Implementation of a Novel System for Cross Platform Communication of Diversified Applications over Network

Manish Kumar
M.Tech Research Scholar
Maharishi Markandeshwar University,
Ambala

Debasis Dwibedy
Assistant Professor
Dept of Computer Science
Maharishi Markandeshwar University,
Ambala

ABSTRACT

Enterprises of all ends are trying to integrate and manage the data within a single sign on system. With the drastic increase in the usage of internet in the last decade, it has been observed that more and more use of web services throughout the industry. Data today is stored in various forms and structure in different OS, mainframes etc, the optimum way of managing this data and the most efficient way to access and retrieve this data is the need of the hour. This is where the versatility of web services comes into picture which enables enterprises and consumers to integrate numerous diversified platforms together to satisfy the essential requirements. This explores a dire need of a cost effective and efficient system that can integrate various cross platform applications to work together in a systematic environment. The aim of this research paper is to design and implement an organized system to demonstrate the data flow, architecture and the techniques used to integrate an ERP system with web applications. This is done by using a SOAP web service which integrates ASP.NET, Java and Database applications. Microsoft .NET as a platform for developing enterprise software is emerging for integration with SAP Enterprise.

Interest in Web services is rapidly increased from their inception. To exchange information among various applications in a standard way is the main goal of web services. This communication between the applications is based on SOAP and REST principle. Web service is a software system designed to support interoperable machine-to-machine interaction over a network. Currently, it has been emphasized quality and security of web services. Therefore, in this paper, the authors highlighted some standard trends such as SOAP, WSDL, UDDI for web services and the security policies to protect user information. This system is in Visual Studio 2010 development environment, using c# programming language, ASP.NET, ADO.NET and SQL Server database to jointly develop a B/S structure of ERP system.

Keywords

SOAP, WSDL, UDDI, REST, Web Services, Single sign on, ASP.NET, ADO.NET, SQL Server, SAP.

1. INTRODUCTION

A web service provides a defined set of functionality on a machine processed interface [1]. The web service interface is described in a formal language like WSDL that allows creating code to access the service thus simplifying web service consumer (client) and provider (server) development [6].

In complex web services, the interface is typically described in WSDL while the access to the service makes use of the SOAP message protocol [5]. SOAP has its roots in remote object access but is now a general message based and asynchronous transport mechanism. SOAP is typically carried in HTTP (HyperText Transmission Protocol), but other message based protocols like SMTP (Email) or plain TCP could be used as well.As the internet is growing fast and large group of people have access to the internet, people started doing transaction through internet Cloud services instead of visiting places directly or placing orders Telco.

In this paper, the authors propose the architecture of the system which will bridge the gap between Web application and ERP system. Basically an ERP system is maintained under any organizational Intra-network. The internal users of the organization are the major man-power in the organization and they need to plan their activities as per the work required to be done in time.Large organizations have hundreds to thousands of external users as their customers. To interact with customers, they need to devote their extra time and work overhead with manual interaction and need strong supervision in this scenario. This may lead to inefficiency, unorganized, error, etc. in the data and result produced. To overcome these problems, the authors will propose an automated system based on Web internet to communicate with internal network of the organization which improves the performance, efficiency and error-free result.

The integration of an ERP system, which is particularly defined for the business tasks of any organization, with Web based system takes place by using concepts of SOAP, RFC, SAP-BAPI, Web Services, SAP Connector, Agent-Cloud theory and some other standards of web protocol [5].The system architecture consists of an Agent and Cloud. Agent is basically a local system or Virtual Machine which is used to connect to SAP server and download data to the local system. The Agent communicates with SAP through SAP connector and RFC (Remote Functions Call) mechanism. The RFC are called using SAP Web Services using SOAP standard. The second web service is used to transfer downloaded data from SAP to Cloud server and this process is carried out using SOAP mechanism.

