Modeling Future Generation E-Mail Communication Model for Improving Quality of Service

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Abstract— **Most widely used communication medium over the internet is E-mail. E-mail is a web based application, which is used to transmit the message from one location to another location through the internet. This E-mail communication medium is used by all the people all over the world for their day to day life. Especially this web based application is mostly used in all the corporate companies, industries, small offices and educational institutions and so on. Various researches have been carried out in the E-mail web based application, to enhance the security mechanism to keep the security constraints in consistent state. However no researches have been taken to improve the Quality of Service (QoS) in E-mail application. In this paper, the concentration has been made on Quality of Service and modeled an E-mail application, which improves the Quality of Service (Qos) in the existing E-mail message handling service. The proposed model notifies to the user, whether sent E-mail reached the destination and whether the E-mail is read by the receiver, i.e. the delivery status and mail reading status are updated to the sender. The proposed model is evaluated and implemented successfully and the quality of service is obviously improved in the E-mail application model.**

Index Terms— **E-Mail, Internet, Communication, Quality of Service, Web, Protocols, CPM.**

I. INTRODUCTION

Communication plays vital role over the internet. The main objective of internet users is to share and exchange their resources with one another. There are many communication medium available in the internet: one among them and most widely used communication is E-Mail system. E-Mail is the process of exchanging digital messages from one author to one or more recipients and in the early days both the sender and receiver must be online to send and receive the E-Mail messages [1]. The recent research development created a model called store-and-forward, in which server stores the mail and delivers it to the intended author [1].

This operation mode made neither the sender nor the receiver to be online simultaneously [1]. E-Mail communication model attracted many internet users because its communication is easy and fast [2]. Every E-Mail packet consists of body and header. The body of the E-Mail contains the original message sent by the sender and it is included with Hyper Text Markup Language (HTML) and Multi-purpose Internet Mail Extensions (MIME) encoded attachments sent by the sender [3, 4]. The header part is very important, for it serves as the envelope to forward the message from the source to destination [4]. The header part consists of fields such as 'From', 'To', 'Subject', 'Date', 'CC', 'BCC' and etc., all these fields help to forward the mail to the intended recipients [4]. The following components are needed to configure an electronic email system to work properly [5].

- Mail User Agents
- Mail Delivery Agents
- Mail Alias Files
- The Mail Queue
- Networking Topographies
- MIME Applications

Mail User Agents are software programs that run on the user machine to send and read the E-Mail messages [5]. Mail Delivery Agents run in the background and it is responsible to route and deliver the E-Mail messages and this Mail Delivery Agents are the core part of the electronic mail system [5]. Mail Alias Files used for mapping the real world names to the user login names [5]. The Mail Queue is a place used to hold the messages

