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Integrating on-premises data with customer relationship management application on cloud: A hybrid IT infrastructure support service

H. S. Chiranjeevi[1]*, Manjula K. Shenoy[1] and D. Syam Sundar[2]

*Corresponding author: H. S. Chiranjeevi, Information & Communication Technology, MIT, MAHE, Manipal, 576104, India
E-mail: chiranjeevi.hs@learner.manipal.edu

Abstract: Customer relationship management (CRM) is a group of data-driven, integrated solution that enhances how an organization interacts and does business with the customers. University support service centres provide hone support for the university stakeholders' queries and requests related to academic information. The support centre uses retrieval of information from huge text documents, records, and log files from disparate data sources residing on on-premises. Handling data has become a critical task and moving all the data to the cloud is not feasible. The objective of designed hybrid solution is to serve a resolving customer service request and a scalable solution to a large set of data for the organizations concerned with security, efficiency, and to use the advantages of the cloud service. In the proposed hybrid solution, the data resides on the on-premises is connected to the customer relationship management application deployed on the cloud, this reduces the IT in-frastructure tasks at a university support service. We describe the system's architecture and the technical challenges we have faced. The CRM application is deployed on Microsoft Azure cloud test instance and the Azure service bus relay is used to connect the on-premises data.

ABOUT THE AUTHORS

H. S. Chiranjeevi is a Business Head who has worked primarily in IT industry for over 6 years. He completed his undergraduate and postgraduate in the field of information science and digital communication. He is a founder director for Edufino Technologies and MythInit Technology Private Limited, where he is currently on sabbatical. His industry oriented work has led onto extended research as a P.hD. candidate for MIT, MAHE, Manipal.

Manjula K. Shenoy is professor in department of Information and Communication Technology, MIT, Manipal. She has 22 years of teaching and industry mentoring experience. She has over 16 publications, 1 government funding and guiding four PhD students in the area Semantic Web Technologies, Data Mining and Big-Data Analytics, Sentiment Analysis and Cloud Computing.

D. Syam Sundar is professor for over 12 years. Since then, he has been with IBM India, Hyderabad, where he is currently the Senior Project Manager in Cloud space. His research focus is on Cloud Migration, Data Mining and DSP.

H. S. Chiranjeevi

PUBLIC INTEREST STATEMENT

The organizations support center uses information retrieval system to handle huge amount of text documents and retrieve information to communicate with their customers. Today, customers are the primary revenue source of any organization, and managing, organizing, satisfying, supporting are the key constraints. Approximately 60% of the organizations are handling data on-premises, but on the other side cloud services is growing better to serve customers. Data integration and migration are the constraints if they opt for cloud services. With respect to this scenario, existing organizations are willing to have their data on-premises. To overcome all this issues, we propose a hybrid solution that, data resides on the on-premises and customer relationship management (CRM) application is deployed on the cloud. This Hybrid CRM solution offers a very high-level data integration with back-end systems, greater flexibility, speed and disaster recovery benefits with high availability of information.

1. Introduction

Today, the customer is the primary revenue source of any organization, and managing, organizing, satisfying, supporting are the key constraints. We can define that the customer relationship management is a process of interaction with the present and targeting the future customers to improve the organization's marketing, sales and revenue. The customer relationship management is termed as one of the systems tuned it into an automated software model and the deployment of the management software plays an important role in many organizations. In today's trending cloud market, the organizations want to hold the control and manage their domain specific resources making the data reside on the on-premises. The on-premises is a deployment platform for the organization software and organize the data very securely at the organization premises, privately (Kaviani, Wohlstadter, & Lea, 2014). Wherein the information technology, cloud computing and cloud deployment is trending to handle a flexible work environment for an organization software. The design and development of internet information technology based cloud services enhance the quality with a scalable approach towards customer service. The Software-as-a-Service CRM is used by many large organizations to handle customer satisfaction for their action plans, leveraging the cloud CRM by achieving better business processes, scalability with data, and increased mobility (Chen, Wu, Chu, Lin, & Chuang, 2017). A survey report states that since 2014 the stability in an organization by having private workloads and operated on-premises data centres is reported up to 65% opting rate between the 22% opting to go with the private or multi-tenant data centre providers and 13% opting with cloud platform. However, the on-premises solution is leveraging the organizations due to a massive growth in critical business applications, customer data representation and transformation. With respect to growing rate, 50% of the Information Technology (IT) professionals are opting the on-premises setting versus a cloud platform setting. The data centre (on-premises) professionals in the organizations are working towards the performance enhancements of data process, expanding server loads, and integrating CRM application on cloud platform (DataCenters, 2017). Today customers expect any organizations service to be up and running all the time. Organizations to have highly available application site requires resilient infrastructure to handle service failure. The failure may occur at the on-premises datacentre. And also datacentres rarely suffer from failure. Services at the data centres may impact the organizations critical components. These services could be software update, bandwidth, networking equipment, power etc. during such situations organizations need to utilize a resilient infrastructure and continue to serve their customers (Passmore, 2016). If organizations decide to have new technology adoption, one of the biggest risks in building a new infrastructure is migration and integration of data. With respect to the technologies, the cloud services are standard option for business organizations with growing and fluctuating bandwidth. Cloud service provides more flexibility, work anywhere-anytime, increases the collaboration and secured environment. Wherein, the for the business organizations with highly sensitive data, the on-premises data warehouse is a best option. To take advantage of cloud computing services and safeguard the investment on the existing premises system, the organizations are planning to transact to cloud deployment, many organizations take the cloud advantage and move applications completely, and some are planning to move partially. The migration of existing application is a process of re-deploying the entire deployment process and adapting new computing strategies. The hybrid solution is for any organization, who wish to run the service application in the cloud and manage full ownership control on data residing on-premises. The data integration policies are highly secured by using service relay bus (Linthicum, 2017; Sabiri & Benabbou, 2015). The relay service provides the connection establishment between the on-premises and the cloud with PUSH and PULL operation to make sure the communication is secure between the hybrid entities (Frischmuth et al., 2012). An approach towards a new era of a model-driven hybrid solution has the quality of being satisfying many disaster

recovery requirements (Microsoft Corporation, 2014). The objective of our hybrid computing will be a model driven architecture where the system is built to seek advantage of both the on-premises and the cloud infrastructure to achieve different requirements to serve the customers better in the organizations. To leverage the advantage of both the on-premises and the cloud, it is recommended to adopt the hybrid strategy.

