- **Encryption**

Converting plain text into a ciphertext with using public and private keys
Consider Z is a set of plain text with using secret keys converted into ciphertext. In fig-2 as per the paper, Client sends query requirement to Cloud then owner sends encrypted key index to Client.
Z=queries
E (I) = encrypted index key

- **Decryption**

Converting ciphertext into a plain text with using public and private keys
In fig-2, data owner sends the decryption scheme E^{-1} (I)to the data cloud for future distance decryption.
E^{-1} (I) = decrypted distances

5. Privacy-Preserving Query Processing Framework

When processing distance-based queries, a multidimensional index can be treated as traversal on the tree nodes. Very clearly, this may be divided into two alternate processes i.e. node traversal and distance access.

The distance access determines the next node to traverse which is depending upon the distances computed from the current node and query point. To safeguard query and data privacy, both procedures must remain secure in the outsourcing model of three parties i.e. when query is being processing not only data owner but the cloud can identify the traversed nodes also or may obtain any information that may point out the query point as the exact distances to the query point. Till time, the client should have no access to the actual node contents during distance access and node traversal. Here, in fig-3, showing the framework of secure query processing. Whereas, other part is to protect data privacy, the client has only access to an encrypted version of the index, and must go ahead to process their query together with the cloud, which will decrypt the distances it, computes locally. The distance access is a collective procedure of the client and data cloud, in which not a single party has access to the actual distances [2].

The detailed process flow of this framework is as follows:

1. Sending query requests to cloud by client
2. During this process data owner sends an encrypted variant of index –E (I). In each index node, the key entry e.g. e1, e2, e3 is encrypted by encryption scheme E(·),
3. Although the pointers e.g., p1, p2, p3 are not encrypted. It means that, the index has common topology as the basic index but each key value is encrypted. The index is to be saved at the client side for future connections.
4. Simultaneously the data owner sends decryption scheme E–I(.)to the data cloud for future distance decryption. It does not require that data owner should get involved in initial stage and can further reduce their involvement by handing over the task of decrypted indexing to the cloud.
5. Index in the cloud should again be encrypted by the owner's private key through any public key cryptography. During initialization, owner needs to forward their public key to the client who then recollects and decrypts the index from cloud.
6. In the course of traversal, each time the client is required to go for index node which results node E(I) that computes the local distances, and are sent to the data cloud which decrypts and re-codes them for the client
7. This re-coding ensure that, only client can receive an encrypted version of the actual distances that acceptable and tolerable for the query processing. Whereas additionally to prevent the cloud from accessing the actual distances after decryption, the client is required to scramble local distances prior to forwarding them to the cloud from accessing the actual distance after decryption.
8. The traversal begins at the root node, and the node access process repeats until the query is completed.

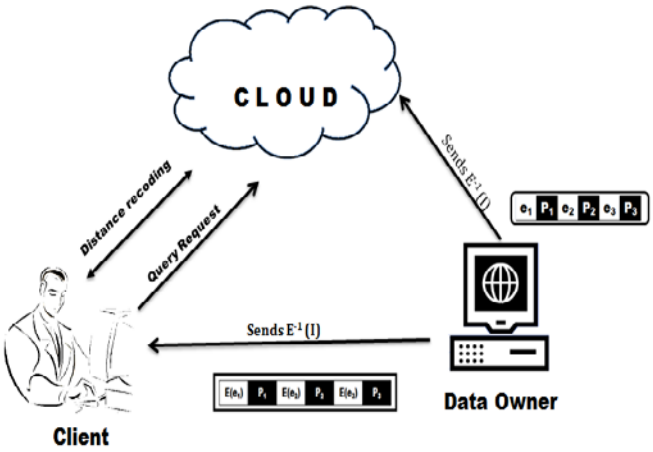

Figure 3: Privacy-Preserving Query Processing Framework

6. Privacy-Preserving Query Processing Algorithms Used

6.1 Distance-based Queries

a) Owner sends Encrypted index E(I) to the client
b) Owner sends the decrypted E-1(I) to the cloud
c) Client initializes the root of E(I) as I , the next node to access
d) Client retrieves index node(i), computes and scrambles the local distances
e) Cloud receives the scrambled local distances, decrypts and recodes them.
f) Client updates the query and move to the next node (follow all above steps)

6.2 Distance Recoding Scheme

a) Local distances computed as per above, are encrypted by E(·)
b) Sent them to cloud for decryption.
c) The client scrambles the encrypted distances and the cloud decrypts them.
d) Instead of forwarding the sign results directly, the cloud must encrypt the distances to prevent the client from accessing the actual distances, the process called is distance recoding where it sends back a recoded version of

the distances that are only sufficient for distance comparison.

7. System Model for kNN on R-Tree Index

Consider the following Fig-4, data owners may outsource their query services and data, but data is very sensitive and private assets of them and it should be protected from the service provider and the querying users in some extent. Data owner might be update, query and authorize access on the data, while the service providers in cloud should know nothing about especially detailed data about data, and query users should know not more than the exact answers for what she/he is querying[2].

