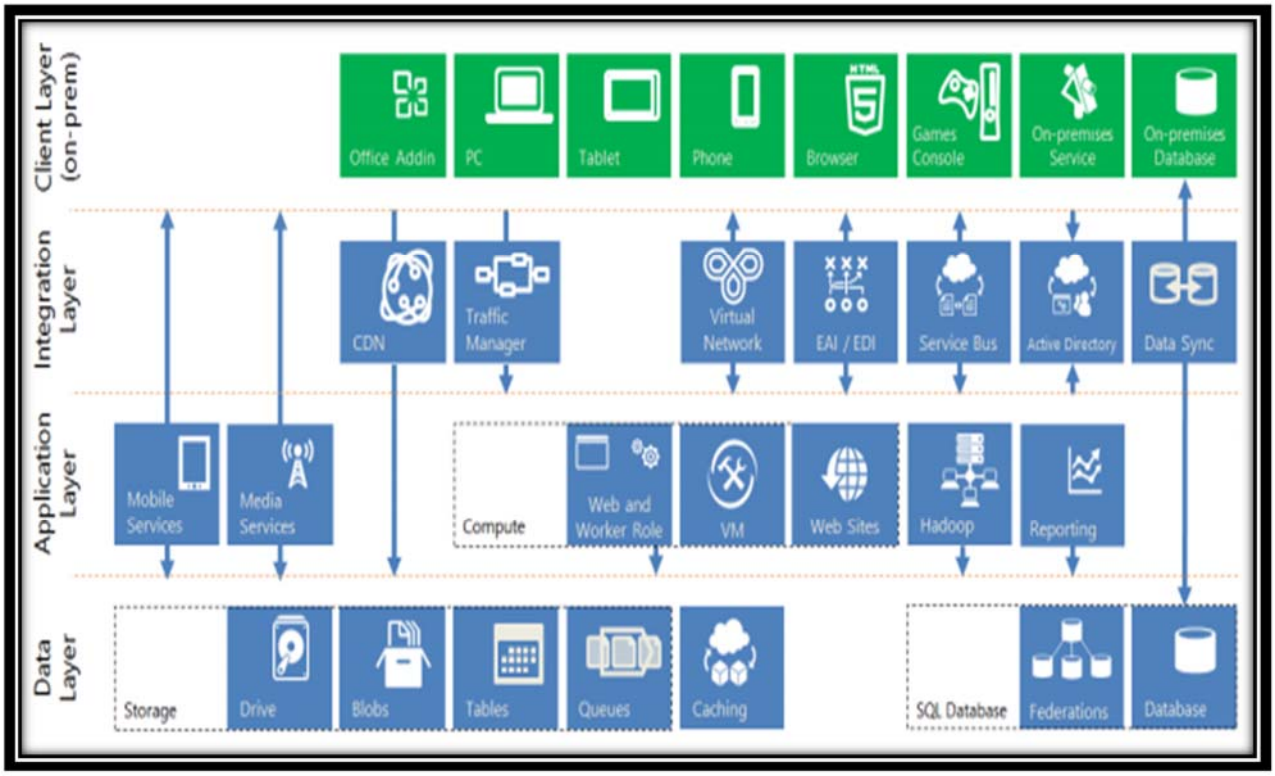

Fig 1: Microsoft Azure Service Model Layers [2].

Below are details of some major Microsoft Azure cloud service components and subcomponents. There are different alternate set of components and subcomponents associated with each layer which gives flexibility to consumers to choose services according to their requirements. For example, Development and IT service component provides different set of tools and software's for designing and development of applications and API's. Data layer provides different set of options to store structured and non-structured data. Performance component provides different sub components like caching and content delivery network services to increase the performance of end consumer applications and contents.

