A Survey on Security of Web Services and its Implementations

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Abstract

Web Services are software snippets that can be integrated in HTTP and XML based messages based on web technology. Security plays a crucial role in web services. Web services provide a basis for system integration without any programming language and operating system constraint. The security of web services are determined by the secrecy and reliability of the XML based SOAP message that are used for communication. The valuable data stored on computers and servers over the internet need to be secured based on information security features. The security of web services is an important part and security algorithms using encryption techniques are implemented in web services for key generation and encryption of the messages in SOAP and RESTful Services, to provide more secure communication between two electronic devices. Our work focuses on a systematic study on the security features provided by SOAP and RESTful Services and tries to address the different issues faced in security and presents the research scope in the area of web security

1. Introduction

A service is a public interface that offers the right to use a unit of functionality. Services factually provide programmatic 'service' to the caller who makes use of them. They are platform separate and numerous applications are developed in web services based on SOAP and RESTful principles. Web services support machine to machine information exchange in network. In the SOAP based web services XML is used for secure information exchange and RESTful web services are used with HTTP. Web services uses XML to tag the data, SOAP-Simple Object Access Protocol for information transfer, WSDL-Web Services Description Language to describe the structure of the service, UDDI-Universal Description, Discovery and Integration to define the list of web services.

RESTful services are easy, lightweight, flexible and good alternative of Simple Object Access Protocol which makes them better for mobile applications but for the security purpose, SOAP is a great option in case of Banking Applications. Web Services run on Heterogeneous Platform. Web Services play a major role in education and medical fields. SOAP web services located on remote machine and RESTful web services uses the client server architecture. SOAP is used with XML and some standards for sending and receiving the messages whereas RESTful is used with HTTP protocol. SOAP is platform independent, operating system independent, development platform and RESTful web services are based on URLs, HTTP methods POST (used for insertion), PUT (used for update the records), DELETE (used for remove the records), GET for (getting the record).

The paper is organised as follows. Section 1 discusses the background of web service security

by giving the key points of significance and need for security. Section 2 details the research motivation in the services security and section 3 lists the review done on recent papers to understand the current state-of-art of the research on web services security and we conclude in section 4.

2. Background

Secure Web Service deployment is a crucial stage of Service life cycle. Web Service Security incorporates tools deployment, authenticating users and defending data so that users only see what they should see. Security means that the verification should be necessary for all messages to check the integrity of the messages and define the mechanism of single message authentication and integrity features within SOAP messages. Web Services Security uses the XML Encryption and Signature to determine how to include message digests, digital signature and encrypted data in SOAP messages. Web Services Security is more and more important for increasing numbers of Web Services. XML Encryption technique is used to encrypt the data between different applications which is running on different platforms and it uses the key encryption for secure communication. This XML technique is used in Simple Object Access Protocol and asymmetric key encryption for more security. Web Service Security utilizes the XML Signature and XML Encryption particulars and in addition characterizes how to incorporate advanced marks, message processes and encoded information in SOAP messages. The Web Services Security arrangements mean to give a blueprint to build secure web administrations utilizing SOAP and XML Encryption is being used to give secrecy, while message respectability is given using XML Signature through which the SOAP message body components and headers used for encryption.

2.1 Significance and need for Web Services Security

Security is important for any distributed computing atmosphere. In any case, security is turning out to be rather more essential for web benefits. Due to its open nature, SOA realized by web services supplements a new set of requirements to the security setting. Web services security includes several facets such as

• Authentication- Endorsing that the user is who he or she privileged to be. A user's uniqueness is proved based on the authorizations given by that user.

• Authorization- Surrendering access to specific properties based on a genuine user's privileges. Privileges are outlined by one or several attributes. An attribute is that the property or characteristic of a user, as an example, if "Mary" is the user, "Keynote Presenter" is the attribute.

• Confidentiality- secrecy is keeping information secret. Confidentiality and privacy could also be accomplished by encrypting the content of a message and complicating the sending and receiving party's uniqueness.

• Integrity, non-repudiation is assuring that a communication remains unaffected throughout transit by having the source digitally sign the dispatch. A digital signature is used to certify the signature and be responsible for non-repudiation. The timestamp at intervals prevents the signature from replaying this message once the termination.

