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Implementing Security in Fog Computing

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Abstract: ***In Fog computing, services can be hosted at end devices such as set-top-boxes or access points. The infrastructure of this new distributed computing allows applications to run as close as possible to sensed actionable and massive data, coming out of people, processes and thing. Such Fog computing concept, actually a Cloud computing close to the 'ground', creates automated response that drives the value. As the data generation rates are increasing, it is a tedious task for cloud storage providers to provide efficient storage. Cloud storage providers use different techniques to improve storage efficiency and one of leading technique employed by them is de-duplication. Data once deployed to cloud servers, its beyond the security premises of the data owner, thus most of them prefer to outsource their in an encrypted format. We also propose efficient approach for encryption for providing security on fog computing.***

Keywords: Cloud Computing, edge computing, Fog computing.

I. INTRODUCTION

Computation technology has entered to a new era with the origination of Cloud computing,. Many computation service providers including Google, Amazon, IBM, Microsoft, etc. are currently nurturing this popular computing paradigm as a utility [1]. They have enabled "cloud based services such as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)", etc. to handle numerous enterprise and educational related issues simultaneously. However, most of the Cloud data centres are geographically centralized and situated far from the proximity of the end devices/users.

As a consequence, real-time and latency-sensitive computation service requests to be responded by the distant Cloud data centres often endure large round-trip delay, network congestion, service quality degradation, etc. To resolve these issues besides centralized Cloud computing, a new concept named "Edge computing" has recently been proposed [2]. The fundamental idea of Edge computing is to bring the computation facilities closer to the source of the data. Taking the notion of Edge and Cloud computing into account, several computing paradigms have already been introduced in computation technology. One of them is Fog Computing.

The Fog computing [3] over the cloud data storage provides numerous benefits to their clients such as cost savings, accessibility, scalability etc., users around the world tend to shift their invaluable data to cloud storage.

We adopt a simple three level hierarchy as in Figure 1.

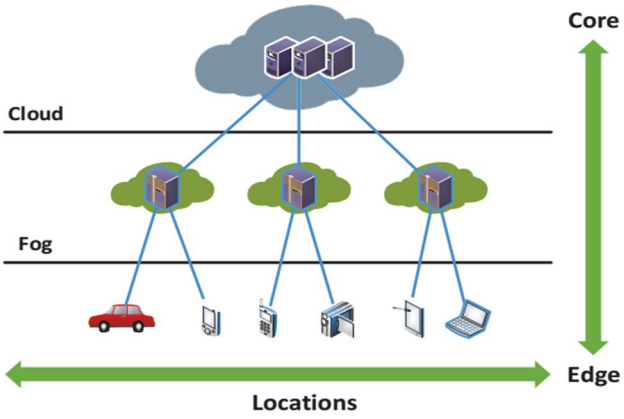


Fig 1: Fog between edge and cloud.

In this framework, each smart thing is attached to one of Fog devices. Fog devices could be interconnected and each of them is linked to the Cloud. In some way fog computing behaves similar to cloud computing. Both computing technologies provide application, storage, data and computing services to their registered clients. But fog computing provides services close to its end users as compared to cloud computing that provides services remotely.

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Cloud and Fog both techniques provide data, computation, storage and application services to end-users. However, Fog can be distinguished from Cloud by its proximity to end-users, the dense geographical distribution and its support for mobility [4].
In this paper we also propose hybrid and efficient approach for encryption for providing security on fog computing.

II. PROPOSED METHODOLOGY

A new hybrid encryption based scheme for data de-duplication in fog computing is to be propose. The main objectives of research work are to Study Fog Computing and its data de-duplication issues in detail. Finally we evaluate the performance of proposed scheme using various parameters. The proposed methodology is given in figure 2.

