XaaS for XaaS: An Evolving Abstraction of Web Services for the Entrepreneur, Developer, and Consumer

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***Abstract*— With the emergence of demands of virtual infrastructure, cloud storage, hyper-computing, semantic search, collective intelligence, and semi-structured mining, the entrepreneur, developer, and everyday consumer would be unrecognizable when viewed by their counterparts even as recent as the beginning of the millennia. Adoption of XaaS (anything-as-a-service) has allowed the ushering of "anytime-anywhere-any-size" with social and entertaining aspects for the consumer, breadth-expansion capabilities for the software developer, and multidimensional marketing/sales channels for the entrepreneur. What is presented here is the dilation of these services through the increased abstraction with yet another layer of web services. One theoretical entry point is the ESB (enterprise service bus) which represents a robust architecture for a wide matrix of web services. Within it, there can exist concentric ESBs that ultimately serve as an XaaS for XaaS itself.**

Index Terms—XaaS, IaaS, PaaS, SaaS, CaaS

I. Introduction

The emergence of the cloud has served as a vehicle for new goods and services for the consumer, simple and efficient ways for businesses to offer and expand on those goods and services, and wide-reaching and highly complex application frameworks for application developers [1].

In particular, the cloud is the source for a variety of information technology services that has the immediate vertical impact from big business down to the consumer. The cloud has also provided developers with new tools that assist in research as well as discovering and assisting in the general movement of monetizing the web.

A. *Commonly Consumed Services*

The major cloud services currently being offered include the following:

- Infrastructure-as-a-Service (IaaS)
- Platform-as-a-Service (PaaS)
- Software-as-a-Service (SaaS)
- Communication-as-a-Service (CaaS)

B. *Infrastructure-as-a-Service (IaaS)*

As the heading suggests, this service provides end-to-end hardware solutions (laptops, desktops, networking components, etc.). There are generally two contexts that are involved: (1) Managed service and (2) Computing. In terms of managed services, IaaS operates as a licensing model. In terms of computing (namely, grid computing), IaaS operates as an on-demand model (per use). Storage, computing power, databases are examples of IaaS (namely, Dropbox, iCloud, youSENDit). The platform is a product of a virtualization environment. In terms of storage, cost is based on consumption. IaaS is also referred to hardware-as-a-service (HaaS).

C. *Platform-as-a-Service (PaaS)*

PaaS is an abstraction of infrastructure with support for cloud applications. It is defined as a middleware bridge between IaaS and SaaS. The following serve as examples of PaaS[cloudChar]:

- Google App Engine
- Amazon Elastic Computing (EC2)
- Microsoft Azure

D. *Software-as-a-Service (SaaS)*

Using the browser as the execution environment, SaaS is distributed with the properties of scalability. Furthermore, in addition to scalable distribution due to a consistent execution environment, a consistent look-and-feel is achieved with some care in the RIA (Rich Internet Application) development. Customer Relationship Management and Enterprise Resource Planning are examples of SaaS.

E. *Communication-as-a-Service (CaaS)*

CaaS is composed of unified communication services such as VOIP, conferencing, instant messaging. AT&T, Verizon, and NEC are companies that offer CaaS.

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II. Data Serialization & Interoperability

Platform and Software -as-a-Service (P/SaaS) are external to a corporate network. Therefore, the requirement emerges for robust, language-neutral formats for data exchange. XML, JSON, and Thrift are excellent examples.

A. Extensible Markup Language (XML)

XML is a simple, flexible text format originally designed to meet large-scale electronic publishing. XML documents form a tree root/leaf structure:

```
        <root>
         <child>
<subchild>.....</subchild>
        </child>
       </root>
```

The use XML is ubiquitous and in summary:

- There are basic syntax rules; XML is validated against something called a DTD (Document Type Definition),
- Namespacing and an object model exist for name conflict avoidance as well as standardized access,
- XML transformation is done through XSLT and in addition to the DOM, parsing can all be done within the browser.

B. JavaScript Object Notation (JSON)[json]

JSON is a lightweight data-interchange format. Its value is in the ease to parse and generate the format. It is built on two structures:

- A collection of name/value pairs
- An ordered list of values

C. Thrift[thrift]

Thrift (developed at Facebook) is a software library and set of code-generation tools that allow developers to define datatypes and service interfaces.

This library is a culmination of the following:

- A language-neutral software stack,
- An associated code generation engine which converts a simple interface and data definition into client-server RPC (remote procedure call) libraries.