Web services security wants additionally involve credential mediation (exchanging security tokens in a} very trusted environment), and service capabilities and constraints (defining what a web service can do, under what circumstances). Web services security requirements are supported by business standards each at the transport level (Secure Socket Layer) and at the application level counting on XML frameworks.

2.2 Research questions

Having understood the significance of web service security, defining research questions for the same is an essential part of a systematic review, as they drive the entire survey. To achieve the objectives of this survey, we have identified the following research questions.

• Are there available real time successful implementations for web service security?

• Are there tools and technologies available to evaluate the performance of secure communication between services?

The survey tries to address the above research statements.

3. Literature Survey

The following summarizes the review done on the related research papers regarding web services mechanisms and different security measures taken for efficient and successful communication between machines.

1. **Web Services Based On SOAP and REST Principles[19]**

    The authors have discussed about how the web services exchange information among applications and how SOAP and REST principles are used in web services. XML is used in SOAP based web services and HTTP is used in REST based web services. XML algorithm provides the tight security in transformation of the information. Network traffic and high latency produces by SOAP based web services. According to the analysis, REST based web services shows good performance compared to SOAP based web services. SOAP based web services are implemented in wired and wireless message networks.

2. **Privacy Preserving Remote Data Transfer in Web Service QOS [15]**

    Authors have analysed the security of Web Services, importance, advantages and disadvantages of Web Services. Remote information honesty checking is a significant innovation in web services. They have proposed new remote for data transfer with QOS in web services which supports the insertion, deletion and modification and it is useful for customers to protect information. WWW run on the base of Web Services. This is important to any outsiders that do not abuse our private information. The trouble has that there is no unmistakable mapping relationship between the information and the labels. It is additionally private against outsider verifiers. Author has planned to undertake information level advancement at minor outlays in the future work.

3. **Algorithm for Securing SOAP Based Web Services from WSDL Scanning Attacks [12]**

    The Authors have proposed a calculation for anticipating WSDL assaults which utilizes the current security gauges. For example, Public Key Infrastructure (PKI), Digital Signatures, and XML Encryption/Decryption benchmarks. These calculations utilize "Intelligent Security Engine" which can be arranged to distinguish any sort of WSDL assaults and implemented algorithm is tested by real time information as far as execution. XML (Extensible Mark-up Language) is used for exchange of information in web services. Author had focused on giving security to "distribute" and "discover" a portion of SOA design, i.e. ensuring WSDL operations so as to avoid assailants to assault web benefits by picking up preferred standpoint of deciphering WSDL content which is in plain content organization.

4. **Best Practice for the Design of RESTful Web Services[14]**

    Author distinguish, gather, and sort a few best practices for outlining RESTful web benefits and represent their application on a genuine framework to demonstrate their application and identify and collect the all designs of RESTful Web Services and define the principles of RESTful Services. By applying the best practices, the Competence Service could be composed in a quality-situated way. The goal of this paper was not to re-examine the wheel. Consequently, the best practices of this paper were reused from existing work. Centre of the work displayed in this article was their accumulation, order, and along these lines unification.

5. **Review Paper on Web Services Security [10]**

    In this paper, the authors have explained the various security issues and web services importance in the usage of the encryption and decryption techniques for key generation and secure communication. The paper presents a diagram of the web administrations, web benefit security and the different calculations utilized for encryption of the SOAP messages. The web services security is an essential viewpoint and

3

consequently a security calculation has required executing in web services for key encryption unscrambling of the messages. Algorithm for web services security depicted in this paper has utilized together as a part of blend for key era furthermore, encryption decoding of the messages which will give solid security in web administrations.

6. Improving REST Services Discovery with Unsupervised Learning Techniques [8]

The authors have researched the traditional SOAP Web Services and used metrics as Recall, Recall at_10, Precision, and Precision at_10. The paper presents a unique IR-based revelation approach for REST administrations, portrayed by means of WADL documents. Authors approach exploits unsupervised machine learning procedures for enhancing finding comes about. Specifically, the approach depends on grouping calculations, such as K-means to lessen the look space for a given inquiry. The examinations have taken as a benchmark the outstanding Lucene system, which has utilized as a REST benefit registry. Another commitment of this paper is the huge collection of WADL documents information set accumulated from the Internet.

