Use of RESTful Web Services in Distributed Computing

Smita Patil
Department of Computer Engineering
R.A.I.T.
Navi Mumbai

Prof. Nilesh Marathe
Department of Computer Engineering
R.A.I.T.
Navi Mumbai

Prof. Puja Padiya
Department of Computer Engineering
R.A.I.T.
Navi Mumbai

Abstract—Web services can convert your application into a web application, which can publish its function or message to the rest of the world. Web services help us to take web applications to higher level and provide interoperability between different platforms . Web services are widely used in Distributed system to coordinate their activities and to share the resources of the system. In earlier days SOAP web services work best for distributed computing. Now a days RESTful web services proves best as it provide a natural framework for such asynchronous distributed computing and also its architecture more suited for on-demand computing. SOAP is combination of XML and HTTP used to send and receive messages over internet. The language or platform of application does not affect on its use. REST is not concentrate on protocol syntax instead it focuses on roles of components and their interaction constraints while designing network application. In other words it is an architectural style. This paper compares SOAP web services with the RESTful web services and illustrates how RESTful web services better for distributed computing.

Index Terms—Distributed System, Web Services, SOAP, REST, Grid Computing.

I. INTRODUCTION

Distributed system is nothing but a collection of different independent computers, which communicates with each other through a network and distribution middleware. User interprets it as a single united computing system which allows computers to co-ordinate their activities and to share the resources of the system.

The components of distributed system interact with each other in order to achieve common goal. A problem is divided into many tasks each of which is solved by one or more computers which communicate with each other by message passing. High performance applications which require large amount of computations with large amount of memory and higher speed increases heavy load on computing infrastructre .Data mining, graphics rendering are some examples of such applications. Traditionally standard batch scheduling used for such pleasingly parallel workloads. After that web service based grid middleware which is traditionally based on soap web services[1] used for parallel workloads. Now a days it is suggested that Restful web services proves best for such asynchronous distributed computing with its natural frame-work and architecture. Also it proves best for on-demand computing. Here we discuss Grid Factory as a distributed computing system and the web services of this system.

Grid Factory is a system for aggregating computing re-sources on a local or wide area networks in order to carry out heavy duty batch calculations.[17] The system targets in-dependent, relatively long-running jobs and falls in a category somewhat between desktop grids, traditional batch system and traditional grids. It implements a hierarchical pull-architecture, with servers pulling compute job from other servers. Here we describe the web services of this system. Traditionally the components in a distributed architectures are very sensitive to change as they posses very loose coupling among them-selves.[3]

The paper divided into following sections. Section 2 de-scribes Literature survey. Section 3 give brief explanation of SOAP. Section 4 explain RESTful web service. Section 5 describes workflow in GridFactory. Section 6 compares SOAP and REST web services. Section 7 concludes the paper.

II. LITERATURE SURVEY

A web service enables system interoperability by providing a means of exchanging data between computer systems. Soft-ware applications which are running on a variety of platforms and frameworks communicate with each other over a world wide web through the use of Internet standards, such as XML and HTTP. In earlier days SOAP web services works best for distributed computing. Now a days it is suggested that Restful web services proves best for such asynchronous distributed computing with its natural framework and architecture. Also it proves best for on-demand computing.[1] The overall aim of many research projects and new technologies in the area of dis-tributed computing is to combine the processing power of large no of computers, connected via the Internet to solve scientific problems. The developed technology In earlier days SOAP web services works best for distributed computing.usually categorized under the term grid computing.[2] In distribute application web services provide ultimate solution for shaping application development [3], But as in software engineering there is no perfect solution for anything, web services also offer some advantages over existing technology and have some problems also. Problems faced by the web services in the distributed application include transaction management, security and web services discovery problems. The clients and servers communicate with each other using different ways, considering them as a web services. Web services can be im-

plemented in formal and informal ways. Formals are one that follow the SOAP standard which allows the communication between client and server using XML messages. Informal web services are nothing but that does not necessarily ruled by the SOAP and WSDL specifications. [4] SOAP based approach may be offer opposite effect than desired one due to its increasing complexity. In comparison to that the REST model offers the simplicity and follows the architectural principles of the web that is seen as both practical and appealing. This feature is best suited for computing systems with large resources and also for mobile devices which currently have fewer resources and more constraints. [5]