Both web services run in synchronization for proper data transfer. The Agent-Cloud method must ensure that the Data travels in an encrypted format, no data loss during syncing, no data/information resides on user's computer, no loss/theft of data from user's computer, enhanced password security (Password policy in place), audit trail and session logging, roles and authorization based system, access to application via additional firewall, SSL 128 bit encryptionThe framework for Web based system and ERP system (SAP) integration is given below:

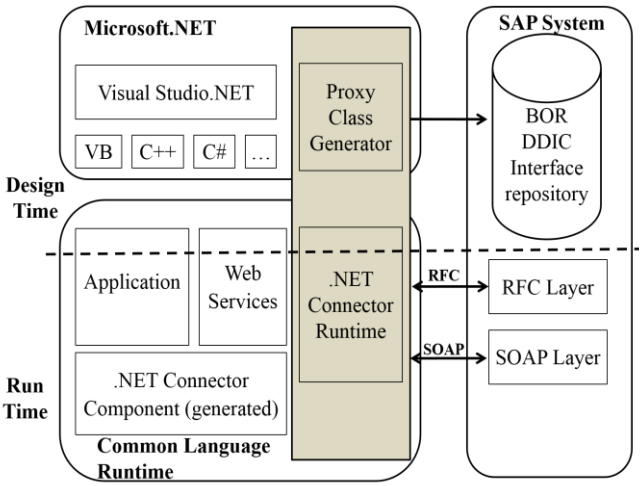

Fig 1: Microsoft.Net connector interface

Thus, by concentrating on these important factors, the authors first purpose a formal definition of these concepts along with an efficient and generalized system design. Secondly, the authors develop an effective framework to represent interface between the two systems. The various sections of the paper are organized as follows. In first section the authors discuss the existing work on web services and system integration techniques. In second section, the authors define the disadvantages of existing scenario for which the proposed system is suggested. In third section, the authors define some technologies and protocols to be used. In fourth section the authors introduce proposed system architecture, design and development. The fifth section of the paper provides the experiment results. In the sixth section, the authors define the future research scope and finally conclusion in the next section.

2. LITERATURE SURVEY

In [1], while analyses of web services, the points of weakness in web services are highlighted and the best of bio-information for web services security are established.In [3], the author describes the part of bridging the gap between Microsoft.Net framework technology and SAP R/3. They tried to setup an environment between these two systems and defined two methods. One is using web services and other is using SAP.NET connector. They describe the creation of web services at Dot Net part of system and DDL creation of assemblies for RFC and SOAP communication using Dot Net proxy classes. The author defines the use of Visual Studio and system namespace to include the web services and the communication flow process in a way the author specifies is brief.In [2], the author describes a warehouse system using ASP.NET and Oracle which describes business flowchart to improve the work efficiency.In [5], the author defines the significance of SOAP as a protocol standard in using web services in the form of XML elements. The paper defines that how the address of the web services is stored in UDDI registry.In [6], the author describes the Software Oriented Architecture (SOA) which defines the topology in which the business logic of the application is planned. He laid down the advantages and risks involved in this approach.In [8], the author describes the smart system based of approach using SOAP which uses Ethernet technology and GSM mobile technology for the system implementation. The proposed solution is embedded system with high performance and real time management services.

In [9], the author proposed a model of secure transmission of SOAP messages based on confidentiality, authentication, non-repudation and single sign-on. The technologies used are XML signature, XML encryption and X.509 certificate.In [11], the author describes integration of heterogeneous web applications such as ASP.NET, Java and database using web services SOAP. The web service used WSDL (web services description language) in XML and defines the usage of SOAP and REST framework.

3. MOTIVATION

Following are the major problems that have been identified in the current system which lead to new system interface development:

3.1 Data Accuracy

With the current manual filing based system, data is not secured as anybody can gain access to the file and manipulate the data. Furthermore, the data written may not be 100% accurate as spelling errors and poor hand writing can cause misunderstanding of data which may lead to other serious problems. In the business environment, data accuracy is important in. Therefore, the interface application can ensure that the data entry reliable and trustworthy.

3.2 Damages

A form made with paper can be easily damaged by water, fire or any other unpredictable circumstances. Using the computerized system, such damages can be tremendously reduced by storing the data in an electronic form.