The remainder of the paper is organized as follows. Section 2 discusses the past work related to the on-premises usage for maintaining data, cloud services and deployments, Customer Relationship Management (CRM) for customer service, and Microsoft Azure services. Section 3 describes how the proposed hybrid model is designed and the system configuration carried out. The section also describes how the system implementation and connection flow is achieved with the data on on-premises, CRM application on cloud and connecting using Microsoft Azure services. Section 4 discusses the University case study with the domain knowledge. Section 5 presents our conclusions and future work.

2. Literature review

In the last few years, optimizing the managing activity of business process has gained high popularity in the business. The customers find very flexible with the cloud platform services and use with their resources. Today, many applications are trending in the market providing the cloud platform solutions such as Microsoft Azure, Google App engine, IBM blue mix etc. That are PaaS and SaaS. Evert Ferdinand Duipmans et al. propose a process of transformation approach which allows the organizations to leverage on the on-premises for their sensitive data and take advantage of the cloud for high performance for the business processes. This work focuses on the customer workflow and the data replicated on on-premises or in the cloud and the automated transformation takes place for the process between the on-premises and the cloud deployment (Duipmans, Pires, & da Silva Santos, 2014).

SolBridge, an established business school in South Korea, has adopted a learning management system, which is an open source. Working for some years, the school switched on to the on-premises during the license renewal process with the cloud. The dilemma with the organization was with respect to cost, feasibility, and scalability, which are the key emerging elements to be considered in IT infrastructure (Hameed & Swar, 2016). Another scenario with the universities in Germany, the project leader faced a complicated issue in decision-making to introduce the cloud storage system in the university. The research of this background work is to understand the relationship and gain trust with the cloud platforms (Öksüz et al., 2015). Health care system is generating a huge patients' data record and looking forward for the next generation electronic health record management system (EHR) for better performance and accessible to all the stakeholders in the hospital. William Hsu et al., worked on building a HER on content-based model by identifying the relevant sections of the records as the sources of domain specific knowledge. The focus of building this knowledge is to draw medical decision-making to improve data access, data integration, and achieve better analysis on the patients' data (William, Taira, El-Saden, Kangarloo, & Bui, 2012). Stefan Walraven et al. compare the performance and application development features of the SaaS and the PaaS platforms, based on the practical case study. They carried out a re-engineering process on the application residing on-premises into a Software-as-a-Service application deployment and the deployment was carried out eventually on the Platform-as-a-Service. The work derives some quality features such as code base portability, multi-tenant based support system, and tool support with PaaS platform countering with SaaS deployment (Walraven, Truyen, & Joosen, 2014). Many challenges are faced with the migration police from the on-premises to the cloud platform. Khadija Sabiri and Faouzia benabbou, propose an architecture that describes the cloud migration process, starting by understand application architecture, Choice of the type of cloud environment and finding different types of application migration between the on-premises and the cloud by identifying and categorizing the migration architectural components (COTE.IO, 2017).

The cloud based CRM applications are trending for several years in many organizations and the inclination towards the cloud CRM has been increasing in the market. Michael K. Poku et al. describe when the value-based care is introduced in the U. S. health care, they focus on strengthening the patients and families engaging policy. The patients' relationship management system and the processes are encouraged at the healthcare domain; the author suggests the benefits for the other domain organizations to engage their customers in the innovative ways (Poku, Behkami, & Bates, 2016). According to 2014 EDUCAUSE report a CRM application is a "Strategy, business processes, and software for managing and enhancing an institution's interactions with customers, such as current and prospective students, alumni, faculty and staff; and current and prospective donors." The report states that CRM systems are the second most rapidly changing core system area in higher education. The report helps in understanding the obstacles faced by the institutions using or deploying their CRM applications (HOBSONS, 2014–2015). The organizations still have the data privacy and security challenges, this paper describes a hybrid model strategy with a use case of university research that integrates the on-premises and the CRM in the cloud by emphasising the major benefits with respect to efficient business and secure performance enhancement. The data can be stored on the on-premises and accessed anytime when required. The organizations using the hybrid solution with Azure cloud platform, and manage workloads at on-premises with disaster recovery advantages (Altwegri, Alsaleh, Alsenan, & Almutlaq, 2015; Microsoft Corporation, 2014). The hybrid deployments provide flexibility with respect to scalability on the cloud and the ownership control on data residing on-premises. Nima Kaviani et al. discuss their research on the new approach for effective trade-offs for developers between the cost ratio and the performance in the hybrid deployments. First, the data transfer optimization policy in the IaaS environment. Second, a new encoding plan for the database query programs, this enables simultaneous code optimization and placement of data in the hybrid platform. The two-case study approach reports that it is 54% compared to the on-premises only deployment and increase in response time compared to the naïve partitioning when the application is deployed on the cloud (Kaviani et al., 2014). Using a case study, Mauricio Verano et al. propose several approaches to present and evaluate and can be used by the organizations to work on the on-premises application to deploy in the cloud. The approaches increase the application usability, scalability with less infrastructure cost (Verano, Salamanca, & Villamizar, 2015).