until they are sent on their way [5]. Networking Topographies used to connect group of computers for configuring electronic mail service system [5]. The MIME Applications are used to send variety of data over the E-Mail such as audio, video and other graphics in different formats. This can be achieved with MIME (Multi-purpose Internet Mail Extensions [5]. Sending and receiving of electronic mail over the internet can be done with the help of some protocols. The protocols SMTP and POP3 are the widely used protocols to send and receive the electronic mails. The following diagram depicts how the E-Mail message is routed from one source to other destination. The figure 1 consists of three components namely E-Mail Client [Sender & Receiver], Internet and Public mail servers. As shown, the sender enters the mail address and forwards the mail to the SMTP server through the internet. SMTP server forwards the mail to the POP3 server associated with the receiver's address [6]. Then receiver retrieves the mail form the POP3 server to his local machine [6].
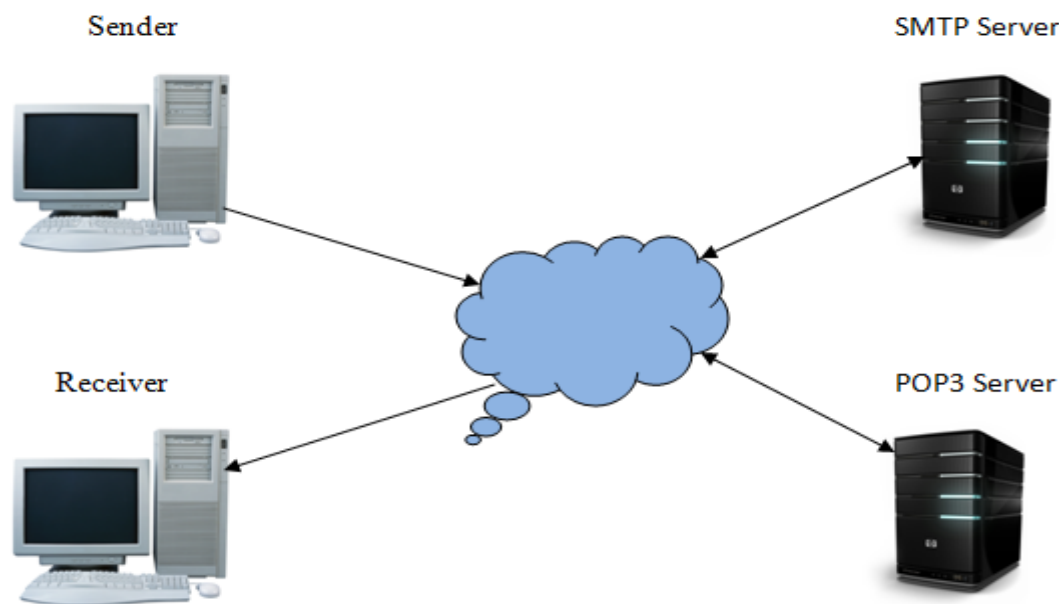

Figure 1 E-Mail Processing System

When the internet users are growing, Quality of Service (QoS) becomes the key point in the network communication. Quality of service (QoS) has a direct impact on user satisfaction with the service provided by Internet Service Providers (ISPs) [7]. E-Mail service is the one of the earliest service emerged on the internet to exchange the message from one recipient to one or more other recipient over the internet [7]. This E-Mail communication model is almost used by every one for their day to day life; however providing quality of service to all the E-Mail users is the key parameter in E-Mail message handling service. In this paper, QoS is chosen as the research area and novel mechanism is presented to improve the Quality of Service (QoS) in the E-Mail application.

II. RELATED WORK

Every network communication must consider the following two key factors: Security and Quality of service. These two factors should be maintained in stable status to obtain better performance forever. Similarly electronic mail network communication should keep these two factors in stable condition to provide, best sort of communication over the internet. Research has been carried out in electronic mail communication especially on the two factors in various ways. The two factors security and quality of service are interconnected with each another. That is, when security is improved that should not affect the quality of service and similarly when quality of service is improved that should not affect the security constraints. Whenever research is carried out in any network communication these two factors must be keenly observed to obtain better performance. The E-mail usage is long been considered as a major facility in enabling employees to gain quick and easy access to the sources of information and contacting people [8, 9, 10, 11]. The relationship between information and work performance has been addressed with two district factors: Technological approach and Human focus approach. The technological approach deals with what new technologies can be offered [8, 12] and the human focus approach focuses on social aspect claiming that information is essential for both individuals and groups of users [8, 13, 14]. The above survey shows the use of E-Mail in organizations level only and it does not speak about quality of service in E-Mail system.