MICROSOFT AZURE		
Compute	Virtual Machines	Websites
	Cloud Services	
Data Management	SQL Database	Storage Blobs
	Storage Tables	Import/Export
	File Service	
Netowrking	Virtual Network	Traffic Manager
	Express Route	
Developers and IT Services	Visual Studio Online	Azure SDK
	Azure tools for visual studio	Automation
	API Management	
Identity and Access	Active Directory	Multi-Factor Authentication
Mobile	Mobile Services	Notification Hubs
Backup	Site Recovery	Backup
Messaging and Integration	BIzTalk Hybrid Connections	BizTalk Services
	Storage Queues	Service Bus Queues
	Service Bus Relay	Service Bus Topics
Compute Assiatnce	Schedular	
Performance	Cache	Content Delivery Network
Big Compute and Big Data	HDInsight	High Performace Computing (HPC)
Media	Media Services	
Commerce	Store & Marketplace	
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Fig 2: Microsoft Azure cloud services components and sub components

2. Microsoft Azure Architecture

Below Fig 2 is showing the high level architecture of Microsoft Azure cloud service platform. It's a generic architecture as well which is used by almost all cloud service providers where the difference is only the different technologies and way they have implemented it internally. Consumers access the cloud applications using their browser via net. First it comes to a load balancer (Traffic Manager in Azure case) via firewalls. Load balancer identifies a backend best serving candidate or you ca say a web server instance based on different efficient configurations. Web server instance further pass request to the backend actual application instance where actual code is deployed and running, and application tier further backend data layer to access different kind of structured and non-structured data. From security perspectives, there is a joint responsibilities consumer and vendor to secure complete computing environment. Physical and some internal communication securities managed by vendor but customer should have to implement security features like ssl certificates, virtual private network etc configurations to make data transmission safe. There are different joint responsibilities based on different cloud models.

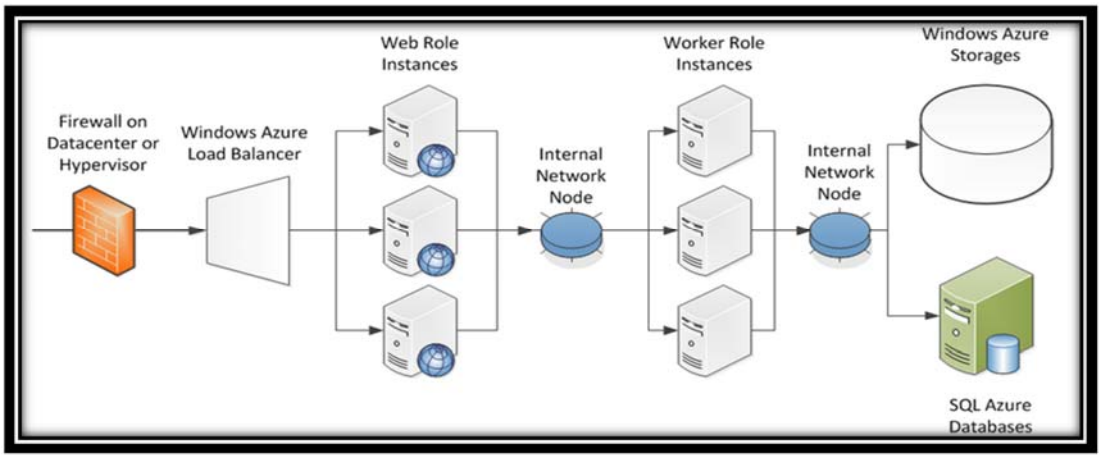

Fig 3: Microsoft Azure Basic Architecture [3]

Windows Azure cloud services architecture based on certain scalable components called roles. Every service hosted on azure implements one or more roles based on consumer requirements. Running instance of each role can be migrated and replicate across different computers for implementation of complete or few part of the 5services [4, 5].

There are three main different kinds of roles in Azure –

- **Web Role**

Web Role host the IIS (Internet Information System) MS web server for hosting front end web applications or as load balancer or for security reasons which further redirect the requests to Worker Role. You can easily deploy your web applications on Web Role and depend on your requirement easily scale up and down your web role compute requirements,

- **Worker Role**

Worker role is where you actually deploy your business applications for executions of your business logic. It's typically the compute environments where you deploy your applications on some application server or run time engines. This is the role where your web role forwards the requests for actual execution of business functionality to get the desired results to forward to end user.

- **VM Role**

This is an optimized role to deploy and run your entire virtual machine as a monolithic entity [9]. Here you can copy your complete operating system image with all necessary software's, patches, tools, etc directly to azure machines in a push and publish model. You have to maintain your machine for all patches and updates.

Please refer below figure 4 to understand difference between a traditional on premises and Microsoft azure cloud delivery model.

