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A Roadmap to Application Integration Using IoT Cloud Platform

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Abstract--- *Internet of Things (IoT) provides an opportunity to connect all dumb and net-aware physical devices. The cloud helps to store, compute and to do analytics services on need basis. Providing storage facility for managing IoT data is more complex. The Cloud IoT platform solves this kind of scalability issues to great extent. The IoT is all about the sensors, the inter-process-correlation of sensors makes a specific application and it also depends on the divisional components and its pattern of interaction. The cloud IoT platform provides the range of solution to help the easy storage and efficient process of the IoT data. The competent platforms available are Microsoft Azure, Amazon Web Services (AWS), Google Cloud Platform, and IBM Watson. In this paper, we like to annotate the fundamental components in all these architectures and creating procedural checklist to ease the understanding under one review through broad literature analysis. Secondarily to substantiate these components its detailed features are analyzed for its impact. This paper also suggests the guideline mechanism for deriving solutions across different market verticals application integration using IoT Cloud Platforms*.

Keywords--- *IoT Cloud Platform, Google Cloud, Azure, IBM Watson, AWS, Oracle Cloud, BigTable, BigData, NoSQL, Ontology, OLAP, Zookeeper, Procedure Checklist etc*.

I. INTRODUCTION

The IoT Cloud is a platform, which helps to perform all real-time activities on IoT data. The IoT platforms used to wear different color caps for different tasks, but the cloud involves the content delivery over the Internet to data centers. The IoT Cloud platform is available for different market vertical application development. To name a few, AWS IoT, IBM Watson IoT, Google Cloud platform, Microsoft Azure, Oracle and Cisco IoT Cloud Connect are in the top listing platforms helps for the IoT application development. The cloud role is to store all daily routine IoT data by ensuring the congestion and quality of service. In overall the cloud based solutions are cost-effective, collaborative, mobility, fault-tolerant disaster recovery plans and secured.

For the Cloud, IT infrastructure elements include servers, software and secured data storages, high performance network backbones and cloud services. Data storage is a significant factor in infrastructure requirements of any enterprise and business applications. Cloud technology solves the kind of problems like optimized resources utilization, efficient data storage, and demanding computing needs and other infrastructures [1]. According to the researchers Chatterjee, S. (2010), VTK Tran, JW Keung, A Liu, A Fekete (2011), cloud migration means the process of shifting the existing application from in-house datacenters to cloud technological platform. There are many challenges such as pragmatics, backward compatibilities, storage options, system and application software variations etc.

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For IoT, essential IT infrastructure includes sensor access technology, communication protocols, storage and analytic processing with security [2]. Choosing the IoT technology platform is significantly essential for deploying the applications securely. IoT handles exponent increasing amount of data of volume per unit amount of time [3]. Thereby the Cloud IoT platform helps to integrate the IoT storage requirements through cloud storage techniques. The widely used Cloud IoT platforms are AWS, Google Cloud Platform, IBM Watson and Microsoft Azure. In this paper, we discuss the Cloud IoT platform and its underlying technologies in the constitutional components, structures and utilizations.

II. LITERATURE ANALYSIS

Every cloud platform offers various functionalities related to computing processing and storage infrastructure facilities. But the cloud IoT platform performs the services to connect billions and trillions of sensor devices and processes by routing the end to end communication through Cloud IoT platforms reliably. Sales force defines the IoT Cloud as a scalable processing engine [4]. The platform is to handle the data massively generated by micro sensors, devices and customer applications for real-time responses.

AWS structure has four main layers of functional units, namely, Geographical or Global infrastructure (GI), Foundation services, Management and Application Services.

To support the global customer service the AWS infrastructure has four components, namely, Availability Zones (AZs), Regions, Datacenters and Caches. The AWS GI has multiple locations called Regions, Regions are divided into Availability Zones which has one or more data centers.AWS Foundation services provides efficient scalable and economical computing set-up to enable the business application operational and other on-demand services from cloud. Application Platform provides specific functions such as tools for development, execution engines, data bases, cloud services and operating system. Finally, administration block contains services to manage, monitor, and control other services.

GCP has been developed by Google. It helps to host Web and mobile apps. GCP provides low cost utility computing cloud platform (Xiaojing, 2010) [10]. There are four components in GCP, which includes Compute, Storage, Big Data and Services.

The compute layer of GCP has all components used to build, deploy and maintain the applications. The critical elements processing engines for Apps, Compute and Container. The objective of App Engine is to host the apps. Storage layer is used to store the application's required resources, asset data. The storage compartment is bagged with group of different storage components to support relational and non- relational database. It supports MySQL and NoSQL databases. The storage part also handles huge amount of data with minimal latency (Krishnan & Gonzales, 2015; Cohen, Hurley & Newson, 2015, Garrison 2015) [7,8].

The big data section has more evolving components such as Big Query, Cloud Pub for message subscription and message passing between applications and cloud dataflow. Big Query is an analyzer, which works based on the On Line Analytical Processing (OLAP).