Privacy is the major issue in electronic mail services. When the user deletes the mail from the mailbox, the copy of the mail is maintained at the E-Mail Service Providers (ESPs), which does not define the E-Mail privacy policy [4, 15]. The sender in E-Mail

communication model can easily provide fake identities and even other details, this kind of faking is called spoofing [4, 16]. Spoofing is the process of changing the original sender address with the fake address and this leads to the intended user will not get the reply from the receiver side. This spoofing result in security issues and causes financial losses through forwarding like spread of virus, worms and denial of services and etc [4, 17]. Several protocols such as SMTP and S/MIME and authentication of sender domain by digital signatures are developed to prevent the spoofing and keep the security and privacy of the E-mail system in consistent state. Here, importance is given to improve the privacy and security systems in E-Mail and no measures taken to improve the quality of service in the E-Mail communication system.

Spam mail is another issue in E-Mail communication model. Unsolicited Bulk E-Mail (UBE) and Unsolicited Commercial E-Mail (UCE) are known as spam [18]. Various anti- spam techniques have been proposed to overcome the spam but that was not successful enough [19]. Three techniques have been provided to prevent the anti- spam such as: misuse detection system, anomaly detection system and social network based methods. Spamassian uses a signature based anti-spam system, which applies a prior of spam signatures [20]. These signatures are manually developed by monitoring the

previous spam mails by the experts. Whenever new mail arrives the signature is matched with the new E-Mail, if mismatch found the mail is blocked as spam [18]. Observing all the previous studies once again the research has been carried out mostly on the security side of the E-Mail system.

However the security is one the factors of network communication the other factor quality of service also must be considered. Every network communication must provide user satisfaction to obtain better performance of the communication model. As everyone knows, E-Mail communication system is widely used by all the people of the world. So the E-Mail message handling system must provide good quality of service to its users. This paper concentrates on the quality of service on E-Mail system and develops the novel E-Mail communication model for improving the quality of service. The rest of the paper is divided into following sections: Section 3 gives the details of System Model (both existing and proposed system model) and proposed data flow model. The section 4 describes the details of Implementation of the proposed model. This section discusses performance evaluation, details and working principles of the proposed algorithm and results obtained by the proposed algorithm. Next section 5 is the conclusion of the proposed system model.
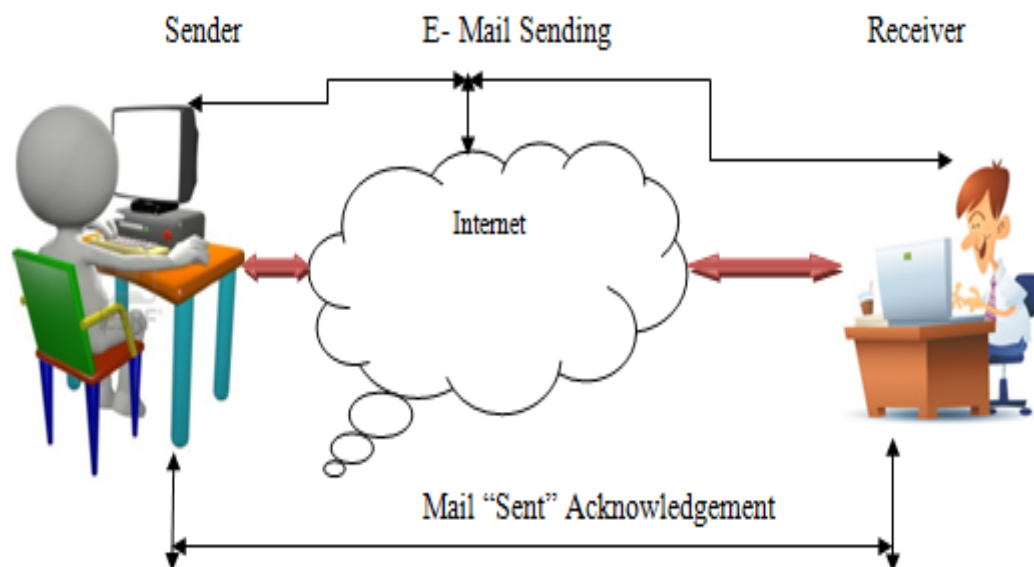
III. SYSTEM MODEL