The enterprise level workloads demand the on-premises infrastructure with high availability. Because of which the enterprises are sometime forced to run the application on the on-premises. V. Salapura et al. discuss the challenges with the features afford by IBM CMS cloud platform (Salapura & Mahindru, 2016). Many vendors provide the CRM framework; organizations can use these frameworks to develop their customized CRM application. Considering an instance, salesforce.com provides an AppExchange integration platform which is an open-source, the organizations can build their own customer relationship management application. To establish the data centres, the IBM provides a Trusted Virtual data centre platform for organizations to integrate the running CRM application on the cloud (Bibi, Katsaros, & Bozanis, 2012). Windows high performance computing using the windows server and the Microsoft Azure combine can form a hybrid cloud and an on-premises world. Amandeep S. Sidhu et al., explore a high performance computing and using the Azure deployment model to demonstrate genome application (Sidhu, Balakrishnan, & Dhillon, 2013). Good relationship between a customer and an organization creates higher customer satisfaction. The hybrid customer relationship management system gives the road map/solution for bringing the two worlds of big data and data analytics. Ninety per cent (90%) of the enterprises say that they are going to pursue a hybrid solution this year (CRM Vendor Guide, 2015).

Cloud services provide a wide variety of tools which reduce cost and increase the performance for higher education system and institutions for their data and information's. these in turn intuitions should be ready for integration and migrations between the datacentres to compete with the on-demand computational power. The authors propose a hybrid cloud model which relies on several private cloud integrations within higher education institutions. These proposed system supports platform heterogeneity and provides different level of relationship (Lopes & Pereira, 2017).

A research project is carried out and stated Estonian president's website and state Gazette website were able to successfully migrate and operate in the public cloud during the project duration. But, certain issues are encountered and made clear that cloud services may be leveraged to enhance performance and resilience of the government services for a given cloud capability such as scalability and DDoS security. The researchers also found that make multiple virtual machines and host in different places, because the functioning of the state in any given emergency situation or for any down times. They also come across some findings stating, originally designed for on-premises use, can be moved to the cloud "as is", this might result in difficulties with scaling and achieving full functionality. For e-government applications to truly benefit from a migration to a cloud platform, they should be thoroughly evaluated, e.g. undergo a risk assessment (Kotka, Johnson, Cebul, Lovosevic, & Liiv, 2016).

3. Hybrid model

The technical methodology flow and the architecture (Figure 1) is explained in this section. The Hybrid Connection is established using the cloud App Service Web Apps to the on-premises resources that use a static TCP port using a service bus relay. The supported resources include SQL Server, database, HTTP Web Application Programmable Interface (API), App Service, and the Web Services are used in our system deployment. The Relay service is used for our hybrid connection by securely exposing the data response service reside on the on-premises to the request from the application on the cloud, this works well without establishing the connection with firewall or not changing the network infrastructure. The relay service supports receiving the request call from the cloud application and reverts to the cloud application with the on-premises service response. The request call from the cloud is first taken by the service bus relay and sends to the on-premises, which is a PULL operation. The response to the request call from the cloud will be a PUSH operation to service bus relay in the form of JSON format and responds to the cloud application securely which a pseudo code shown in Listing 1 and as described in Figure 2, sequence diagram describes the stereotypes of the designed application with respect to data on-premises and application server, web server and user browser on cloud.

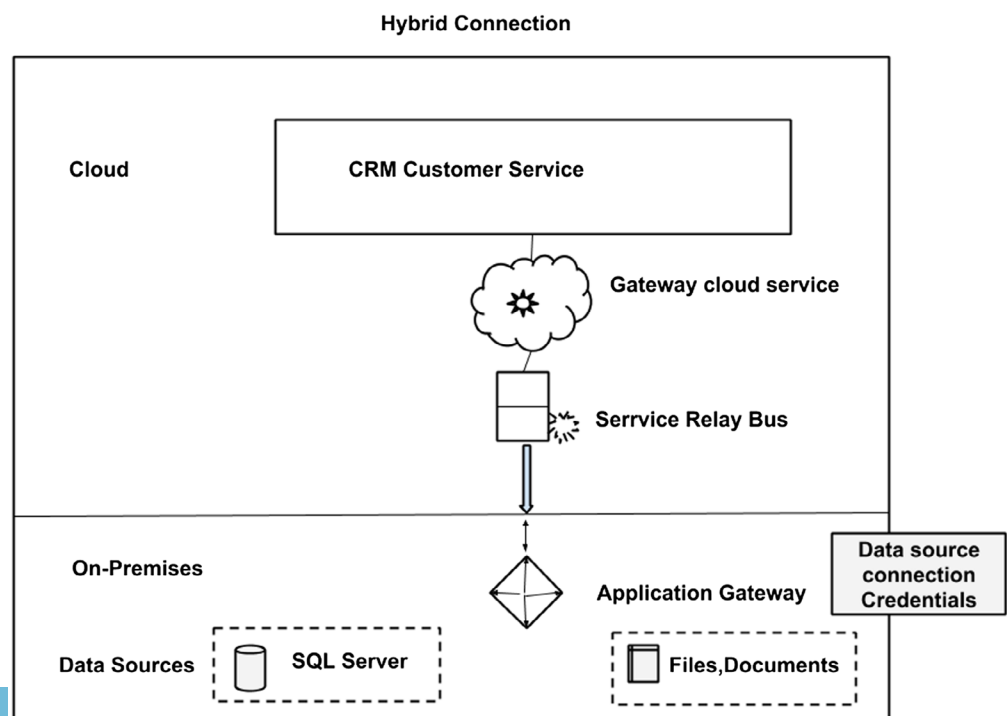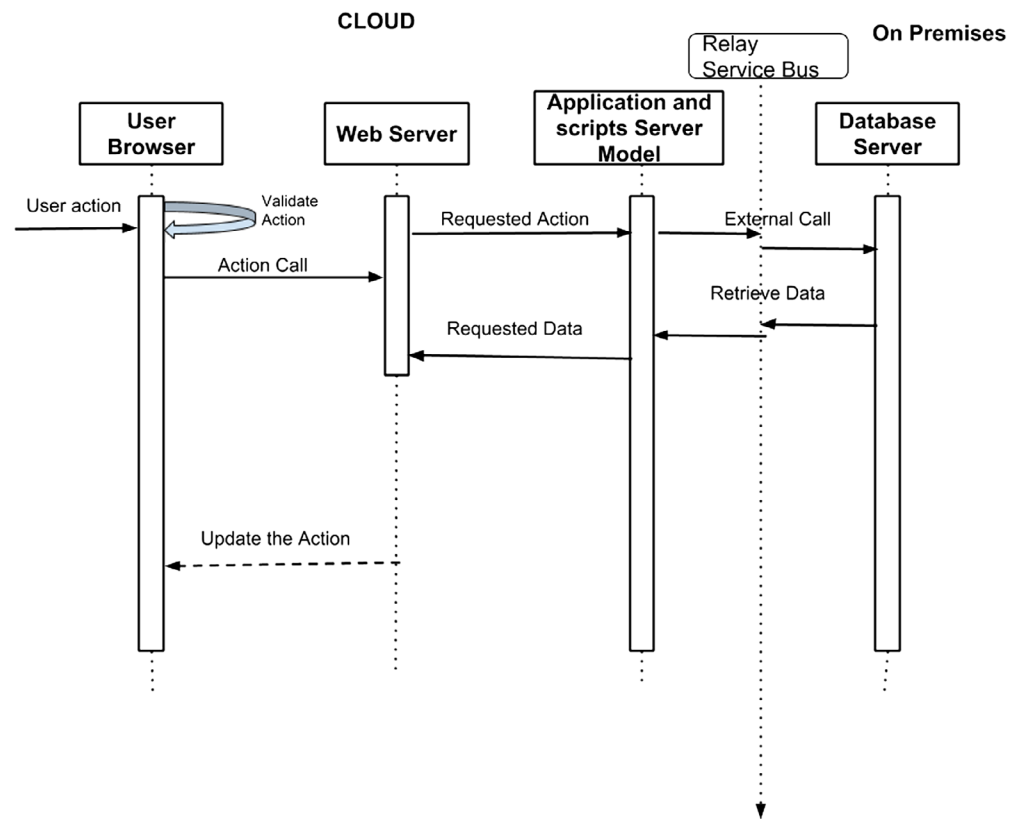**Figure 1. Proposed hybrid architecture, data on-premises, and CRM customer service application on cloud service.**