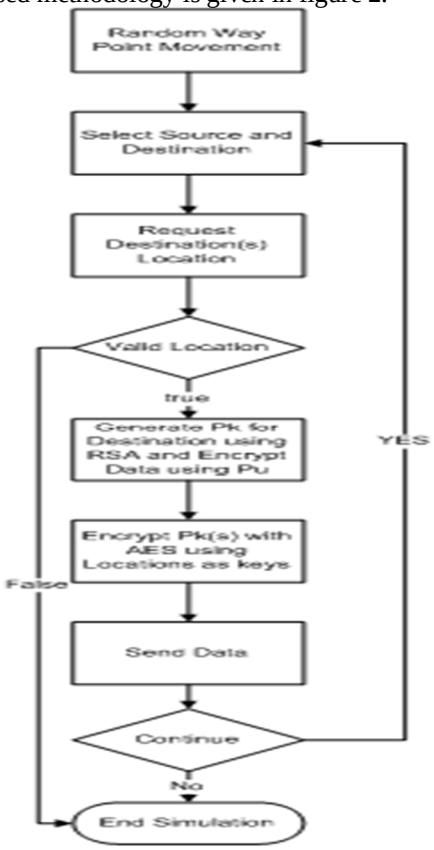


Figure 2: Workflow of Deduplication process

Following steps will explain the procedure of proposed work.

Step 1: Receiver **R** Requests data from the node S, only receiver knows the exact location of itself.

Step 2: On receiving request from the **R** node the sender initiate public key Exchange using RSA algorithm and stores keys P_k as private key of the node R and P_u acts as the public key for encryption of data.

Step 3: Node S then Request the Location L_{Rxy} of the node R.

Step 4: After receiving request from the node S the R sends its location L_{Rxy} to the node S.

Step 5: S then Encrypts the private key of the by using L_{Rxy}as Private key using AES algorithm.

Step 6: For multiple recipients the same process in repeated and a matrix is formed and forwarded to recipients.

Step 7: After receiving the packet the recipient decrypts the private key using its location and then decrypts the data sent by the sender.

In Fog computing, services can be hosted at end devices such as set-top-boxes or access points. The infrastructure of this new distributed computing allows applications to run as close as possible to sensed actionable and massive data, coming out of people, processes and thing. Such Fog computing concept, actually a Cloud computing close to the 'ground', creates automated response that drives the value.

III. PROPOSED TOOL

MATLAB [10][11] is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include:

1) Mathematical computation
2) Algorithm development
3) Data acquisition
4) Modeling, simulation, and prototyping
5) Data analysis, exploration, and visualization
6) Scientific and engineering graphics
7) Application development, including graphical user interface building

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar non interactive language such as C or FORTRAN. The name MATLAB stands for matrix laboratory. MATLAB was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects. Today, MATLAB engines incorporate the LAPACK and BLAS libraries, embedding the state of the art in software for matrix computation. MATLAB has evolved over a period of years with input from many users.

In university environments, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is the tool of choice for high-productivity research, development, and analysis. MATLAB features a family of add-on application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow you to learn and apply specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others.

IV. IMPLEMENTATION

The implementation results for various parameters are performed as explained below.

Figure 3 below the first screen of our implementation. It asks for number of simulation nodes and simulation duration. Let number no. of nodes be 10 and simulation time be 10.

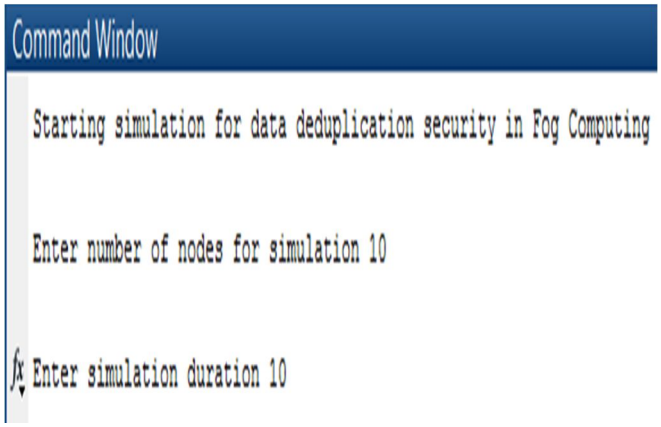


Figure 3: The first screen of our implementation

It then asks for the text file need for communication between two nodes.

Figure 4 below shows the list of connecting nodes for communication in fog network.