A. Existing System Model

Figure 2 Existing System Model

The above figure 2 represents the existing system model of electronic mail communication. As indicated in the figure 2 both the sender and receiver are connected via internet and they can communicate with each other. This figure gives the simple representation of E-Mail message forwarding from the sender to receiver and vice versa. However, while forwarding the E-Mail message,

the existing E-Mail protocols are used to transmit the message to the intended user. Namely the SMTP protocol is used to receive the mail from the sender and store the mail in the SMTP server. Then the SMTP server forwards the mail to the POP3 server associated with the intended receiver address. Later the receiver retrieves the message from the POP3 server with the help of POP3

protocol. However the existing model provides the communication without any trouble to the both sender and receiver but the existing communication model still lacks in quality of service.

B. Problem Statement

User satisfaction plays vital role in electronic mail system. The existing system can be improved to provide higher satisfaction and quality of service to the users. The key factor of network communication is Quality of Service (QoS), which is considered in this paper. In the existing system model the sender sends an E-Mail to the receiver and gets the acknowledgement of message has been sent successfully. However the user will never know, whether sent E-Mail has been delivered to the destination or not. User has to wait until the receiver

sends back the response to the sender. Let's consider the case, when sender sends an E-Mail, the message is sent from the sender but the message packet is lost on the way, while forwarding to the destination. In this situation, the sender will think that the message has been successfully forwarded and sender will wait for the response from the receiver. The receiver will never send the response back to the sender because the receiver does not receive any mail from the other end. Actually the message packet is dropped somewhere. This scenario leads to poor quality of service in this existing E-Mail communication model. Quality of Service must be improved for the ease of use to the E-Mail users. This paper proposes an alternative methodology to improve the quality of service, which will obtain higher satisfaction from the users.
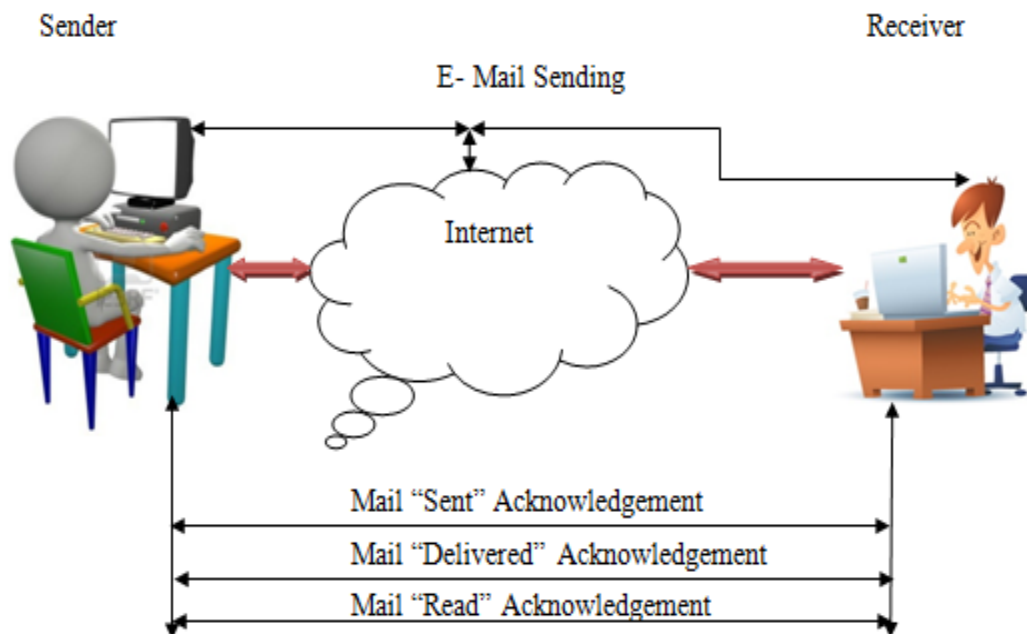
C. Proposed System Model