RESTful Web services are now emerging as an alternative to SOAP-based web services. For developing multimedia conferencing applications shows that the RESTful Web interface offers better performance.[6] The use of web services has been limited in some areas mainly because of poor performance. Caching is considered to be a well-known performance boost-ing approach in these type of applications.[7] SOAP based web services are produces considerable network traffic[9], high latency and message size is also large this is not in the case of RESTful. The RESTful web services have better performance than SOAP based web services in wired and wireless communication network. The RESTful web services are lightweight, easy and self-descriptive with higher exibility and lower overhead. Building a RESTful distributed system requires more than the adoption of HTTP and the remainder of the web technology stack. In order to develop a system that works in harmony with the web, one need to carefully model distributed application state, business processes that affect that state, distributed data structures which hold it, and the contracts and protocols that drive interactions between the constituent parts of the system. The key REST concept of hypermedia is a design pattern that can greatly help building software to meet these demands. [10] RESTful services proves best for service providers as well as end users . If we have done comparision with SOAP it improves system flexibility, scalability, and performance.[11] According to the end users it consumes less resources just like battery, processor speed, and memory etc. Production and consumption of REST-based web services are easier because they do not include complecated standards and heterogeneous operations. Also with advances in mobile communication technologies and wireless securities, now it has become possible to host web services on mobile devices. RESTbased framework is more suitable for handheld, resource constrained mobile device and wireless a network also. [12]

III.   SOAP

SOAP is a Simple Object Access Protocol uses XML for the messaging framework to communicating between computers in distributed environment. There are different versions of SOAP published by W3C to increase compatibility with the general architecture of web.It is an XML-based protocol, which consists one root element known as SOAP envelope

which is used to send web service messages over Internet. SOAP envelope contains two parts

1) SOAP header: which is optional, provides information about authentication and a set of encoding rules
2) SOAP Body: that contains messages that can be exchange over any protocol and convention for represent-ing remote procedure calls and responses.

Neutrality is one of the major characteristic of SOAP which means it can usually operated with a variety of other protocols such as SMTP,TCP, etc. Actually HTTP is the only protocol for which SOAP defines binding therefore generally it is used with HTTP.[18] Figure 1 shows the basic outline of a SOAP message. The outer element is the envelope tag,acts as a real envelope holding two child elements inside namely body and header.

The body element can contain an XML document or if it is an RPC request, it contains structured return data or arguments, or some fault for error reporting. The header element is a sort of dumping ground for tags. The header can contain zero to many custom tags and was purposely left open for flexibility in future applications. As the SOAP message travels from server to server, these tags are read and possibly acted upon. Other tags in the header can be instances of transaction or session ID tags to create a state, although they can be anything.
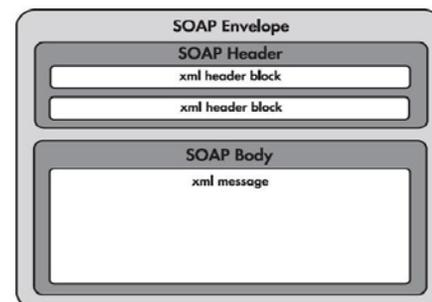

Fig. 1. Format of SOAP Message .

IV. REST

REST (Representational State Transfer)is nothing but a set of architectural constraints applied to all components,data elements and connectors for distributed system. It is not a protocol and not provides component implementation. It is sometimes spelled"ReST". REST is based on following principles.

It provides a layered, stateless client server design with caching of request.

Uniform Interface between components.

support code-on-demand

CORBA, RPC or SOAP are the complex mechanisms for communication between machines.The REST focuses on roles of the components and their interaction with other components using HTTP in more easier ways than these complex mecha-nisoms.[16]

REST is a simple as well as fully-featured and lightweight alternative to all other mechanisms. Even though it is not protocol base, it allows us to do everything which we can do with other web services As REST uses simple HTTP for communicaton, RESTful applications use HTTP requests to post data (create and/or update), read data (e.g., make queries), and delete data. All four CRUD (Create/Read/Update/Delete) operations are perfomed using HTTP protocol.(described in table below) REST is not a "standard". There will never be a W3C recommendaton for REST.