3.3 Data Redundancy

By using paper forms, users need to fill in the same information or details each time they want to make an order. With the Cloud server, the repeated information or details will only need to be keyed in once and will then be stored in the system's database for future reference.

3.4 Time Consuming

Most of the time, one will find filling a form is time consuming and annoying especially when there may be a lot of orders to be made. Thus, by using this system, user may find it faster and more effective as data that is already in the system's database don't have to be keyed in and any erroneous or incomplete data detected by the system will be alerted to the user.

3.5 Storage Problem

Basically, forms are made of papers. Some come in good quality and some don't. As time goes by, these forms will start to accumulate and will require a large space to store all of them. These forms will also start to deteriorate where some of the hand writing cannot be read anymore as the ink has faded. These problems can be easily overcome using the computerized system comprising of PCs, software and other peripherals. All the information contained in the forms can be stored on Cloud space.

3.6 Security

Using the paper-based forms, all the information including confidential information can be viewed by anybody who can access the file or the filing cabinets. The interface system provides data security where only authorized users can access the information or make any changes to it.

The advantages of automating the system are as follows: -

- Data will no longer be maintained manually
- Larger amount of data can be stored
- Operations will be faster
- Retrieval of data will become easier and hassle free
- Reports will be just a click away
- Queries can be answered by selecting the appropriate menu option
- Maintenance of records will become easier
- User friendly front end

4. TECHNOLOGIES - SOAP, WSDL, UDDI, REST, SAP, SAP.NET CONNECTOR AND BAPI

SOAP was originally part of the system that included the Web Services Description Language (WSDL) and Universal Description, Discovery, and Integration (UDDI). It is used now without WSDL and UDDI. Instead of the discovery process described in the History of the Web Services Specification section below, SOAP messages are very well hard-coded or generated without the use of a repository part.

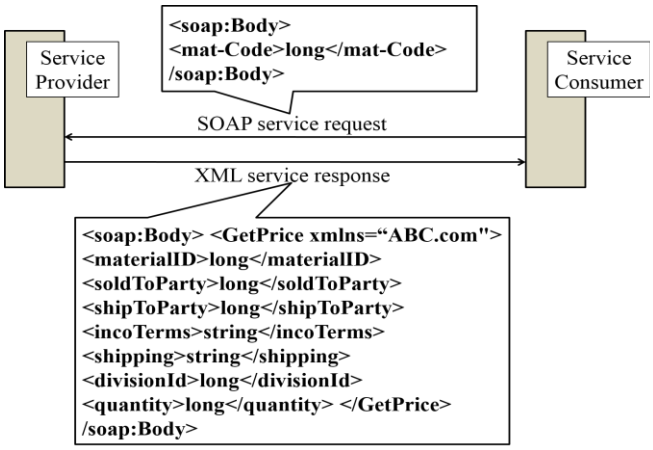

Fig 2: SOAP communication system

Simplicity remains one of SOAP's primary design goals. SOAP defines a communication framework that allows for features such as security, routing, and reliability to be added later as layered extensions.WSDL provides a formalized description of an interface that is coarsely separated in an abstract service interface definition containing operations and data types, a transport binding that describes how the web service is accessed and finally a description of the location (address) under which a web service is accessible. The <message> element defines the data elements of an operation. Each messages can consist of one or more parts. The parts can be compared to the parameters of a function call in a traditional programming language. The steps involved in providing and consuming a service are as follows:

1. A service provider always describes its service using WSDL. This definition is published to a repository of services and the repository could use Universal Description, Discovery, and Integration (UDDI). Other forms of directories could also be used in the scenario.
2. A service consumer issues one or more queries to the repository to locate a service and determine how to communicate with that service.
3. Part of the WSDL provided by the service provider is passed to the service consumer. This tells the service consumer what the requests and responses are for the service provider.
4. The service consumer uses the WSDL to send a request to the service provider.
5. The service provider provides the expected response to the service consumer.