Figure 3 Proposed System Model

Figure 3 describes the entire concept of the proposed model. This proposed system overcomes limitations exists in the existing system model. As indicated in figure 3 both the sender and receiver are connected through internet to exchange E-Mail messages. In the existing model, when the sender sends an E-Mail will get only "Sent" acknowledgement and sender will never know, whether sent E-Mail reached its destination or not. This issue is cleared in the proposed model. Here, when the sender sends an E-Mail, the sender will get three acknowledgements such as message "Sent", message "Delivered" and message "Read" as shown in the figure 3. All the E-Mails sent are stored in the sent box of the user. In the proposed model, the sent box of the user will be updated with the recent status for each E-Mail is sent by the user. Initially once the E-Mail is sent the sent box is updated with the status "Sent", once the E-Mail is

delivered, the sent box is updated with the status "Delivered" and once the mail is read by the receiver the sent box of the sender is updated with the status "Read". Since the proposed model clearly notifies to the users with the recent status updates the proposed system model will improve the quality of service compared to the existing model.

D. Proposed Data Flow Model

The Figure 4 shows the working data flow diagram of the proposed architecture. As shown in the Figure 4, when the mail is sent form the sender the sent box is updated as "Sent". Once the mail is delivered to the intended receiver, the sent box of the sender is updated as "Delivered". Similarly the sent box is updated with the status as "Read", once the mail is read by the receiver.
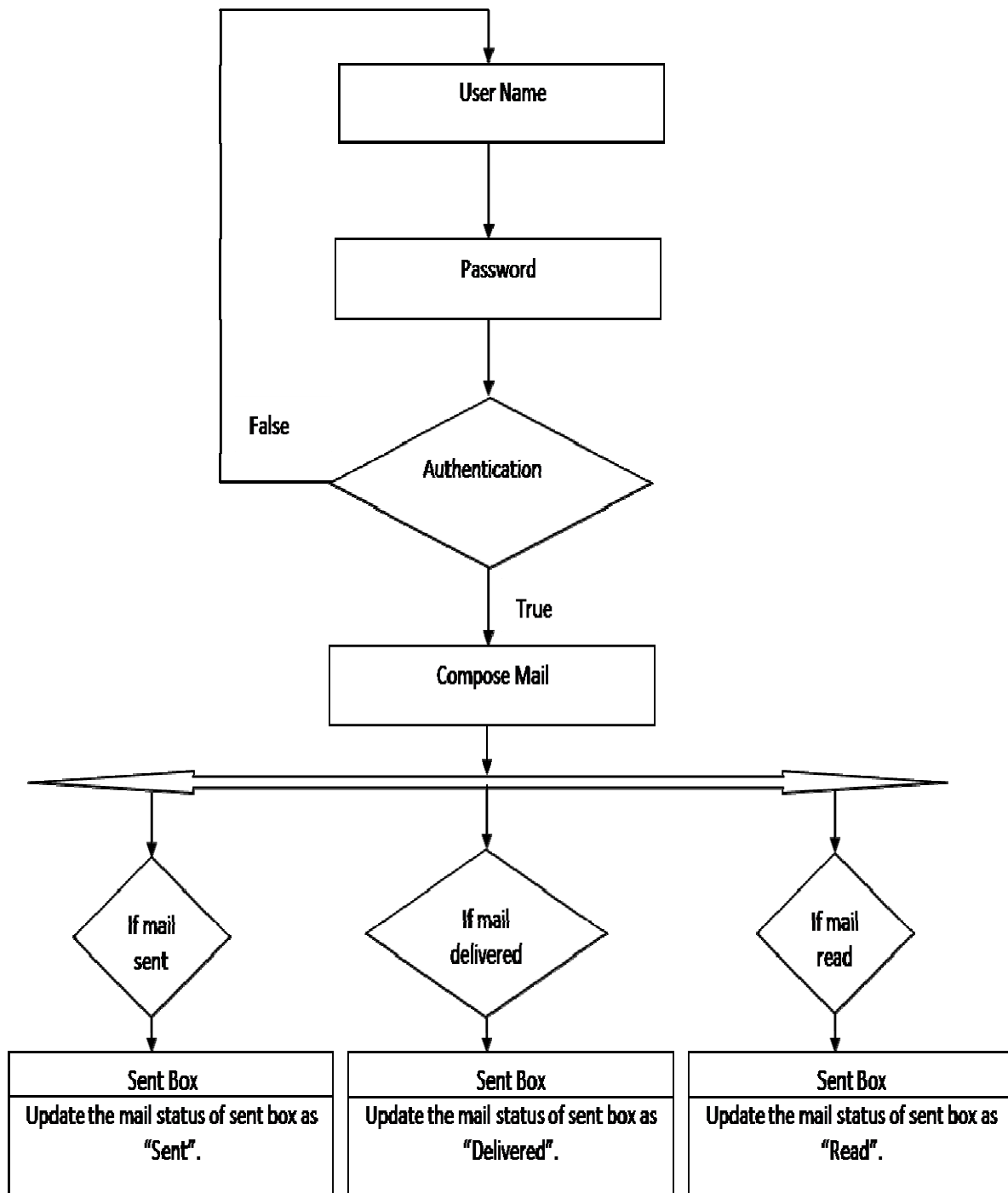
Figure 4 Proposed Data Flow Model