7. Migration of SOAP Based Services to RESTful Services [4]

Authors have proposed a self-loader method for moving a SOAP-based support of RESTful based services and utilize group investigation furthermore, normal dialect preparing to recognize assets and the related HTTP techniques. The consequence of the contextual analysis demonstrates that our approach can distinguish the assets with high accuracy. The contextual analyses additionally demonstrate that our RESTful approach has more execution benefits contrasted with SOAP based administrations. Authors have planned for enhance the execution of our asset recognizable proof approach and approve the approach with an extensive set of WSDL records.

8. Master Broker   REST Oriented Service Broker [5]

Authors have made a study on Broker architecture for web services security. Produced the widely use of Internet Stack protocols and REST of web services. Compare in both SOAP and RESTful services. It produced the component which is control with broker architecture. The paper displays and examines a product arrangement proposition which predominantly depends on generally sent internet stack conventions and REST style of Web Services. The paper also analyses institutionalized approach using SOAP to a proposed one in view of REST and summarizes the outcomes.

9. Performance Comparison of SOAP and REST based Web Services for Enterprise Application Integration [18]

Authors have made a study on, performance of application of web services based on SOAP and REST principles. For the Web Services, use appropriate protocol/ technology for implementation and build the Web Services. Incorporation of heterogeneous application over the undertaking is of prime significance. Loan Broker case has been considered as a contextual investigation. Loan Broker case is reasonable for assessing ESB design, informing low and different parts included.

10. Research on the Model of Secure Transmission of SOAP based Web Services [6]

Authors have analysed the requirement of secure transmission of SOAP messages and produced the performance of SOAP message. SOAP messages provide high security using XML encryption. The primary difficulties of the protected transmission of SOAP messages incorporate secrecy, verification, honesty, both-party nonrepudiation, and single sign-on. The paper discusses the fundamental necessities towards secure transmission of SOAP messages model for the abnormal state security and productivity.

11. Security for SOAP based Communication among Web Services [16]

Authors have used the different APIs that protect SOAP messages from service based threats. These APIs protect SOAP messages from attackers. The proposed MAA API has been connected to every one of the machines where the area web administrations are sent. It catches the SOAP ask for encoding the substance. The encoded message is then sent to the beneficiary services. The got message caught by the MAA API introduced in the services side for unscrambling of substance before guiding the demand to the services. The future work includes making bland APIs for other services based security assaults, for example, Replay of Message Attack and Denial of Service Attack.

12. A Comparative Investigation on Implementation of RESTful versus SOAP based Web Services [1]

Authors have made a study on the complex SOA application that uses the SIMSA (Security Interaction Model Based on SOAP and Authentication) model on heterogeneous platform. The factual examination of the recorded information demonstrates that the watched parameters are like the normal parameters and the information circulations for both the WS are ordinary. Author tried the some new technologies for provide the security and apply these.

13. SOAP Based Security Interaction of Web Services in Heterogeneous Platform[20]

Authors have described about the SOA architecture, security prerequisites amid the way toward calling Web benefits in heterogeneous stage. By making customer validation, marking what's more, scrambling SOAP message during the time spent Web benefit cooperation in heterogeneous stage; it accomplishes the security cooperation of Web services in heterogeneous stage, which incredibly upgrades Web service's security highlights.

14. Provide the Security to a Web Services to a Web Services by Using DES Cryptography Algorithm[17]

Author's used the DES cryptography algorithm and apply this on web services for security purpose and then compare the performance using encryption and without encryption with DES algorithm using three comparison parameters Response Time, Mean time between failure (MTBF) and Mean time to repair (MTTR). The encryption indicated just a little effect on the execution of our test framework. In the meantime encryption brings a major pick up on the security of web benefit.

15. A Survey on RESTful Web Services Composition [3]

Authors, B. Jaya Kaviya and G. Selvakumar describe the combination of various web services used in different fields and provide a good solution to user that will be more helpful. Implemented the algorithm to reduce the execution time and response time of service for faster utilization by user. Web services creation has been executed for consolidating the different web benefits as utilized as a part of numerous fields. The created web services are accessible as web information in the predetermined web storehouse. The calculation must be composed effectively with a specific end goal to decrease the execution and reaction time.