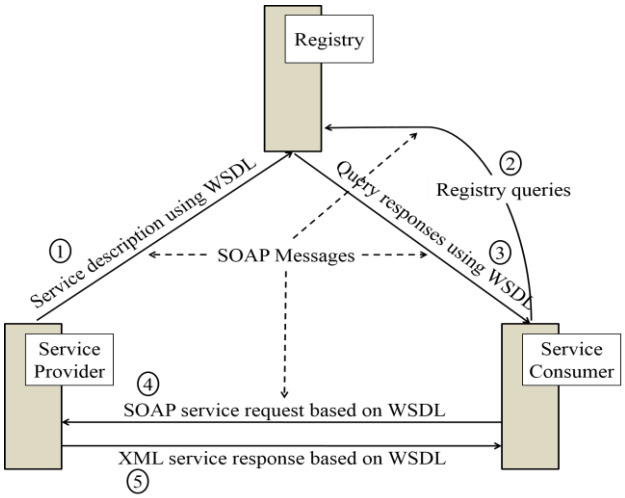

Fig 3: WSDL and UDDI system

UDDI is a platform-independent framework for describing services, discovering businesses, and integrating business services by using the Internet. UDDI stands for Universal Description, Discovery and Integration. UDDI is a directory for storing information about web services and a directory of web service interfaces described by WSDL.

The repository shown in the above figure could be a UDDI registry. The UDDI registry was intended to eventually serve as a means of "discovering" Web Services described using WSDL. The idea is that the UDDI registry can be searched in various ways to obtain contact information and the Web Services available for various organizations. How much "discovery" was ever used is open to discussion. Nevertheless, even without the discovery portion, the UDDI registry is a way to keep up-to-date on the Web Services, the organization currently uses. It can be used at design time and with governance. An alternative to UDDI is the web XML Registry.

Representational State Transfer is intended to evoke an image of how a well-designed Web application behaves: a network of web pages (a virtual state-machine), where the user progresses through an application by selecting links (state transitions), resulting in the next page (representing the next state of the application) being transferred to the user and rendered for their use.

Representation State Transfer (REST) appeals to developers because it has a simpler style that makes it easier to use than SOAP.

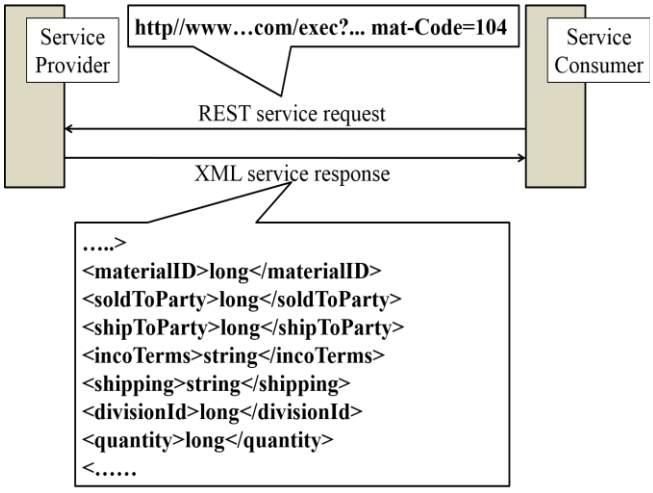

Fig 4: REST communication system

SAP R/3 Software has been developed using ABAP/4 as a programming language. SAP is the ERP (Enterprise Resource Planning) system that aims to integrate all the different modules (SD, MM, CO, HR etc.) in the company. The integration results in consistency of data through out the system and the company as a whole.

SAP R/3 is one of the main product of SAP, where R stands for Real Time and the number 3 relates to three tier application architecture (Data base, Application Server and Client). Most of the business in today's world runs on SAP R/3 system. About 80% of the companies implemented this software.

A Business Application Programming Interface (BAPI) is an interface providing access to processes and data in business application systems. BAPIs can be called within the SAP System from external application systems and other programs. BAPIs are the communication standard interface for business applications.