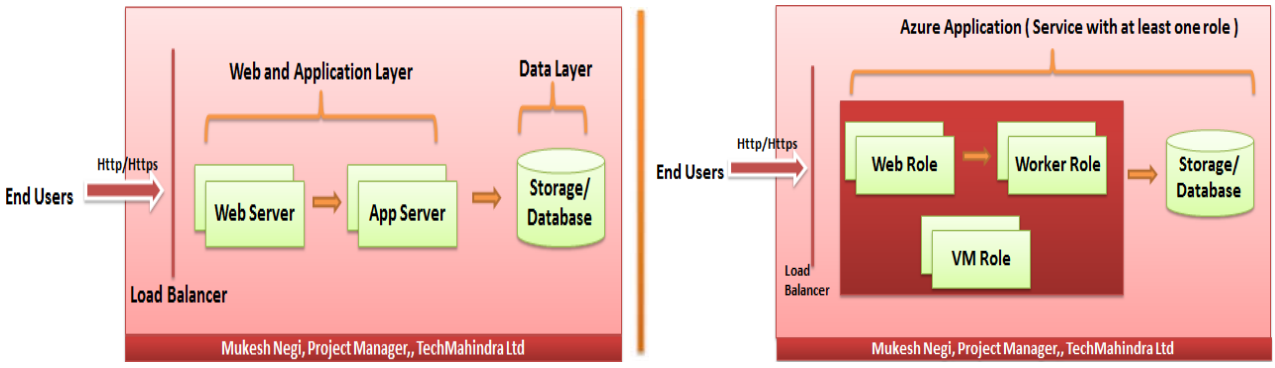

Fig 4: Traditional 3 Tier Architecture MS Azure Architecture

3. Microsoft Azure Controls Mplementation

If we talk about the top threats in terms of the unavailability of the cloud services then, first is the failure of different cloud service such as servers, drives etc, and second is the exhaustion of the resources like at the time of peak service load. Azure cloud service models is configured with all high availability features where they have implemented different service nodes failover and load balancers in front of them for proper load balancing of requests between each service node. Azure storage is also configured in same redundant and failover mode.

Fabric Controller

Azure and almost all public cloud models are built on top of virtual machines. In Azure, all applications are running on different virtual machines running on top of different physical servers. For proper management and scalability, Azure has divided and grouped virtual machines in different clusters of around 1000 or more servers in each cluster. Each cluster is independently managed by a software component called Fabric Controller. Please refer below Fig 5 for same [11].