16. Server SOA Security Threats on SOAP Web Services – A Critical Analysis[11]

Authors have analysed the SOA (Service Oriented Architecture) security threats and their implementation on SOAP web services and explain the security essentials for SOA and provide the information about attackers. In spite of the current security models, some exceptionally gifted assaults are still found in SOAP Web Services particularly after the presentation of Web 2.0, Web 3.0 and new eras of Web Services and this gives an open door for security specialists to outline.

17. A Study on Web Services Security [9]

Authors have described the various security issues occurred in the XML encryption of messages implementation. Implement the Security key generation algorithm and encryption, decryption of messages. The security of web services is a critical viewpoint and consequently a security calculation is required to

actualize in web administrations for key era furthermore, encryption unscrambling of the messages. The security calculation depicted in this paper has utilized together in blend for key era and encryption decoding of the messages which will give solid security in web services.

18. Performance Analysis of SOAP and RESTful Mobile Web Services in Cloud Environment[2]

Authors, Anil Dudhe and S.S Sherekar have conducted a test using two web Servers- Apache Tomcat and local host for getting the result of that which web service is better and then use the Cloud Server Google App Engine for test the REST based web services better in performance. Authors discovered REST services are quicker than SOAP web administrations. At that point conveyed similar administrations on Cloud server Google App Engine and test has indicated REST is great and better in execution. It is additionally seen by numerous specialists that REST is useful for handheld asset obliged cell phones.

19. Differentiating Parameters for Selecting Simple Object Access Protocol (SOAP) vs. Representational State Transfer(REST) Based Architecture [13]

Authors have discussed about the tools and technologies that are used in expanding business using Web Services and describe the SOAP and REST based Web Services architecture and compared the both technologies on different parameters. CRUD operations, Coupling, Format and Network latency these dimensions are used in comparison of parameters. As a rule SOAP has a great deal more many-sided quality joined to it when contrasted with REST

20. Mashup Service Release Based on SOAP and REST [7]

Authors, Huiji Su, Bo Cheng, Tong Wu and Xiaofeng Li have explained about Mashup services and its architecture based on SOAP and REST two technologies in this paper. Authors have presented the benefits of Mashup design of three layer framework, discussed about the capacity of each layer with their assistance to the

fast era of heterogeneous services and presents points of interest of the SOAP protocol. Furthermore, the REST Web benefit plan and execution finishes the deployment, operation and updation and ease the Mash up benefit in an assortment of ways and improves the correspondence of web services.

3.1 Discussions & future directions

The study of survey papers addressing the research questions shows that the researchers focus is mainly related to the different web service security mechanisms, patterns and design issues in both SOAP and RESTful services, instead of the real time implementation of the same, thus keeping the discussion at an abstract level that does not help the wide implementation of these technologies. Despite this gloomy scenario, a few technologies have established themselves in the Web services security realm, and are well worth being considered as industry standards, including the following:

- Security Assertion Markup Language (SAML) for Authentication/Authorization
- XML Access control markup language (XACML) for Authentication/Authorization
- XML Key Management Specifications (XKMS) for Cryptography
- XML Encryption for Confidentiality
- XML Digital Signatures for Integrity and Non-repudiation
- SOAP security extensions for Integrity and Non-repudiation

Our survey has made it clear that, attempts are being made to implement these evolving common security standards and still more standards and technologies are in the process of evolving. However, new security techniques as well as redesigned industrial standards and solutions are needed that can work with SOA architectures. As a result of the above discussion, we propose the following directions for future research in this area:

- Scrutinize new software and service engineering approaches, supported by efficient tools, to simplify the implementation of web service security in Enterprise computing applications.
- Develop security implementation tools that can explore the performance evaluation of

the web service security patterns, so that it could trigger a lot of research analysis in the implementation issues.

4. Conclusion

Web Services are the right example of a solution to the necessity for a simple system that permits many alternative technologies to collaborate and communicate with one another. Being offered to the end user over the net, web services can keep increasing in quality owing to their functionality and this quality also will expose the threat to the servers hosting them. As with many other WS-* standards, there is often a concern with WS-Security about interoperability in a heterogeneous environment. Our survey reveals the fact that there is still a lot of research scope to work with more-complex authentication tokens; encryption, and digital signatures, for security and interoperability of web services to soon become paramount.

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