BAPI interface technology forms the basis for the following developments:

- New R/3 components, for example, Advanced Planner and Optimizer (APO) and Business Information Warehouse (BW).
- Non-SAP software
- Legacy systems
- Isolating components within the R/3 System in the context of Business Framework
- Distributed R/3 scenarios with asynchronous connections using Application Link Enabling (ALE)
- Connecting R/3 Systems to the Internet using Internet Application Components (IACs)
- PC programs as frontends to the R/3 System, for example, Visual Basic (Microsoft) or Visual Age for Java (IBM).
- Workflow applications that extend beyond system boundaries
- Customers' and partners' own developments

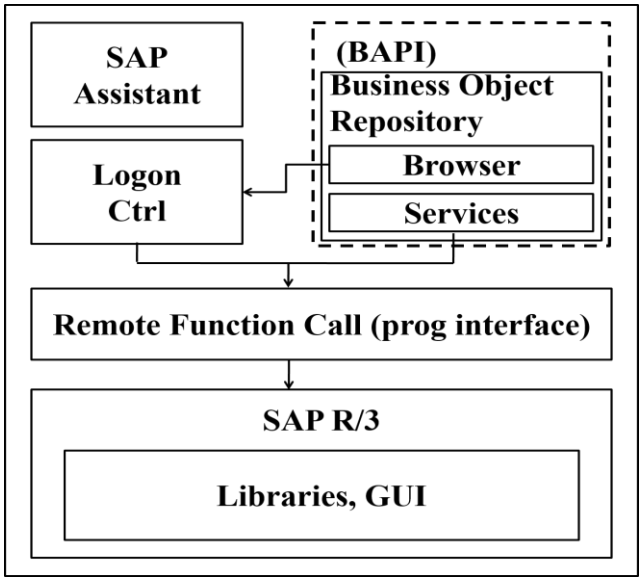

Fig 5: BAPI – RFC connection with GUI

The graphic below shows how BAPI interfaces enable different types of applications to be linked together.

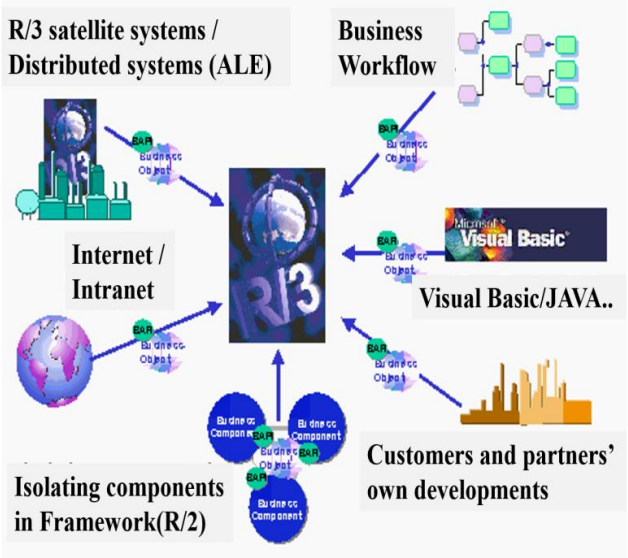

Fig 6: Application linkage via BAPI

SAP.Net Connector is a SAP product which interacts with SAP via RFC/SOAP. It is managed code and fully integrated with Visual Studio.NET

5. THE OVERALL SYSTEM ANALYSIS, ARCHITECTURE AND DESIGN

The overall architecture of the integrated system environment is given below in fig. 7 and the flow of data and steps are identified in the labels given with the activity listed below.

1. Label marked as no. 1 is SAP and RFC setup for communication.
2. Label marked as no. 2 is local system/ virtual machine.

3. Combination of label marked as no. 1 and 2 is Agent setup.
4. Label marked as no. 3 and 4 is Cloud setup.
5. The users interact with Cloud environment (Web based portal)
6. The data flow between Presentation layer, Business layer, Data Access layer and finally to SQL Database Server.