The domain components of Microsoft Azure [5] are Compute, Storage, Database, Security Identity, Integration

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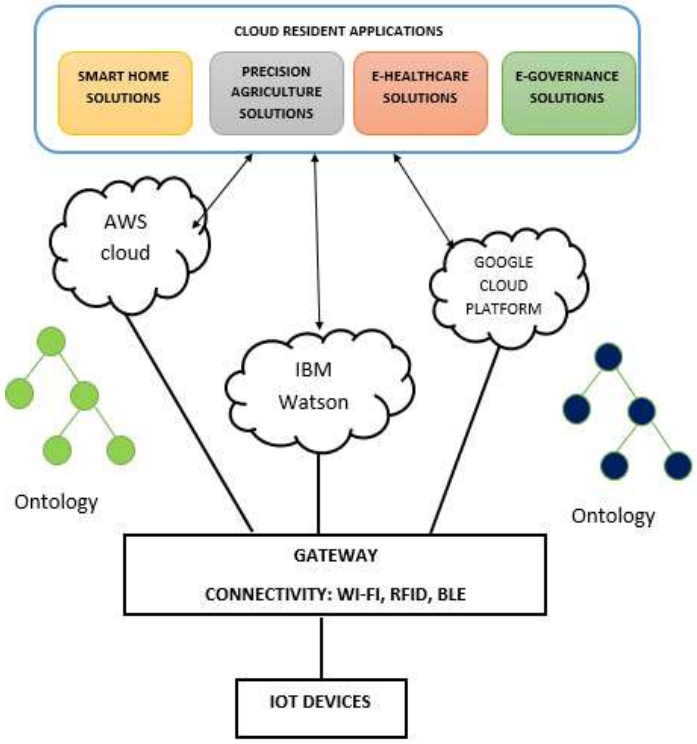
services, Content Delivery Network, Azure Networking, Monitoring, Web & Mobile services and workflows etc.

The compute section handles hosting, development and deployment of azure applications. It has virtual machines to load any operating system. It contains the registry to store all resources required for applications. It has functions, batch and service fabric. The service fabric supports the application development such as PHP, node.js, Python and Ruby. The Blob storage can store any binary data such as media file or installation files. Query storage for delivering asynchronous messages between various components of applications. The database compartment supports the native databases of Microsoft and other NoSQL. The content delivery network responsible for static contents from a distributed locations. Integration service component has a service bus for facilitating third party communication. Azure management component has automation of mundane tasks performed in the cloud and enterprises. The web and mobile service component is for developing web apps, mobile apps and various logic apps for providing integration of scalable applications. Workflow is another unique component in azure platform to automate the process steps of an application.

IBM Watson [6] is another cloud IoT platform which has application builder, explorer engine, administration console, knowledge center, Big Index and Zoo Keeper. Big Index provides API for developing, deploying the enterprise applications. The key components in IBM Watson architecture is text analytic tool for content mining and domain specific ontologies. It helps to do the cognitive intelligent applications for various domain verticals.

III. APPLICATION INTEGRATION SCENARIO



Cloud IoT platform plays a major role in setting up the centralized infrastructure to support all ubiquitous and distributed cross vertical applications. The platform is having the suite of components to setup and manage the inter-

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connected devices everywhere. The datacenters in cloud can remotely collect data, monitor and manage all connected devices with the help of cloud platforms. This remote acquisition can analyze and visualize the data in an understand format which in turn can build a smart application with analytics.

There is a huge number of cloud IoT platforms are available but building a solution for a particular use case is all dependent on IoT platform host, services and supports. Many of the IoT platforms are available for free without much technical support, this can lead a drastic damage in production environment. Every Cloud, IoT platform provides a bundle of services for the application developers through the respective APIs.

This block diagram exemplifies the application integration with cloud IoT platform for cross domain verticals using ontologies. The layered architecture is depicted.

The IoT sensor devices transmits the information from surrounding to cloud server through communication protocols such as Wi-Fi, RFID, Bluetooth and satellite networks (Atzori et al.,2010). Gateway ensures the interoperability and translation of protocols with associated sensor devices.

To manage trillions of data from billions of devices, cloud server provides storage and efficient retrieval. It stores relational and non-relational (unstructured) data. The analytics, mining tools provided in the cloud IoT platform brings the new knowledge for making the smart application. The IoT platform has numerous servers for distinct purposes such as authentication, authorization, message broker and storage. In addition, the ontologies can be used for cross domain vocabularies among cloud servers to interpret the semantics for the fruitful integration.

The cloud IoT platform provides a developer SDK for defining an interface and access the business services provided by the servers. If any changes on IoT sensor devices the system generates an alert to beacon the user immediately. This feature helps to monitor as well as to control the devices remotely. This fault-tolerant feature is crucially important for any smart application environment.

IV. PROCEDURE CHECKLIST FOR CLOUD IOT PLATFORM

The procedure checklist for the application integration using any Cloud IoT platform has been derived as follows.

Procedure

CIP Begin

Cloud deployment selection model (CDSM)

Creating an Cloud IoT Platform (AWS/GCP/Azure/IBM Watson) account

Creating IAM user on Cloud IoT Platform

App Engine set up

Launching an Compute engine instance (e.g EC2 in AWS)

Launching an database service instance (e.g RDS in AWS)

Connecting cloud storage with cloud SQL

Connecting to Compute engine instance

Creating and public storage cloud resource and storing assets file

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Creating and storing files in cloud storage

End Procedure

V. CONCLUSIONS AND FUTURE DIRECTIONS

This paper concludes the task of creating a recommended procedural checklist for the Cloud IoT Platform to integrate cross vertical applications. It is a need for resolving ambiguity in choosing the right platform for cloud migration for crucially important business applications. In this paper by conducting a thorough review of literature on the constituent components of major Cloud IoT platforms to help the novice to get clarity on smart application deployment in an economically feasible and scalable solutions. In our next paper we would like to concentrate on domain ontologies significance in business intelligent solutions using IBM Watson and other Cloud IoT platforms.

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