Figure 2. Sequence diagram of the designed CRM application.

**Listing 1. Pseudo code for operation used on database**

Input: Customer query or request information

Output: Response to customer query or requsted information

Step1: if (size of (Requested Information) ≥ size of (database on on-premises) – 1

Then Exception ("Alert Admin DB")

Else Begin

Step 2: Computation of query/request and response

Add requested information to DBqueue

Retrieve response from DBqueue

Create an App Service web application in the cloud platform, web app is connected to the local on-premises SQL Server database using the Hybrid Connection configuration, the CRM application is developed using ASP.NET application, and deployed the application to the App Service web application. The CRM application on cloud stores the user credentials in a membership database that is on on-premises.

3.1. System design, integration, and deployment

To develop and deploy our proposed hybrid solution and display a working system, we have used open source and free versions of software platforms. Figure 3 describes the implementation of hybrid solution with respect to the use case for university support service. The tools, software's and services used are cloud platform subscription (Free Trial), Visual Studio 2017, Microsoft.NET framework, Windows Operating system and Windows Server 2012 R2, SQL Server 2014 Express with Tools, SQL Server Management Studio Express.

Figure 3. Enterprise information integration between the on-premises data and the CRM application on the hosted on cloud.
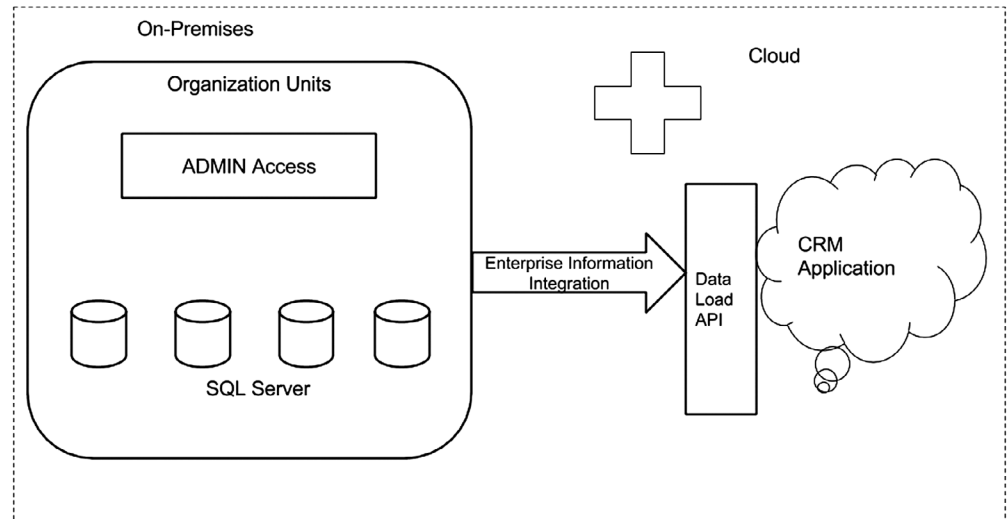
Enterprise information integration (EII) is used to bridge between the on-premises and the cloud deployments. Using the EII organization will have a unified data and information view. In the process of data integration from the on-premises to cloud, the process of data integration provides a uniform data access, a single set of structures to data and a high-level data representation with improved naming conventions. Using the EII, the focus is to arrange a large set of heterogeneous data sources to appear in a single view homogeneous data source to the customers.

3.2. On-premises server deployment

To use on-premises SQL Server or SQL Server Express database with a hybrid connection, the TCP/IP is enabled on a static port. Port 80 is used for HTTP port for certificate validation and optionally for data connectivity, Port 443 is used for data connectivity if outbound connectivity to 443 is unavailable, Port 5671 and 9352 can be used to achieve high throughput with respect to data connectivity. Namespace **HybridCRM** is created for service bus relay.