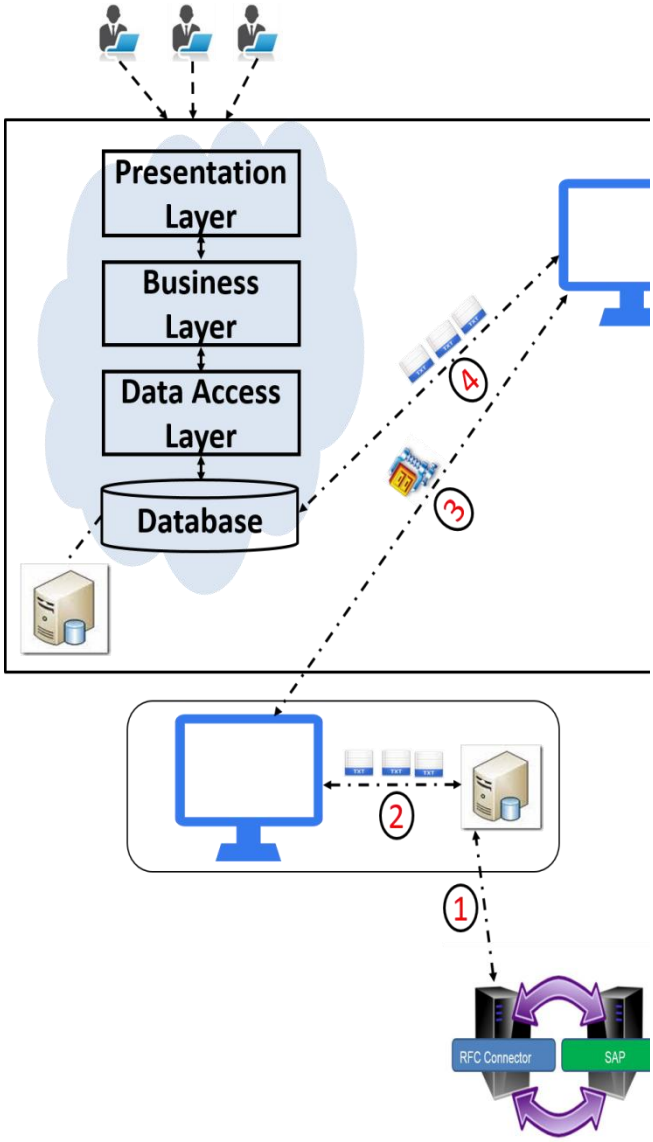

Fig 7: Integrated proposed system architecture

The Cloud Application system flow diagram is shown below in fig. 8:

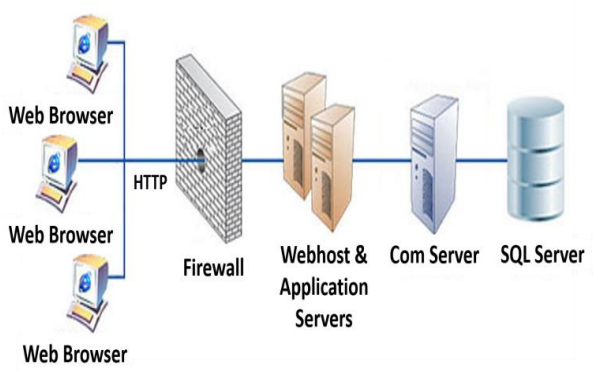

Fig 8: Cloud application system

In the System Workflow as shown below in fig. 9:

- Agent calls the SAP web service for download master data and transactional data from SAP.
- SAP web service gets download the data in different table (here IT_CUSTMAST_DL, etc.) from SAP and dump it into the local SQL SERVER
- SAP web service then clean the downloaded master data
- SAP web service then makes the text file for cleaned data for BCP operation.