HTTP Method	CRUD Operation	Description
GET	Read	Fetches a resource
PUT	Create	Transfers a resource to the server and overwrites existing resources
POST	Update	Adds to an existing resource on the server
DELETE	Delete	Discards resources; names cannot be used

Fig. 2. REST Operations

V. GRID AS A DISTRIBUTED SYSTEM

Grid computing is the collection of many computer re-sources from different locations to obtain a common goal. Grid computing is best example of distributed computing which uses different resources often spread across different physical locations and administrative domains. The resources nothing but compute nodes, storage, applications and data, which optimized through virtualization and collective manage-ment. Traditionally components in distributed architecture can easily undergo to change because they posses relatively brittle coupling among them. Any significant change to any of the aspects such as scale, demand, volume, and rate of business change cause the brittleness of the systems to become a crisis . It is difficult to get quick response from the websites or it may unavailable, slow down the speed and also cant get the new business opportunities. Such system will unable to face the changes because of the high coupling. Hence there is a need of application which undergo structural changes according to system requirement and replace the current models of appli-cation. Grid Factory is a system for aggregating computing resources on a local or wide area networks in order to carry out heavy duty batch calculations.[17] The system targets in-dependent, relatively long-running jobs and falls in a category somewhat between desktop grids, traditional batch system and traditional grids. It implements a hierarchical pull-architecture, with servers pulling compute job from other servers. The role of web services in Grid computing is important in order to compute jobs.

The most fundamental principal underline web services is the service oriented architecture (SOA).[3] An SOA focuses on how service component are described and organized to support dynamic, automated discovery and use.Components in SOA have to follow one or more of three roles, a service

provider, a service broker, a service requester. Availability of its services is published by a service provider and also give response to requests about its services. A service broker register and categorizes published service provider and offers search services. A service requester uses service brokers to find a needed service and then employees that service. The main purpose of web services is to support a dynamic process of discovery and composition of services in heterogeneous environments such as grid computing. WSDL is used to describe web services. It provides a standard mechanism for defining interface definitions which is written in xml. WSDL provides to user the location and the methods of the required service. The applications which are depending on lightweight message exchange mostly prefer SOAP-based web services . It is not suited for big data transfers. It is good for transfer data in heterogeneous distributed environments. As per the performance need the WSDL standard does imply the use of SOAP or HTTP GET/POST mechanisms or any other protocol for data exchange.

The best example of REST based architecture is the World Wide Web because it based on http. REST is better option to connect between machines and transfer data. We can replace complex mechanism such as CORBA, RPC or SOAP , by using REST which based on simple http to make calls between machines. Therefore it is fully feature and lightweight alternatives to mechanism like RPC and web services (SOAP, WSDL). REST is fully featured and lightweight, and relies upon the HTTP standard to do it's work. REST essentially requires HTTP, and is format-agnostic(meaning you can use XML, JSON, HTML,whatever). Therefore REST is a better alternative to SOAP because it improves the performance and scalability of Grid System.

VI. SOAP VS REST

SOAP web services are used where asynchronous process-ing and invocation required ,formal contracts needed and have stateful operations. When limited bandwidth and resources are required and totally stateless operations require caching, REST web services are used.The comparison between SOAP based web services and REST web services are described in table I based on different parameters.

VII. CONCLUSION

Web service is a software system using which one machine can communicate with other machine over a network and designed to support interoperable machine-to-machine inter-action. SOAP, UDDI, WSDL are the different components of web service.Basically web service is nothing but combination of XML and HTTP in conjunction with other Web-related standards. It uses XML for tagging data, SOAP for transfering messages and WSDL for describing the availability of ser-vices. Other systems interact with the Web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization Web services are designed to provide rich functionality for organizations

TABLE I
DIFFERENCE BETWEEN SOAP AND REST

Sr. No	Parameters	SOAP	REST
1	Developer view	Exposes operation which represent LOGIC	Exposes resources which represent DATA
2	Performance	Good	Better, Caching and lower message payload makes RESTful web services performance efficient and scalable
3	Standard Based	SOAP web services are based on SOAP and WS*specification	REST web services not based on any web specification
4	Security	Provide more security WS-security provides end-to-end security covering message integrity authentication	Uses SSL for providing security. less secure than SOAP
5	Caching	No	GET operation can be cached
6	Message size	Heavy, has SOAP and WS* specific markup	Lightweight, no extra xml markup
7	Protocol	XML	XML, JSON, other valid MIME type.as per the consumer needs REST provides specific message payloads
8	Message Encoding	Yes, SOAP Web services support text and binary encoding	No, RESTful encoding is limited to text
9	Service Description	WSDL	NO formal contract defination
10	Simplicity	Soap is not hard as compared to rest	REST is simple
11	Transport protocol support	SOAP uses HTTP,SMTP, JMS any protocol	REST only uses HTTP.
12	Coupling	In SOAP client server interaction is Tightly coupled.	In REST, client-server interaction is loosely coupled.