3.2.1. Create an SQL Server database on-premises

The Visual Studio Model-View-Controller (MVC) web application deployed on cloud requires a CRM DB to access the database. To start with, the database is deployed on the on-premises using an SQL Server or SQL Server Express database is used and schema is created as shown in Listing 2 and Listing 3. First, connect to the SQL Server with SQL server authentication and login credentials using installed SQL server management studio. In the New Database dialog, name CRMDB database is created.

Listing 2. Creating a schema

```
USE Adventure Works2008;
GO
    CREATE SCHEMA UMS admissions AUTHORIZATION MU;
    CREATE TABLE Holder Details (source int,information int,partnumber int);
    GRANT SELECT ON SCHEMA::UMS admissions TO ITdept1;
    DENY SELECT ON SCHEMA::Sprockets TO ITdept2;
GO
```

Listing 3. Creating a schema and a table in the schema and Setting the owner of a schema

```
CREATE SCHEMA Admissions AUTHORIZATION [Contoso\ITdept1];
GO
    CREATE TABLE Admissions.Institution
    (Institution_id int NOT NULL,
    Institution_Name char(5) NOT NULL)
    WITH (DISTRIBUTION = REPLICATE);
GO
```

3.3. Deployment of CRM application on cloud

Using visual studio ASP.NET C# language, CRM web application is designed with Model-View-Controller framework. The CRM consists of the features such as Advance search, customer service [Auto bots], contact management, Activity management, advanced reporting, logs repository and knowledge base. The model-view-controller framework logic is that the data is stored in the Model, which is retrieved on execution of Controller commands and the result is displayed by View. For every update in the Model, the new output is generated by View. The write operation in the models state with every update is carried out on commands triggered from the Controller and the commands can change the View with respect to scrolling, movement of data.

Listing 4. Connection string snippet

```
<connection Strings>
<add name = "Default Connection" connection String
    ="Server = Server Name,1433; Database = CRMDB;User ID = sa;Password
    =pintu4447" provider Name = "System.Data.SqlClient"/>
</connection Strings>
```

   Microsoft Azure cloud platform subscription is used to deploy our designed CRM Application. The visual studio allows publishing the MVC code on Azure and connecting to the CRMDB database on SQL server deployed on-premises using the connection string as shown in the Listing 4. Initially a Web application publish profile is created in the Azure and import the MVC code built using the visual studio to establish the connection. Once the connection is established, the complete code is deployed and the Web application is made accessible to the customers.

3.4. Hybrid connection deployment and results

The deigned CRM application service is deployed on the Azure cloud platform and the on-premises Hybrid Connection Manager is used to establish the connection. In our use case, we have used Microsoft Azure cloud service for the deployment. Microsoft Azure and Amazon AWS are the big vendors in the current market (Carretero & Blas, 2014). The service bus relay is used to handle the request and response calls and connect between the data on-premises and the application on the cloud. The listener is installed at the on-premises system and the primary on-premises gateway connection string shown in Listing 5 is copied to the hybrid connection manager to establish the connection. Figures 4 and 5 results the successful connection establishment between cloud and on-premises. the customer initiation and, the server is listening using the snippets showed in Listing 6, 7, and 8.

Figure 4. Hybrid connection manager to connect the on-premises database and the CRM application on cloud using the relay bus.
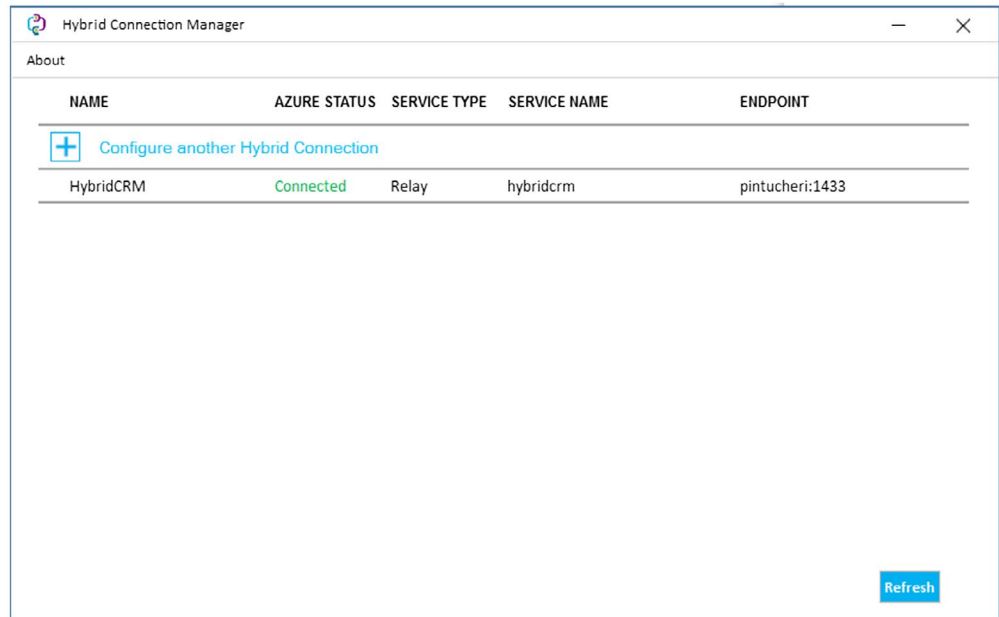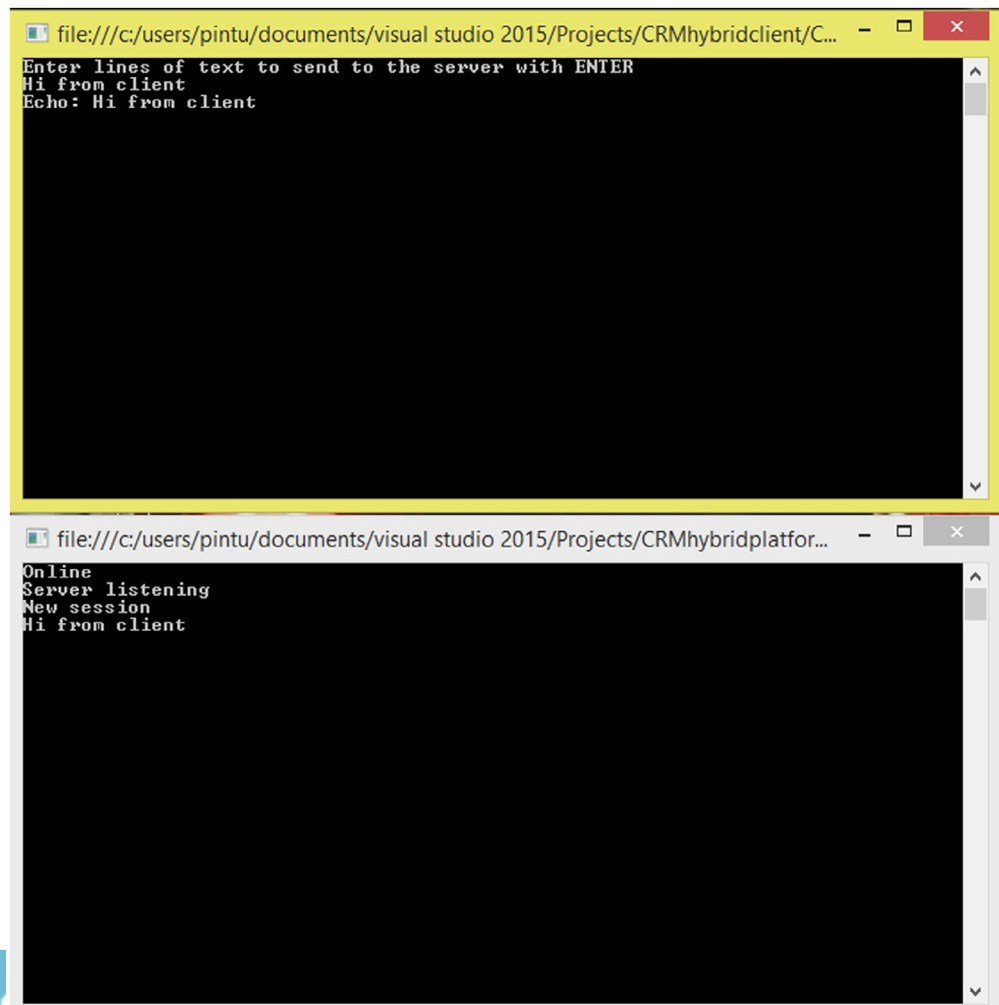