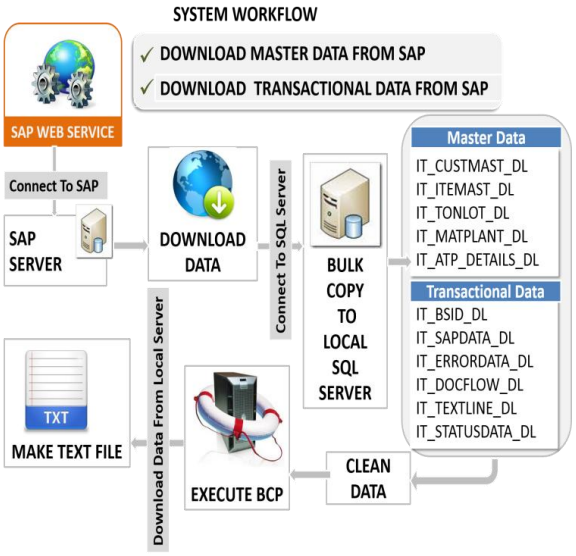

Fig 9: Proposed system workflow

In the System Workflow as shown below in fig. 10, the steps to be performed by agent while synchronizing data:

- Agent call the CN web service hosted on cloud server for synchronize data
- CN web service zipped the folder which contains the downloaded data text files and upload into the cloud server
- CN web service unzipped the folder and call the SQL SERVER stored procedure to make the BCP operation

- SQL stored procedure executes the BCP command against all uploaded text files and then upload all text file data into the SQL SERVER raw tables

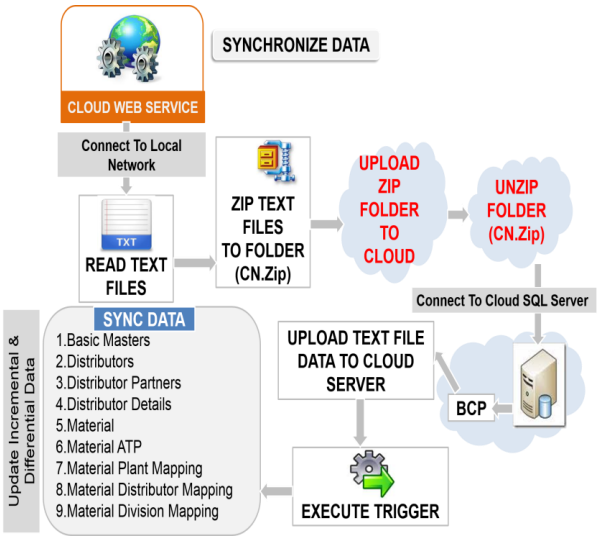

Fig 10: Sync data workflow

In the System Workflow as shown below in fig. 11, the steps to be performed by agent while uploading data to SAP:

- Agent calls the CN web service hosted on cloud server
- CN web service get the data list which are being processed by SAP
- Agent calls the SAP web service
- SAP web service upload the data list into SAP which get downloaded by CN web service

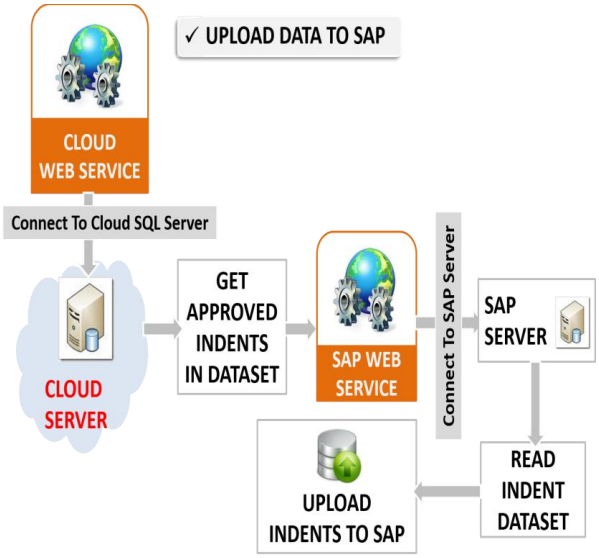

Fig 11: Upload data to SAP workflow

6. EXPERIMENTS AND RESULTS COMPARISON

1. P1 through P8 are the processes included in Download data from SAP process in table 1. The time taken to download the following records from SAP is given in table 1. The status of the records shows that either the records are New, Modified or Deleted.