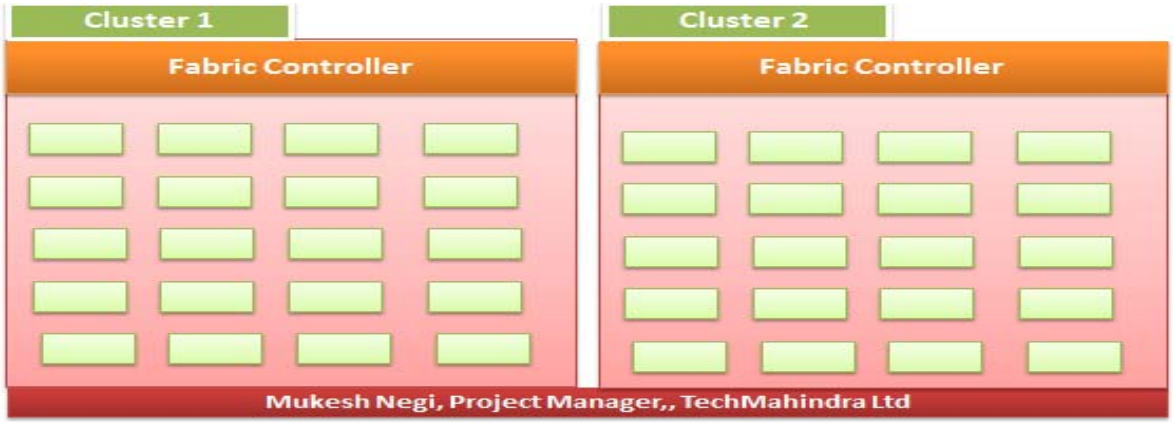

Fig 5: Azure VM Clusters and Fabric Controller

Fabric controllers manages the complete life cycle of applications deployed on azure machine clusters as well as the provisioning and health monitoring of machines running under it. It does all of the applications as well as hardware related works like failover of virtual machines on different healthy servers in case failure of a machines, and compete management of the applications like deployment, redeployment, scaling up and down etc. the reason for diving the machines between different clusters is that it isolates the faults between different fabric controllers and prevent attacks and bugs to scattered outside the cluster machines. All Azure virtual machines run on the Hypervisor (Hyper-V), and all azure cloud serves hosted and runs on dedicated virtual machines excepts Azure website which may deployed, hosted and shared with different customers on different shared virtual machines [11].

A. Fabric And Guest Agent

Each physical host on Azure has a separate machine called Host OS which runs a Fabric Agent. It's connected with Fabric Controller to get commands to control all virtual machines on that particular physical host. Except Host OS virtual machine, each customer controlled, PaaS and IaaS model virtual machines runs a separate agent called Guest Agent (GA), which connected and communicate with Fabric Agent to get instructions to control VM and running applications on it. Collection of Hypervisor, Host OS/Fabric Controller and Other Virtual Machines/Guest Agents define a compute node. Please refer Fig 6 to understand same [10].

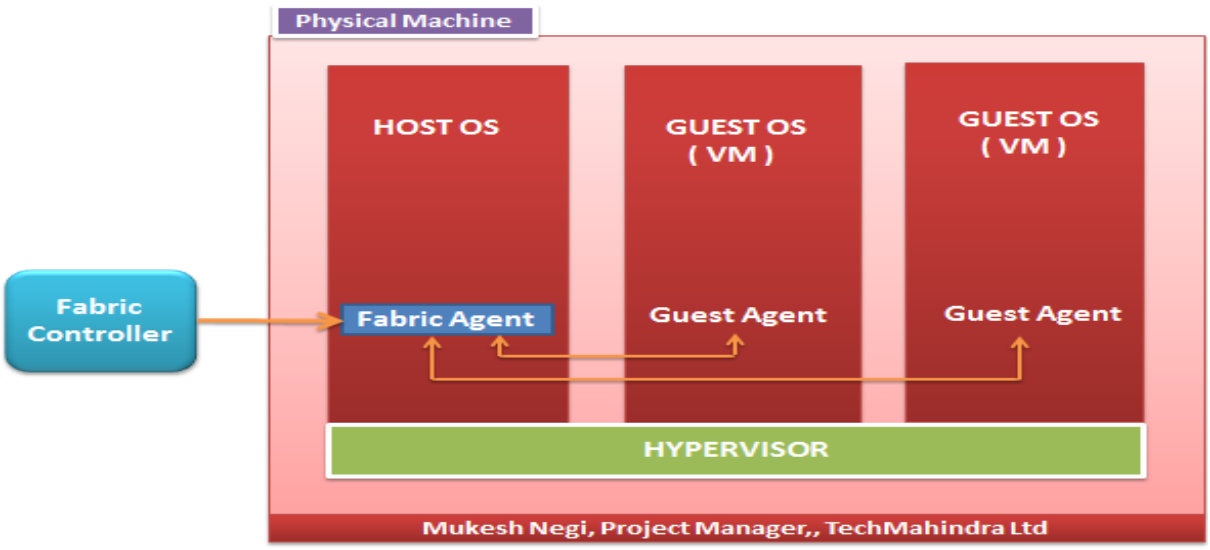

Fig 6: Azure VM Clusters and Fabric Controller

You can say Fabric Controller is the heart and kernel of Cloud OS which manage servers as well as services in the Azure cloud data center. Guest Agents are used by Fabric Agent to determine the heartbeats of all virtual machines to know their health and for failover capabilities as well as for secure communications, like to deploy security certificates with packaged applications for secure encrypted communications between Host OS and Guest Agent machines. Certificate contains the security of your applications so Guest Agent every time creates a transfer certificate for all communications over logical and physical network [11]. Please refer below Fig 7 to understand same.