Figure 5. Cloud and on-premises connection establishment with customer initialization and server listening.

Listing 5. Service bus relay connection string

[*ENDPOINT PORT*]

1433

[*SERVICE BUS NAMESPACE*]

HybridCRM

[*GATEWAY CONNECTION STRING*]

Endpoint = sb://hybridcrm.servicebus.windows.net/;SharedAccessKeyName

> *= defaultListener;SharedAccessKey*

> *= ArOJE3seQjo8BZMtCbwxRXG9Go + oaYV0i4iKSy + BWhM*

> *=;EntityPath = HybridCRM*

[*ON-PREMISES CONNECTION STRING*]

Endpoint = hc://hybridcrm.hybrid.biztalk.windows.net

> */HybridITCRM;SharedAccessKeyName*

> *= defaultListener;SharedAccessKey*

> *= YIzjRZ/LoGRbiJD7JSpR7pSnArnPQpoYGBZ9189bYUY=*

Listing 6. Code snippet for the relay connection with CRM application on the cloud

private const string RelayNamespace = "{hybridcustomerdata}.servicebus.windows.net";

private const string ConnectionName = "{CRM}";

private const string KeyName = "{RootManageSharedAccessKey}";

private const string Key = "{/K4 + GVzfRXDIt6vsWHPi4/YwH9jKfdmUErMUWlFTMrc=}";

Listing 7. Code snippet for creating hybrid connection client

Input: New customer establishing Connection to hybrid through relay

> and enter the query or request

Output: Connected to hybrid connection through relay

Step 1: *If The variable Token Initiates*

> *Then,*

> *Create the shared Access signature of the Token with (KeyName and Key)*

> *Variable client connects to new hybrid connection with new URI*

> *// uses Listing 6 connection string*

> > *The relay initiates the client connection,variable reader and writer is initialized*

Step 2: *The variable writer starts the console*

> *Do,*

> *Collect the string input from reader*

> *Then*

> *Writer writes to the console*

Step 3: *Read from the console and the writer writes to the hybrid connection*

Listing 8. Code snippet for server listener

Input: *Relay service initiates the new connection from the client*

Output: *server listens to the customer query or request*

Step 1: *If The variable Token Initiates*

Then,

Create the shared Access signature of the Token with (KeyName and Key)

Step 2: *Variable listener connects to new hybrid connection with new URI*

// uses Listing 6 connection string

Then,

Step 3: *Subscribe the status events for listener connecting,offline and online mode*

Do,

Listener establish the control channel with the relay service

New thread will start to listen continuously from the console

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3.5. CRM application activity diagram

Figure 6 describes the flow and the activity performed in our proposed Hybrid CRM application. The application is developed with the features Advance search, customer service [Auto bots], contact management, Activity management, advanced reporting, logs repository and knowledge base. The CRM application is developed with respect to university use case, where university handle large amount of text document information pertaining to different department. The detailed explanation is described in the Section 4.

Two modes of operation, use the landing page for basic information else use login page with credentials to start using the features. On login credentials authentication, the user type is decided whether the customers/Admin. Customers can build their profile, search for required information and customer service options. The admin monitors the customer activity and automates the information to build the knowledge base. A log file will be created for every individual credential and for a specific period as per the admin requirement for the organization.