RESTful services can improve system exibility, scalability and performance as compared to the SOAP-based web services. It is equally attractive to end users as it is consume less resources(i.e, battery, processor speed and memory). Addition-ally, REST do not include complex standards and heteroge-neous operations so it is easy to produce and consume.

REFERENCES

[1] Frederik Orellana and Marko Niinimaki Hepia "Distributed computing with RESTful web service", 2012 Seventh international conference on P2P, Parallel, Grid, Cloud and Internet Computing.
[2] F. Orellana, and M. Ninimaki,"GridFactory-Distributed computing on ephemeral resources",june 2011, proceedings of PGCIC-2011.
[3] A.S. Chaudhary, M.A. Saleem, H.Z.Bukhari "Web Services in Distributed Applications Advantages and problems", Pakistan 2002.
[4] www.hostbridge.com, "SOAP and REST Choosing formal and informal Web services for CICS integration", March 2009.
[5] Madeleine Wright,"Web services yesterdays hype or tomorrows promise?", Rhodes University,2006.
[6] Fatna Belqasmi, Jagdeep Singh, Suhib Younis Bani Melham, and Roach H. Glitho., "SOAP-Based vs. RESTful Web Services , A case study for multimedia conferencing", Published by IEEE computer society 2012.
[7] Amila Liyanaarachi, Shahani Weerawarana, "An End-to-End Caching Protocol for Web Services",Advances in ICT for Emerging Regions (ICTer), 2012 International Conference on. 2012 .
[8] Tommi Aihkisalo, Tuomas Passo , "Latencies of Service Invocation and Processing of the REST and SOAP Web Service Interfaces" , IEEE Eighth World Congress on Services. 2012.
[9] Snehal Mumbaikar, Puja Padiya, "Web Services Based on SOAP and REST Principles", International Journal of Scientific and Research Pub-lications, Volume3, Issue 5, May 2013.
[10] Savas Parastatidies, Jim Webber, Guilherme Silveira, Ian S Robinson, "The Role of Hypermedia in Distributed System Development", WS-REST 2010 April 2010.
[11] Bipin Upadhaya, Ying Zou, Hua Xiao, Joanna Ng, Alex Lau. "Migration of SOAP-based Services to RESTful Services",13th IEEE International Symposium on Web Systems Evolution (WSE)2011.
[12] Kishor Wagh , Dr. Ravindra Thool."A comparative Study of SOAP Vs REST Web Services Provisioning Techniques for Mobile Host" ,Journal of information engineering and application ISSN 2224 5782 (print) ISSN 2225 0506(online) Vol 2 , No.5 , 2012.
[13] W.Gentzsch, " Sun Grid Engine: towards creating a compute power grid„ cluster computing and the Grid" , 2001. Proceeding. First IEEE/ACM international symposium 2001.
[14] D.A. Kramar and M.MacInnis , "Utilization of local grid of Mac OS X Based computers using X grid", in proceedings of the thirteen IEEE international Symposium on high performance distributed computing. 2004.
[15] D.P Anderson,"BOINC: A system for public resource computing and storage", GRID 04 proceedings of the fifth IEEE / ACM international work shop on Grid computing. 2004.
[16] R.T.Fielding , "Architectural Styles and The Design of Network-based Software Architectures" , PhD thesis, University of Calofornia, Irvine(2000).
[17] Maozhen Li, Mark Baker.,"The Grid Core Tech- nologies" , John Wiley and Sons, Ltd. 2005.
[18] Robert Elfwing, Ulf Paulsson, and Lars Lundberg."Performance of SOAP in Web Service Environment Compared to CORBA"Software Engineering Conference, Ninth Asia-Pacific 2002 .
[19] Subbu Allamaraju ,"RESTful Web Services Cookbook",Published by OR- eilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472,2010.

and support interoperable interactions over a network. Web services are mainly realized in two ways

    SOAP based web services

    RESTful web services

By comparing these two web services we conclude that,