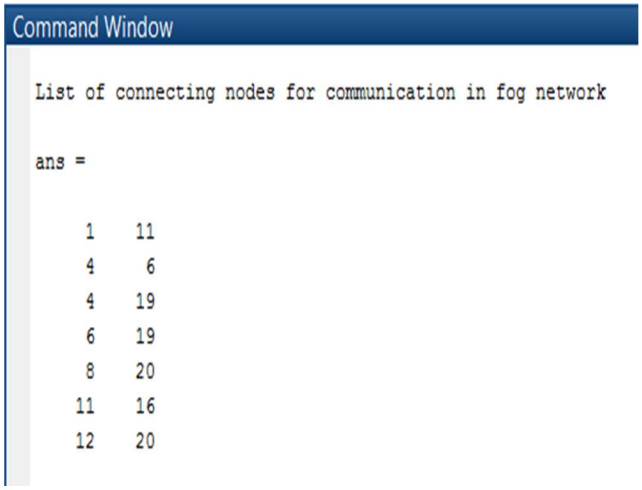


Figure 4: The list of connecting nodes using random waypoint

Figure 5 below shows the final result of fog computing networks. It shows simulation nodes in blue colour, node range in green colour and communication link between two nodes in red colour.

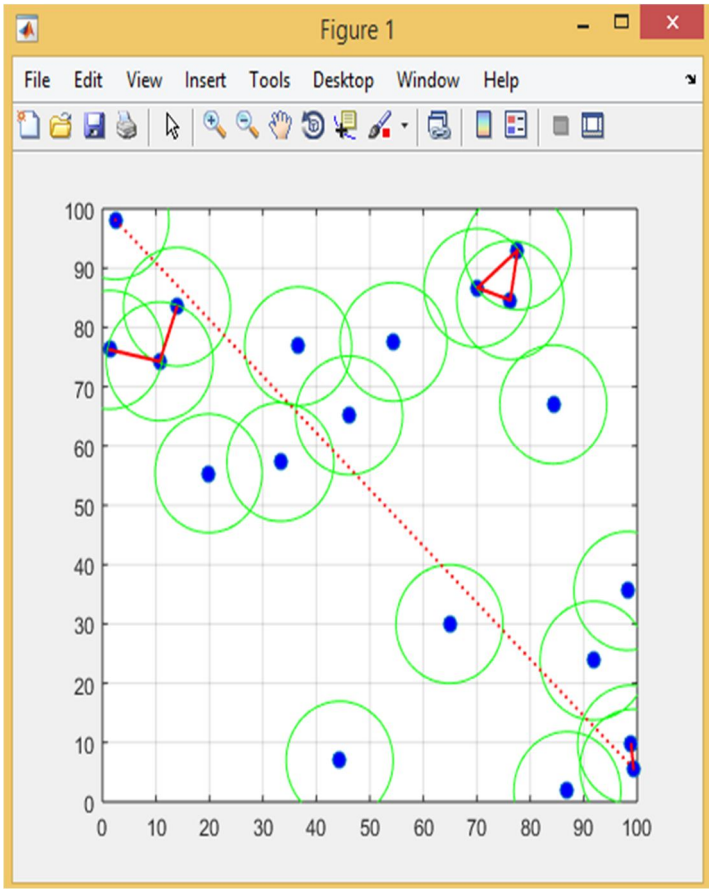


Figure 5: The final result of fog computing networks.

We have used RSA and AES encryption algorithms to encrypt the data before sending to the destination and decrypt at the destination location.