Table 1. Records in downloaded data from SAP

S.No.	1	2	3	4	5	6	7	8
Process Name	P1	P2	P3	P4	P5	P6	P7	P8
Time To Execute(in Seconds)	13	37	20	23	50	35	44	117
Record Count	43626	52916	51231	18187	27726	4012	1745	23634
Status	New	New	New	New	New	New	New	New

The graphical representation of the experiments with three comparisons between three sets of processes is shown in fig. 12.

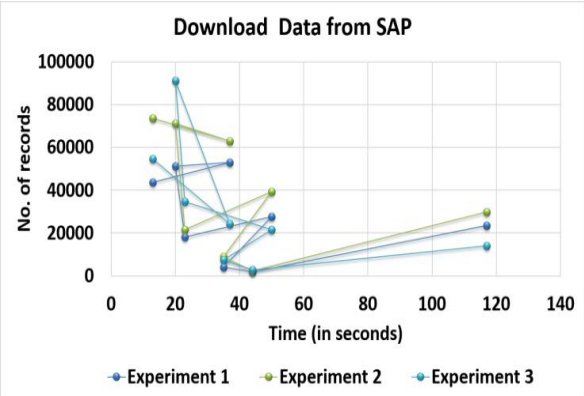

Fig 12: Graph of downloaded data from SAP

2. P1 through P12 are the processes included in Synchronize data process in table 2. The time taken to download the following records from SAP is given in table 2. The status of the records shows that either the records are New, Modified or Deleted.

Table 2. Records in sync data process

S.No.	1	2	3	4	5	6	7	8
Process Name	P1	P2	P3	P4	P5	P6	P7	P8
Time To Execute(in Seconds)	60	8	2	5	10	12	45	8
Record Count	1	580	812	6000	1204	1170	867	1120
Status	New	New	New	New	New	New	New	New

The graphical representations of the experiments with three comparisons between three sets of processes are shown in fig. 12.

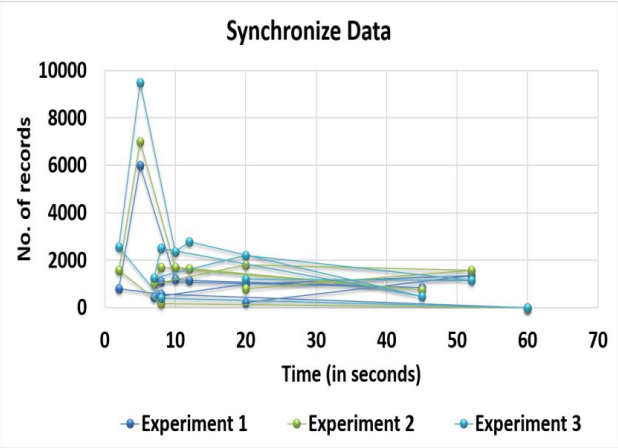

Fig 13: Graph of sync data process

7. FUTURE SCOPE

The communication between a web application and ERP system can be made possible more secure and less time consuming in future. The system can be more automated and the result of the execution may be much better. The system can be integrated to an environment which is more secure and powerful. This approach can be used in multinational corporations to incorporate two or more different environment. The integration between two different systems is made for easy use and the problem for data security and data corruption need to be avoided later on.

8. CONCLUSION

The authors find the result based on no. of records and time taken (in seconds) to compile those records in this communication system. The results are shown in table and compared graphically with three experiments. P1, P2, P3… So on are the different processes in the data communication between ERP system (SAP) and web based system. Since the primary task of management is effective decision making, the primary task of research, and subsequently system, is to generate accurate information for use in that decision making. It is imperative that an organization's Cloud system strategies reflect changes in the internal and external business environment in addition to the direction in which the business is traveling. Playing an integral role in the growth, development and success of an organization, the integration of Web application system and ERP system facilitate meaningful research which facilitates effective management. This report shows that the functional requirements and non functional requirements of the purposed system. This report highly stresses, requirement analysis with the use of powerful tools such as Class Diagram and Use Case which show what the system should perform and who are the system users. This report also showed functional prototypes of customer registration and order creation. The authors believe this report is clear and understandable for everyone.

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