III. Rich Internet Applications (RIAS)

RIAs are web applications that share traditional desktop application characteristic. There are several key differences which include the execution environment (web browser) with built-in XML parsing and JavaScript support over HTTP (built-in).

There are a number of technologies that assist in the development of RIAs but two are briefly described here on the basis of "multiplexed" technologies (HTML, JavaScript, and XML) and implementation language (Java). These technologies are jQuery and Google Web Toolkit.

A. jQuery

jQuery is a JavaScript library. It essentially assists in the following for AJAX (Asymmetric JavaScript and XML) development:

- html document traversing,
- event handling,
- animating,
- Ajax interactions

B. Google Web Toolkit (GWT)

GWT allows the development of RIAs using Java. The toolkit generates JavaScript that runs on the browser based on classes defined for the client-side. The toolkit provides interfaces for the client-side and classes on the server-side that are extended by the application code to achieve services with asynchronous callbacks.

IV. Web Services

Two major web service standards include SOAP (Simple Object Access Protocol) and WSDL (Web Services Description Language). These two are described below along with a web architectural style known as REST (Representational State Transfer).

A. Representational State Transfer (REST)

There is an abundance of documentation and tutorials on both REST services as well as how to implement them. This is merely a brief description.

REST is essentially an architectural style that embraces a stateless architecture. This stateless architecture views web services as resources.

At the same time, REST is also an analytical description of how the web operates in terms of the underlying HTTP protocol. HTTP verbs such as POST, GET, PUT, and DELETE correspond to CRUD (Create, Read, Update, Delete) actions. These actions map seamlessly to database activities.

B. Simple Object Access Protocol (SOAP)[soap]

SOAP is a lightweight protocol intended for distributed environments. It allows cross-communication in a decentralized, web-based environment. It provides a basic messaging framework. Its message format is XML.

C. Web Service Description Language (WSDL)

WSDL is a language formatted as an XML formatted description of network services. Network services are defined as a set of endpoints that operate on messages. These messages contain either document or procedure-oriented information.

V. Future Applications: Extrapolating from the Trend

A. Consumers: Bundled Everything

Consumers are already experiencing a bundling of service offerings from automobile purchases (auto and financing) to consumer electronics (device and insurance) to home entertainment (cable, voice, and internet). This will continue.

Although there will be many benefits to the consumer, there will continue to be consumer "victimization" through bundling of services. A warranty for products that remain operational longer than the term, above book-value auto-financing with near-predator terms, etc. Furthermore, although some may quickly argue that cable is a shrinking market, the struggle between cable and wireless continues. Major MSOs (multiple subscriber organizations) currently offer Internet service combined with Television and Voice. This now includes "home monitoring". The basis of characterization of the consumer being victimized is due to the impossible cost-effective decoupling of the services. A loosely related analogy is the concession stand at a movie theatre: Pay a high price for a small soda and popcorn; for tiny fraction more, you are futilely given enough to feed a family of ten.

B. Entrepreneurs: Expanded Business Models[ac1]

As consumers experience bundled services so too will entrepreneurs and big business experience change by moving beyond their core business models. The opportunities for inventive entrepreneurs will be endless (monitoring, social connecting, gaming, advertising, intelligent and semantic search, etc.). For big business, the tie-in to cloud computing:

- Software publishers expanding to SaaS,
- Hardware Manufacturers expanding to IaaS,
- Consumer electronics producers will expand to content and service providers (Apple, Sony),
- Content and service providers will continue to expand in producing content (a la Netflix) and IaaS (Apple iCloud storage)

C. Emerging Development Requirements

The expansion of corporate business models in entertainment, social connectivity, convenience, and mobility relates heavily to the monetization of the web. By extension, business intelligence, cluster computing, collective intelligence, and web analytics are technological goals. "Big Data" and the tools to work with it are already in the mainstream of software development. What is not is the mature promotion of ORM (Object-relational Modeling) to OGM (Object-to-Grid Modeling). What is expected here is another technological shift on data handling and web application areas of specialization.

VI. Conclusion

In this paper, the authors identified a principal use of the internet in terms of "anything" as a service. They also identify key technologies used in the development of web-based applications. Furthermore, some forecasting is offered in terms of how future businesses will be formed and existing big business will adapt in terms of parallel business models. Finally, a major criteria for upcoming technology as it relates to the increasing reliance on data collection, modeling, search, and semantic processing.

Acknowledgments

This research was supported by the MKE (The Ministry of Knowledge Economy), Korea, under the ITRC (Information Technology Research Center) program (NIPA-2012-H0301-12-1001) supervised by the NIPA (National IT Industry Promotion Agency) of the Republic of Korea.

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