Journal of Information Technology and Telecommunications
Received: Nov 09, 2015, Accepted: Dec 19, 2015, Published: Dec 22, 2015
J Inform Technol Telecomm, Volume 1, Issue 1
http://crescopublications.org/pdf/JITT/JITT-1-R004.pdf
Article Number: JITT-1-R004

Review Article Open Access

Privacy-Preserving Multi-Keyword Ranked Search over Encrypted Cloud Data

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Citation: Kesava D (2015) Privacy-Preserving Multi-Keyword Ranked Search over Encrypted Cloud Data. J Inform Technol Telecomm 1: R004.

Abstract

With the advent of cloud computing, data owners are motivated to outsource their complex data management systems from local sites to the commercial public cloud for great flexibility and economic savings. But for protecting data privacy, sensitive data have to be encrypted before outsourcing, which obsoletes traditional data utilization based on plaintext keyword search. Thus, enabling an encrypted cloud data search service is of paramount importance. Considering the large number of data users and documents in the cloud, it is necessary to allow multiple keywords in the search request and return documents in the order of their relevance to these keywords. Related works on searchable encryption focus on single keyword search or Boolean keyword search, and rarely sort the search results. In this paper, for the first time, we define and solve the challenging problem of privacy-preserving multi-keyword ranked search over encrypted data in cloud computing (MRSE). We establish a set of strict privacy requirements for such a secure cloud data utilization system. Among various multi-keyword semantics, we choose the efficient similarity measure of "coordinate matching," i.e., as many matches as possible, to capture the relevance of data documents to the search query. We further use "inner product similarity" to quantitatively evaluate such similarity measure. We first propose a basic idea for the MRSE based on secure inner product computation, and then give two significantly improved MRSE schemes to achieve various stringent privacy requirements in two different threat models. To improve search experience of the data search service, we further extend these two schemes to support more search semantics. Thorough analysis investigating privacy and efficiency guarantees of proposed schemes is given. Experiments on the real-world data set further show proposed schemes indeed introduce low overhead on computation and communication.

Existing System

The effective data retrieval need, the large amount of documents demand the cloud server to perform result relevance ranking, instead of returning undifferentiated results. Such ranked search system enables data users to find the most relevant information quickly, rather than burdensomely sorting through every match in the content collection. Ranked search can also elegantly eliminate unnecessary network traffic by sending back only the most relevant data, which is highly desirable in the

"pay-as-you-use" cloud paradigm. For privacy protection, such ranking operation, however, should not leak any keyword related information. On the other hand, to improve the search result accuracy as well as to enhance the user searching experience, it is also necessary for such ranking system to support multiple keywords search, as single keyword search often yields far too coarse results.

Disadvantages of Existing System

- The encrypted cloud data search system remains a very challenging task because of inherent security and privacy obstacles, including various strict requirements.
- On enrich the search flexibility, they are still not adequate to provide users with acceptable result ranking functionality

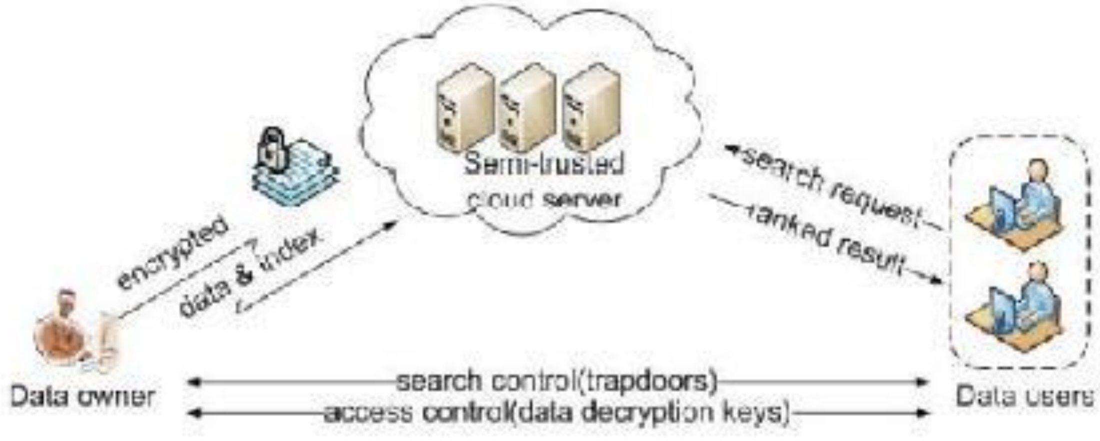
Proposed System

In this paper, for the first time, we define and solve the problem of multi-keyword ranked search over encrypted cloud data (MRSE) while preserving strict system wise privacy in the cloud computing paradigm. Among various multi-keyword semantics, we choose the efficient similarity measure of "coordinate matching," i.e., as many matches as possible, to capture the relevance of data documents to the search query. Specifically, we use "inner product similarity", i.e., the number of query keywords appearing in a document, to quantitatively evaluate such similarity measure of that document to the search query. During the index construction, each document is associated with a binary vector as a sub-index where each bit represents whether corresponding keyword is contained in the document. The search query is also described as a binary vector where each bit means whether corresponding keyword appears in this search request, so the similarity could be exactly measured by the inner product of the query vector with the data vector. However, directly outsourcing the data vector or the query vector will violate the index privacy or the search privacy. To meet the challenge of supporting such multi keyword semantic without privacy breaches, we propose a basic idea for the MRSE using secure inner product computation, which is adapted from a secure k-nearest neighbour (kNN) technique, and then give two significantly improved MRSE schemes in a step-by-step manner to achieve various stringent privacy requirements.

Advantages of Proposed System

- Search result should be ranked by the cloud server according to some ranking criteria.
- To reduce the communication cost.

System Architecture


Semi-trusted cloud server
encrypted data & index
search request
ranked result
Data owner
search control(trapdoors)
access control(data decryption keys)
Data users

System Requirements

Hardware Requirements:

➢ System	:	Pentium IV 2.4 GHz.
➢ Hard Disk	:	40 GB.
➢ Floppy Drive	:	1.44 Mb.
➢ Monitor	:	15 VGA Colour.
➢ Mouse	:	Logitech.
➢ Ram	:	512 Mb.

Software Requirements:

➢ Operating system	:	Windows XP/7.
➢ Coding Language	:	JAVA/J2EE
➢ IDE	:	Netbeans 7.4
➢ Database	:	MYSQL

Reference

Ning Cao, Cong Wang, Ming Li, Kui Ren, and Wenjing Lou, “Privacy-Preserving Multi-Keyword Ranked Search over Encrypted Cloud Data” IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, VOL. 25, NO. 1, JANUARY 2014.