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# **Data security and privacy assurance for cloud computing in education based on a third party auditor**

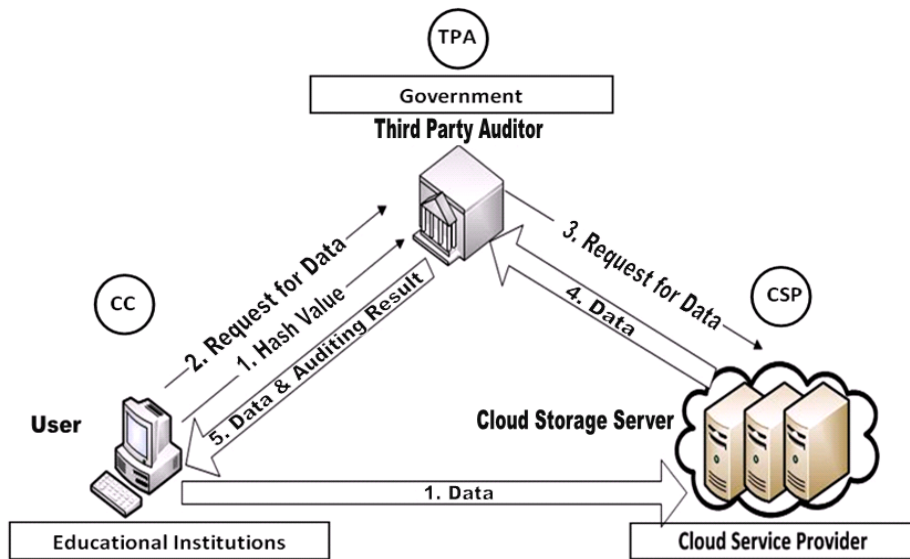
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**Objectives:** A guarantee of data security and privacy is an important issue in cloud computing within education, since educational institutions have vital and sensitive data that should be protected in terms of its integrity, privacy and confidentiality. Recently, encryption technology has experienced significant progress. The combination of encryption technology with a third party auditor scheme (TPA) can provide tough data security and privacy. This security guarantee is expected to be able to improve the trust of education institutions in the acceptance of cloud based technology.

**Methods:** We propose the use of semi-trust TPA to ensure data security in cloud data storage, this strategy can be applied in the cloud computing application in educational field. This audit plan involves the government, in its role as a stakeholder in the field of education, becoming an auditor institution (TPA). Educational institutions are the service users of cloud computing as clients, and the service provider is the administrator of the cloud storage server. Cloud service provider (CSP), the cloud client (CC) and the TPA are three parties in our system model as shown in Figure 1.



**Figure 1.** Architecture model of the TPA Computing in Education.

In a laboratory analysis, we use a robust plan to deliver integrity, security, and privacy of stored data on the cloud. This plan uses the advanced encryption standard (AES) and elliptic curve cryptography (ECC) algorithms to protect data and reduce loss in the cloud. To protect data during auditing, we used the AES encryption function; which is, the Semi-trusted TPA cannot expose nor reveal the details of files. To maintain the privacy during data transmission, we used the ECC encryption function; hence, before storing on the cloud, the file was encrypted. No external, like a man-in-the-middle (MITM) attacker, a fault analysis attacker, or an exceptional procedure attacker could gain accessibility of file information, since an asymmetric key was used by ECC that makes a robust algorithm for this task.

**Results:** In simulations, the CC is the educational institution, and data storage with the cloud service provider has been successful; the request is then made for an audit by the TPA (governmental data auditor institution in the field of education). Then, the auditor institution verifies the data to the service provider in terms of data integrity. Finally, the

auditor institution reports the results of the audit to the educational institution (cloud client). From measurements in the laboratory, the computational time needed in the upload phase by the educational institution as user (cloud client) was 0.05 seconds. This is faster than the results of measurement of the computational time in the upload phase in previous research which took around 14.21 seconds. In the auditing phase, the computational time needed was 0.046 seconds. This is faster than in previous research which took around 7.25 seconds.

**Conclusions:** Data security and privacy is greatly needed within the use of cloud storage. Moreover, cloud computing in education involves sensitive data that needs to be protected in terms of its security and privacy. With the auditing process that can continue to be improved, ensuring data security and privacy using TPA can be applied easily. This is very useful for education in general, including education in the field of nursing or medicine that requires large data storage.

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