IV IMPLEMENTATION AND EXPERIMENTAL RESULTS

A. Performance Evaluation

The performance of the proposed E-Mail communication model can be evaluated in the following ways.

- Case 1: Updating the status field of the sent box as "Sent".
- Case 2: Updating the status field of the sent box as "Delivered".
- Case 3: Updating the status field of the sent box as "Read".

B. Case 1: Updating the Status Field of the Sent Box as "Sent"

Whenever an E-Mail is sent from the sender to receiver in the proposed model, the sent box of the sender is updated with the status "Sent" immediately.

The following algorithm represents the working principle
of the updating the status field of the sent box as "Sent".

```
Get User name;
Get Password;
If (authentication success)
{
Sign in;
}
Else
{
User name & Password mismatch;
}
Compose Mail (CPM);
Integer count=0, count1=0;
On click "Send"
{
Count=count+1;
Count1=count1+1;
Get Sender, Receiver, Subject and Message from CPM;
Forward the mail to the Server's inbox;
INSERT Sender, Receiver, Subject, Message and count to the server's sent box;
UPDATE the Status field of Sender's sent box as "Sent";
}
```

Algorithm 1: Updating the status field of the sent box as "Sent

In Algorithm 1, after composing the mail the sender enters the receiver's mail address and press "Send" button to send the mail to its destination. As soon as the mail is sent from the sender's local machine the status field of the sender's sent box is updated with the status "Sent". The following experimental result shows the working nature of the proposed algorithm.

Figure 5 Updating the status field of the sent box as "Sent"

The figure 5 shows the sent box of the user and it consists of three fields namely "To" notifies to whom the mail is being sent, "Status" notifies the current status of the mail that is being sent and "Sub" gives the subject of the mail, which has been sent. In the proposed model the "Status" field added newly to improve the quality of service in the E-Mail communication system. Whenever a mail is sent the status field is updated as "Sent" as shown in the figure 5.