**Figure 6. Hybrid customer relationship management service application activity.**
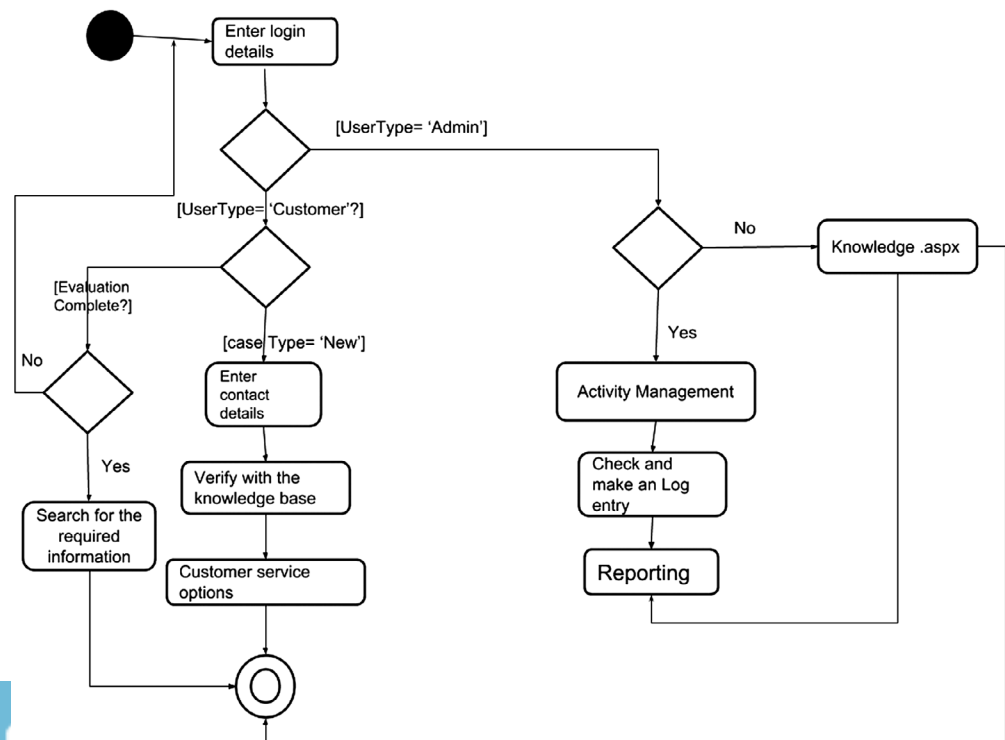
4. Domain knowledge

Referencing to Section 3.5, in the support services of the Universities, the assistants should have a prior knowledge about logic to identify the information that needs to update in the database and suggest the solution to resolve it. Regularly they depend on searching the records of the past queries and resolutions to find the exact request to resolve the query at hand. Our data driven model uses a domain specific information, helps to extract the knowledge indices data at the on-premises and improves the information retrieving quality.

The components of knowledge processing keep the crawls timely manner and process different knowledge sources that are defined by the organization units. These knowledge sources can take the form of PDFs, structured databases, documents, JSON, extensible mark-up language (XML) flow-charts, etc. Therefore, the knowledge processing at the on-premises with a disaster recovery site has been developed with various implementations of crawlers and different pre-processing units, depending on the domain of the data that is essential to be indexed and crawled. For instance, the support service assistants of the university face many challenges to find huge records, documents to relate and come with answers for the requested customers query or requested information. Technically, sometimes the documents/records they search manually vary and time consuming. The Figure 7 describes the context diagram pre-processing component for each knowledge source uses information retrieval techniques that rely on the domain knowledge to implicitly identify the key elements of the diagnostic logic and incorporate this information in the structure of the documents before indexing them.

Our Enterprise CRM connects to knowledge processing unit on the on-premises for customer service. These portal enable the customers to access FAQ or troubleshooting articles without the assistance of an assistant. With CRM, the assistants can work together through interactions with the

Figure 7. Meta model of university management system.
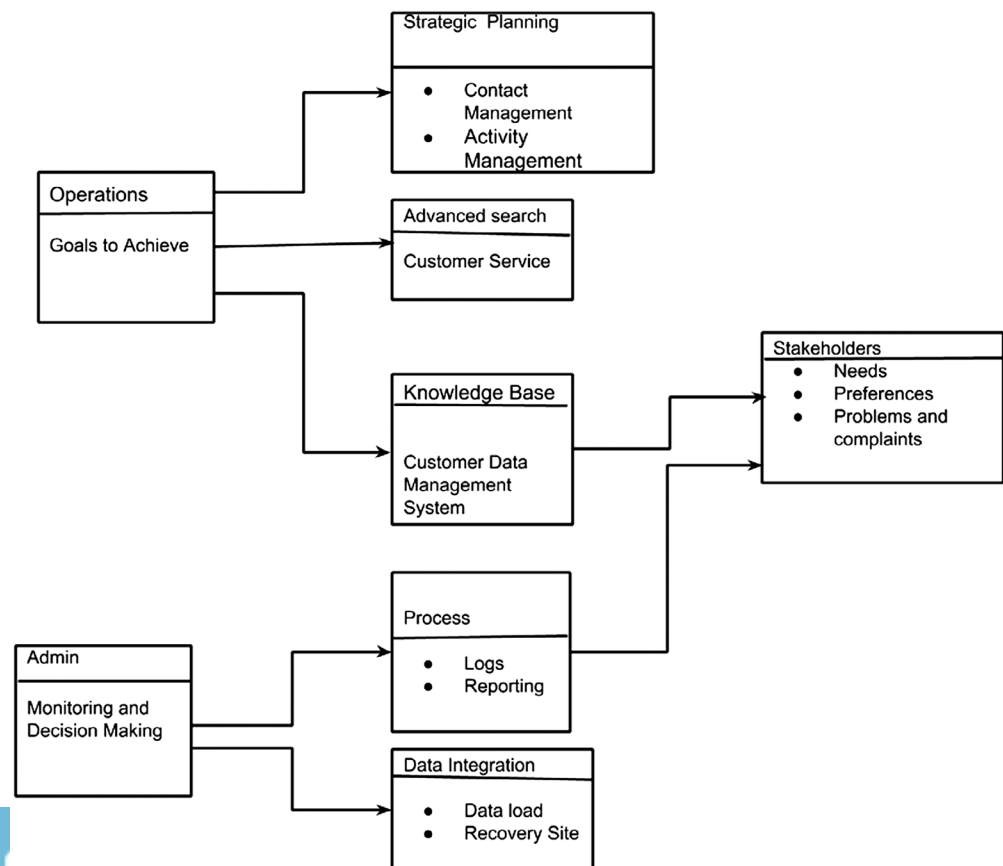
stakeholders of the university. This CRM provides knowledge management at the cloud and creates log scripts at the on-premises for knowledge processing with CRM application of the University, service system for their customers, customers through their website and mobile application anywhere-anytime.