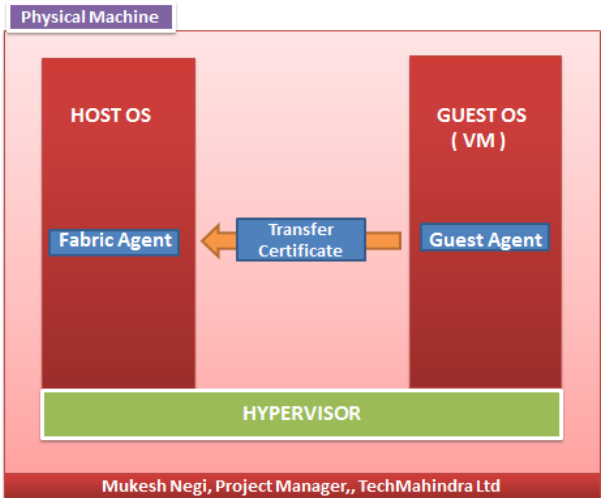

Fig 6: Secure Transmission (via certificate transfer) between FA and GA

4. Conclusion

Cloud architecture is the base to understand any cloud delivery model, and then to understand the internal implementations is equally important to continue future research and recommendations. In this paper I have discussed about cloud architecture and how controls implemented to protect customer's data by one the leading cloud service provider Microsoft Corporation in their cloud services model with name Microsoft Azure. This article gives a clear understanding on how they have implemented compute services at different layers, and how they secure customers data during internal component and sub components level transmissions to avoid any data compromise by hackers in between. Considering the leap year bug in 2012 when some of Microsoft azure services were down for around 6 to 10 hours due to guest agent certificate validity error [11], Microsoft has enhanced Azure a lot in last three years, but still there are lots of scope to understand and do some advance research to identify such gaps to avoid such kind of events in future.

5. References

1. Introducing Microsoft Azure, https://azure.microsoft.com/en-us/documentation/articles/fundamentals- introduction-to-azure/
2. Windows Azure Interactive Feature Map, http://blogs.msdn.com/b/jimoneil/archive/2012/09/21/windows-azure-feature-map.aspx
3. File:Windows Azure Network and Computes Architecture. png, https://commons.wikimedia.org/wiki/File:Windows_Azure_Network_and_Computes_Architecture.png
4. The difference between Azure VMs and Azure VM Role, http://blogs.msdn.com/b/plankytronixx/archive/2012/06/08/the-difference-between-azure-vms-and-azure-vm-role.aspx
5. In Windows Azure: What are web role, worker role and VM role?, http://stackoverflow.com/questions/7118942/in-windows-azure-what-are-web-role-worker-role-and-vm-role
6. Microsoft Azure Cloud Services Part 1: Introduction, http://justazure.com/microsoft-azure-cloud-services-part-1-introduction/
7. Kim H, Parashar M. (2011) CometCloud: An autonomic cloud engine, cloud computing: principles and paradigms. chap. 10. John Wiley & Sons, Inc., pp 275–297. http://onlinelibrary.wiley.com/doi/10.1002/9780470940105.ch10/summary
8. Kim H, Chaudhari S, Parashar M, Martyy C. Online Risk Analytics on the Cloud International Workshop on Cloud Computing In: conjunction with the 9th IEEE International Symposium on Cluster Computing and the Grid, 2009, 484-489.
9. Rajkumar Buyya. Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility, Future Generation Computer Systems, 2009; 25(6):599-616
10. Cloud Computing for IT Pros (3/6): Windows Azure Computing Model - See more at: http://blogs.technet.com/b/yungchou/archive/2010/12/28/cloud-computing-concepts-for-it-pros-3-6.aspx#sthash.ThCH9rhJ.dpuf, http://blogs.technet.com/b/yungchou/archive/2010/12/28/cloud-computing-concepts-for-it-pros-3-6.aspx
11. Mell P, Grance T. The NIST Definition of Cloud Computing, NIST Special Publication 2011, 800-145.
12. Azure Fabric Controller Internals: Building and Updating High-Availability Apps, https://channel9.msdn.com/Events/Build/2014/3-627
13. Windows Azure and Cloud Computing, http://oakleafblog.blogspot.in/2010/12/windows-azure-and-cloud-computing-posts_30.html
14. Summary of Windows Azure Service Disruption on Feb 29th, 2012, http://azure.microsoft.com/en-us/blog/summary-of-windows-azure-service-disruption-on-feb-29th-2012/