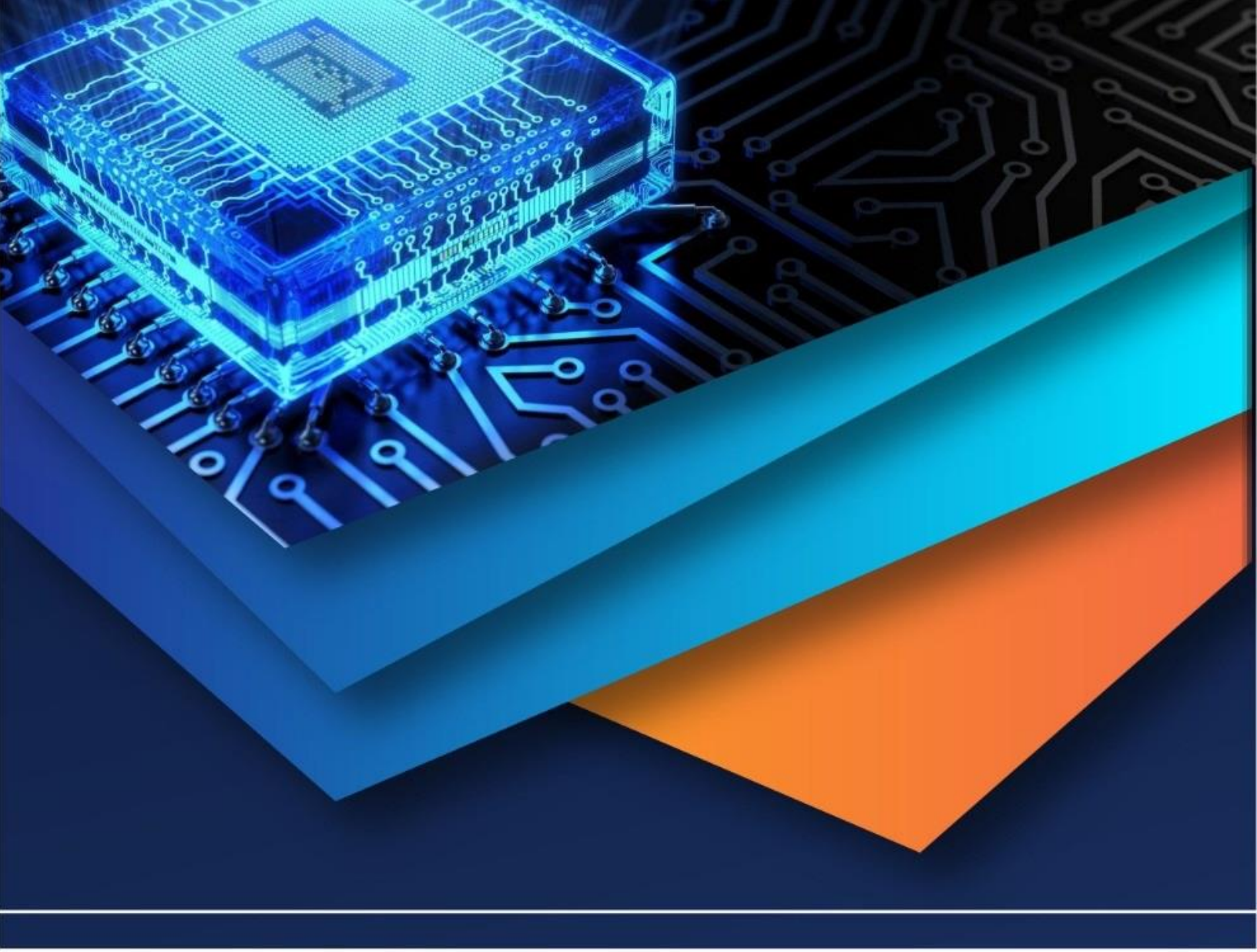
As for each location a new private key is generated and attached to the packet, we require that there must not be a significant overhead as the Number of recipient grow. It can be seen from above figures that the encryption time & decryption time do not increases too much when number of nodes (iterations).

V. CONCLUSION

The Fog computing over the cloud data storage provides numerous benefits to their clients such as cost savings, accessibility, scalability etc., users around the world tend to shift their invaluable data to cloud storage. In Fog computing, services can be hosted at end devices such as set-top-boxes or access points. The infrastructure of this new distributed computing allows applications to run as close as possible to sensed actionable and massive data, coming out of people, processes and thing. Both Cloud and Fog provide data, computation, storage and application services to end-users. However, Fog can be distinguished from Cloud by its proximity to end-users, the dense geographical distribution and its support for mobility. In this paper we proposed efficient approach for encryption for providing security on fog computing.

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