C. Case 2: Updating the Status Field of the Sent Box as "Delivered"

The second metric of the proposed system updates the status field of the sent box as "Delivered" as soon as sent mail reached its destination. The following algorithm describes the entire concept of the second metric that is updating the status field of the sent box as "Delivered".

```
Get User name;
Get Password;
If (authentication success)
{
    Sign in;
}
Else
{
    User name & Password mismatch;
}
Compose CPM;
Integer count=0, count1=0;
String s=" ";
On click "Send"
{
    Count=count+1;
    Count1=count1+1;
    Get Sender, Receiver, Message and count from CPM;
    Forward the mail to the Server's inbox;
    INSERT the Sender, Receiver, Message and Count to the server's sent box;
    UPDATE the Status field of Sender's sent box as "Sent";
    SELECT sender from inbox where count=count1 and store it in s;
    UPDATE the Status field of Sender's sent box as "Delivered" WHERE count=count1 AND sender=s;
}
```

Algorithm 2: Updating the status field of the sent box as "Delivered"

The Algorithm 2 is used to update the status field of the sent box as "Delivered". When the user compose a mail and press the button "Send" to send the mail, at once the mail is sent from the local machine of the user and the status field of the sent box of the user is updated as "sent". The sent mail is routed to its intended mail address with the help of the existing protocols SMTP and POP3. Once the mail reached its correct destination, the status field of the sent box of the sender is updated with the current status as "Delivered". This could be done because the mail is delivered to its destination.

The figure 6 shows the status field of the sent box is updated with the recent status as "Delivered" when the message reached its intended destination.

Figure 6 Updating the status field of the sent box as "Delivered"

D. Case 3: Updating the Status Field of the Sent Box as "Read"

The third metric of the proposed model will provide the reading status of the mail that has been sent. That is if the mail has been read at the receiver end, then the status field of the sent box of the sender will be updated as "Read". The following algorithm is used to obtain the third metric successfully.

```
Get User name;
Get Password;
If (authentication success)
{
     Sign in;
}
Else
{
        User name & Password mismatch;
}
String sen=" ", sub= "", msg=" ";
List of mails are displayed in the inbox;
When clicking subject of the mail the message is displayed;
On clicking the subject of the mail
{
    SELECT sender, subject, and message from inbox and store it;
    Sen=sender;
    Sub=subject;
    Msg=message;
    UPDATE the status field of the sender's sent box as "Read" WHERE sender=Sen AND subject=Sub
    AND message=Msg;
}
```

Algorithm 3: Updating the status field of the sent box as "Read"

The Algorithm 3 describes the working principle of the third metric. When the user log into his/her mail id, the inbox is displayed with the list of mails received. When the user clicks the subject of the mail, the content of the mail will be displayed to the user for reading. Using Algorithm 3, as soon the subject of the mail is clicked the sender of the particular mail, subject and the message of the mail is identified. Immediately the sender's sent box status field is updated with the recent status as "Read", since the mail has been read at the receiver end.

Figure 7 Updating the status field of sent box as "Read"

The above the figure 7 shows the sender's sent box and the status field of the sent box is updated as "Read" since the messages have been read by the receivers respectively.

Figure 8 Updating the states field with various status updates

Figure 8 shows the status updates with the combination of "Sent", "Delivered", and "Read". The message has been sent is updated as "Sent", the message that has been delivered to the intended address is updated as "Delivered" and the message that has been read at the receiver end is updated as "Read". Thus, the proposed E-Mail communication model is evaluated based on the three metrics and the experimental results show clearly, that the proposed model gives good performance. Using the proposed method, Quality of Service (QoS) is improved in the E-Mail web based application.

IV. CONCLUSION

The characteristics of the E-Mail application is completely analyzed in this paper and by observing the previous research works, it is clear that all the works have been done in the security constraints of the E-Mail communication. However Quality of Service (QoS) plays vital role in the E-Mail services. So this paper concentrated on QoS and a new E-Mail communication approach is developed. In the proposed model, all the metrics are obtained successfully, which improves the efficiency of the E-Mail service. These metrics are updating the status field of the sent box as "Sent", "Delivered" and "Read". In the existing E-Mail service, the user can identify only whether the mail has been sent or not. In the proposed model, the user can verify whether the mail has been sent, delivered and read by the receiver.

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