In the following, we will present a case study for unstructured knowledge source processing documents to illustrate how domain knowledge was used and expose the Application Programmable Interface (API) to the cloud Customer service application.

4.1. Case study: Processing documents

Universities have different departments and keeping a track of various activities will be very difficult. The proposed CRM application helps the university management to handle documents and information very effectively. With respect to the cloud service cutting edge technology, customers can access the information anywhere-anytime. It is very important for a university that, using the CRM application functionality they can build relationships with prospective students, meet the needs of the existing students and maintain the on-going relationships with the alumni. Consolidate all the data into an easy-to-access location: A CRM centralises all the data so that everyone within the university has access to all the information they need from one single source of trust, including contact details and communication history. File storage and indexing system to keep a track of the documents. Millions of queries, request for information interactions are generated by the customers at the university on a regular basis. Log history documents capture all these interactions to document how a request was diagnosed and handled. These documents are highly confidential and only PUSH operation is granted from the on-premises side. A service request call or log history database is used to record and process the queries/requests of the customers. These documents are typically stored in a database and are unstructured. A large variety of details such as information of students, student's history, academic data, parent's information, machine generated text, alumni's etc. are logged in the database. Figure 8 describes the complete flow with customer access application on the cloud and the back end data processing at the on-premises.

In the case study scenario, the university data are maintained on the on-premises. Considering data processing, from the past to the current year, the data considered has a history data as-per the data retention policy of the university and stored on the on-premises. From the current year, the data is replicated on the cloud with the new data retention policy and for the data queried or requested from the past year are routed, based on the switch case; from the on-premises to the cloud and vice versa without storing the data on the cloud. The designed hybrid solution strategy is the data reside on the on-premises, the CRM application deployed on the cloud with an access control on the customer queries and requests to data on the on-premises. This enhances a university to use the flexibility of the cloud service with full control and security on the on-premises data.

Figure 8. Flow of knowledge processing with domain specific data the on-premises, connected with the customer service application on the cloud.

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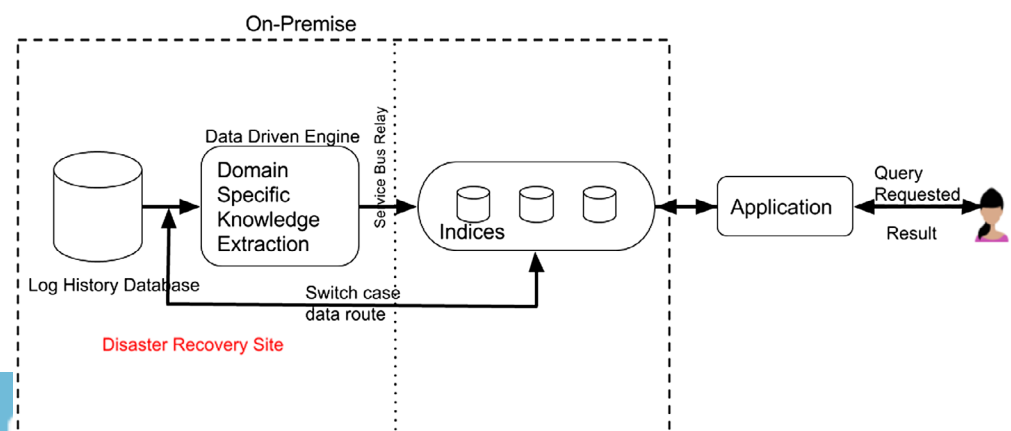
5. Conclusion and future work

This is a powerful model-driven strategy which should be used to the maximum by many business organizations. The proposed work considers the current challenges facing in handling abundant domain specific data and providing better customer support. The university case study is demonstrated using the designed IT infrastructure architecture. We have presented hybrid solution which provides integrating the on-premises data and deploying CRM application on the cloud service. The organizations maintaining data on-premises and CRM application on the cloud improve the scalability with multi-tenancy and role based system. The designed disaster recovery site in on-premises handles the historical data and works on the switch case route based on the CRM application request and the customer logs are stored in knowledge base. The business and support results are extremely promising using our Hybrid CRM solution that improves customer service, developing domain knowledge base and log analytics. This methodology will increase in service requests, which in turn increase effectiveness in action plan, scalability, better data availability and overall reduction time in the business organizations, which will opt for this hybrid CRM solution.

Although the design and the use case are built for a university support services, the methodology we have developed and adopted is not limited to this domain. In the future, we will (1) integrate the deep learning techniques to automate response for the customer queries and requests, (2) propose a solution for the organizations to deploy their own cloud model.

Author details
H. S. Chiranjeevi[1]
E-mail: chiranjeevi.hs@learner.manipal.edu
Manjula K. Shenoy[1]
E-mail: manju.shenoy@manipal.edu
D. Syam Sundar[2]
E-mail: sdiwakar@in.ibm.com
[1] Information & Communication Technology, MIT, MAHE, Manipal, 576104, India.
[2] IBM India Private Limited, Hyderabad, India.

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