On the other hand, query users need to query and exact data from cloud, but the query might disclose some sensitive information, behavior patterns of the user. For example, when Bob searches a website, such as Face book, for friends who share the all general backgrounds things (e.g., age, education, home address) with her should not disclose the query that involves her own details to the cloud. Privacy of data owners and query users are defined as data privacy and user privacy respectively [1].

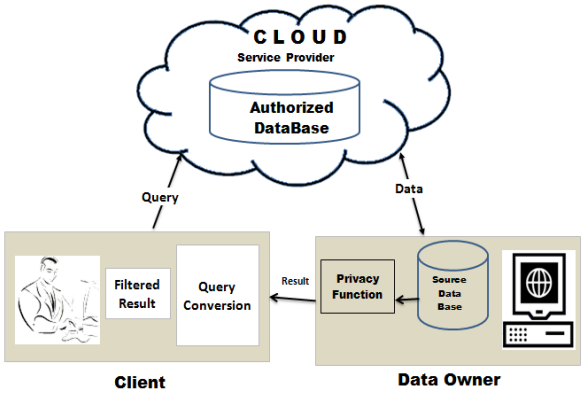

Figure 4: Architecture of Data Service on Cloud

It shows increasing importance as cloud computing in more businesses to outsource their data and various querying services. Hence, most of the study including, how to outsource their data, how to make privacy on private data and how to retrieve the data by using appropriate query. The solution for all these problem is secure traversal framework and encryption scheme based on the privacy homomorphism. The framework is scalable to the large data sets by developing an index-based approach. Depending upon this framework, secure protocols such as k-nearest-neighbour queries (kNN) on R-tree index are used. Highly Enhanced developing techniques are used to improve the efficiency of query processing protocols [2].

8. Basic Private Query Processing

One of the main challenges for private query processing is to privately represent a given user query, and find and retrieve the qualified values from Rpub.for the query. In our basic framework, we propose to use a novel approach of data bucketization with homomorphic encryption to solve this challenge, and we provide perfect privacy of query in distinguish ability for clients, meaning that the adversaries who may have control of servers should not be able to differentiate accesses of different queries on Rpub.B. One advantage of our framework over any other PIR protocols is that our framework can answer a query in only one round of client server interaction, thus saving the bandwidth for the server [12].

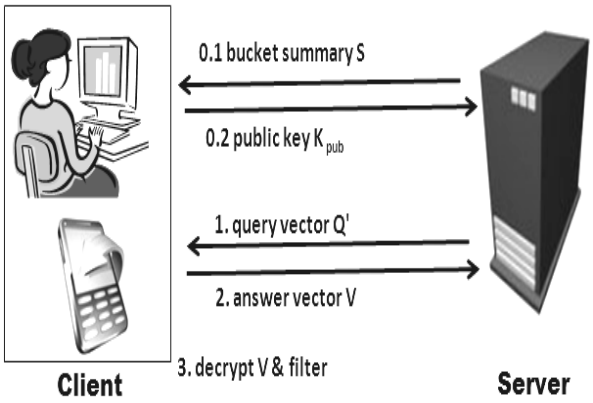

Figure 5: BHE. In this protocol, before processing any queries Steps

0.1) Server sends the bucket summary S of its database to the client
0.2) Client sends her public key Kpubto the server. Then to process a query q.

1. Client formulates an encrypted query vector Q′based on S and q, and sends Qto the server.
2. Server performs blind processing on Q′and public database, sends the answer vector V back to the client
3. Finally, the client decrypts V and reconstructs the answer to the query q.

9. Security Domain

Security conditions are checked and analyzed from the client and cloud/ data owner angle. Initially, data security of the proposed framework depending upon theoretical results from PH are shown [12], afterwards, understands the query security especially the security of scrambling process and the optimization for distance re-coding.

9.1 Data Security

It has been based on two factors - the security of the secret keys in the PH and distance recoding scheme.

1) Key Security: PH security is depend upon the encryption and decryption of key against the oppose of set number of ciphertext [12]
2) Distance Recoding: Scrambled modified distances are unable to react. It means they are independent.

9.2 Query Privacy

Query Security is based on two factors.
The security of the scrambling and “untraceable root access”, latter means cloud is unable to point out or short list the

query when first node accessing. Cloud continues to treat it as root node.

1) Scrambling Security: Arithmetic operations are used to derive deviations on the basis of initial seeds and composite seeds because composite seeds are in large volume to derive at few steps.
2) Untraceable Root Access: It has been observed that scrambling process is quiet effective and trustworthy which helps convert genuine distances into relative ones. This decomposes substitute entries because cloud cannot narrow the query in the root access.

10. Conclusion

As per the process mentioned herewith a study is conducted on processing problems of private queries on indexed data in a cloud. A secure traversal framework in indexed environment is given to secure protocols for such classic queries.

The assumptions and approached mentioned in this paper are thoroughly useful, efficient to perform and effectively used under settings of different parameters. It has been summarized that the process mentioned here, on privacy homomorphism, is used to protect processing queries on cloud is high scalable.

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