

AHP-Based Quantitative Approach for Assessing and Comparing Cloud Security

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Abstract—While Cloud usage increasingly involves security considerations, there is still a conspicuous lack of techniques for users to assess/ensure that the security level advertised by the Cloud Service Provider (CSP) is actually delivered. Recent efforts have proposed extending existing Cloud Service Level Agreements (SLAs) to the security domain, by creating Security SLAs (SecLA)s along with attempts to quantify and reason about the security assurance provided by CSPs. However, both technical and usability issues limit their adoption in practice.

In this paper we introduce a new technique for conducting quantitative and qualitative analysis of the security level provided by CSPs. Our methodology significantly improves upon contemporary security assessment approaches by creating a novel decision making technique based on the Analytic Hierarchy Process (AHP) that allows the comparison and benchmarking of the security provided by a CSP based on its SecLA. Furthermore, our technique improves security requirements specifications by introducing a flexible and simple methodology that allows users to identify their specific security needs. The proposed technique is demonstrated with real-world CSP data obtained from the Cloud Security Alliance's Security, Trust and Assurance Registry.

I. INTRODUCTION

The paucity of comprehensive approaches to specify, assess and quantitatively reason about security in Cloud systems is a major impediment that customers encounter when they decide to migrate their key applications to the Cloud. On one hand, the Cloud Service Providers (CSPs) are trying to convince users to trust the security of their provided services. On the other hand, users should themselves be able to assess and validate the security claims from the CSPs and then select the best provider that suits their security requirements. In order to meaningfully model and assess CSP security, the European Network and Information Security Agency (ENISA) and the Cloud Security Alliance (CSA) have targeted the specification of security in Cloud services in the form of Service Level Agreements (termed as Security Level Agreements or SecLA [1]). Subsequently, CSA has designed a self-assessment questionnaire framework to define the security information contained in a SecLA: the Consensus Assessment Initiative Questionnaire (CAIQ) [2] where CAIQ currently

contains more than 200 security relevant questions. Multiple CSPs have filled their answers to the CAIQ and published them in the STAR repository (Security, Trust and Assurance Registry) [3]. With the published CAIQ, users are able to browse the claimed information that represents capabilities of the Cloud providers regarding their security controls and policies. However, this is still mostly free-text level qualitative information that is hard to be quantitatively parsed by the user.

While the state of the art predominantly focuses on the methodologies to build and represent Cloud SecLAs [4]–[6], the techniques to quantitatively reason about Cloud SecLA are conspicuous by their paucity. Having user friendly approaches (including automation) to specify desired security attributes and flexible comparison techniques are needed to effectively rank the level of security provided by several CSPs and especially to compare them for matching with respect to the users' security requirements.

A. Contributions

This paper aims to solve these aforementioned issues by developing quantitatively reasoning approaches about Cloud SecLAs. Thus, we propose a framework that allows to (i) automatically compare, benchmark and rank the security level provided by two or more CSPs, (ii) provide a composite quantitative and qualitative SecLA assessment technique based on Analytic Hierarchy process (AHP) depending on Cloud user security requirements and, (iii) allow users to specify their security requirements at varied levels of the security provisions, which would help to remove the need to specify every single security requirement (more than 200 in case of CAIQ). Finally, (iv) we introduce a system validation tool (*SecCloudcomp*) that implements the proposed framework. This tool is publicly available¹ and allows Cloud users to choose the most suitable CSPs by assessing the security of Cloud SecLAs. In this paper we also perform the initial validation of the proposed framework by evaluating a real world case study based on the Cloud SecLAs found on the CSA's public STAR repository.

¹<http://cloud-qa.com-security.org>

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