

Network Working Group  
Request for Comments: 5550  
Obsoletes: 4550  
Updates: 4469, 4467  
Category: Standards Track

D. Cridland, Ed.  
A. Melnikov, Ed.  
Isode Limited  
S. Maes, Ed.  
Oracle  
August 2009

## The Internet Email to Support Diverse Service Environments (Lemonade) Profile

### Abstract

This document describes a profile (a set of required extensions, restrictions, and usage modes), dubbed Lemonade, of the IMAP, mail submission, and Sieve protocols. This profile allows clients (especially those that are constrained in memory, bandwidth, processing power, or other areas) to efficiently use IMAP and Submission to access and submit mail. This includes the ability to forward received mail without needing to download and upload the mail, to optimize submission, and to efficiently resynchronize in case of loss of connectivity with the server.

The Lemonade Profile relies upon several extensions to IMAP, Sieve, and Mail Submission protocols. The document also defines a new IMAP extension and registers several new IMAP keywords.

### Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

### Copyright Notice

Copyright (c) 2009 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents in effect on the date of publication of this document (<http://trustee.ietf.org/license-info>). Please review these documents carefully, as they describe your rights and restrictions with respect to this document.

This document may contain material from IETF Documents or IETF Contributions published or made publicly available before November 10, 2008. The person(s) controlling the copyright in some of this material may not have granted the IETF Trust the right to allow modifications of such material outside the IETF Standards Process. Without obtaining an adequate license from the person(s) controlling the copyright in such materials, this document may not be modified outside the IETF Standards Process, and derivative works of it may not be created outside the IETF Standards Process, except to format it for publication as an RFC or to translate it into languages other than English.

## Table of Contents

1. Introduction .....	3
2. Conventions Used in This Document .....	4
3. Summary of the Required Support .....	4
3.1. Lemonade Submission Servers .....	4
3.2. Lemonade Message Stores .....	5
3.3. Lemonade Message Delivery Agents .....	7
4. Lemonade Submission Servers .....	7
4.1. Forward without Download .....	7
4.2. Pipelining .....	8
4.3. DSN Support .....	8
4.4. Message Size Declaration .....	8
4.5. Enhanced Status Code Support .....	8
4.6. Encryption and Compression .....	8
5. Lemonade Message Stores .....	9
5.1. Quick Resynchronization .....	9
5.2. Message Part Handling .....	9
5.3. Compression .....	10
5.4. Notifications .....	10
5.5. Searching and View Filters .....	12
5.6. Mailbox Handling .....	12
5.7. Forward without Download .....	12
5.8. Additional IMAP Extensions .....	13
5.9. Registration of \$Forwarded IMAP Keyword .....	13
5.10. Registration of \$SubmitPending and \$Submitted IMAP Keywords .....	13
5.11. Related IMAP Extensions .....	14
6. Lemonade Message Delivery Agents .....	14
7. Lemonade Message User Agents .....	15
8. Forward without Download .....	16
8.1. Motivations .....	16
8.2. Message Sending Overview .....	16
8.3. Traditional Strategy .....	17
8.4. A New Strategy .....	18
8.5. Security Considerations for Pawn-Tickets .....	27

8.6. Copies of Sent Messages: The fcc Problem .....	27
9. Deployment Considerations .....	28
10. Security Considerations .....	28
10.1. Confidentiality Protection of Submitted Messages .....	28
10.2. TLS .....	29
10.3. Additional Extensions and Deployment Models .....	29
11. IANA Considerations .....	30
12. Changes since RFC 4550 .....	30
13. Acknowledgements .....	31
14. References .....	31
14.1. Normative References .....	31
14.2. Informative References .....	35
Appendix A. Errata .....	37

## 1. Introduction

The Lemonade Profile, or simply Lemonade, provides enhancements to Internet email to support diverse service environments. Lemonade mail servers provide both a Lemonade Submission Server and a Lemonade Message Store, which are based on the existing [SUBMIT] and [IMAP] protocols, respectively. They MAY also include a Lemonade Message Delivery Agent, which provides delivery-time filtering services based on [SIEVE].

This document describes the Lemonade Profile that includes:

- o General common enhancements to Internet Mail, described in 5 and 4.
- o "Forward without download" that describes exchanges between Lemonade clients and servers to allow submitting new email messages incorporating content that resides on locations external to the client, described in Section 8.
- o Quick mailbox resynchronization, described in Section 5.1.
- o Extensions to support more precise, and broader, notifications from the store in support of notifications and view filters, described in 5.4.1 and 5.5.
- o Delivery-time filtering in support of typical mail management use cases, as described in Section 3.3.

The LEMONADE WG used the architecture shown in [LEMONADE-ARCH] to develop the Lemonade Profile.

It is intended that the Lemonade Profile support realizations of the OMA's mobile email enabler (MEM) (see [OMA-MEM-REQ] and [OMA-MEM-ARCH]) using Internet Mail protocols defined by the IETF.

## 2. Conventions Used in This Document

In examples, "M:", "I:", and "S:" indicate lines sent by the client Message User Agent, IMAP email server, and SMTP submit server, respectively.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [KEYWORDS].

Other capitalized words are typically names of extensions or commands -- these are uppercased for clarity only, and are case-insensitive.

This document uses terminology defined in [RFC5598]. See [RFC5598] for further details on Email Architecture.

All examples in this document are optimized for Lemonade use and might not represent examples of proper protocol usage for a general use Submit/IMAP client. In particular, examples assume that Submit and IMAP servers support all Lemonade extensions described in this document, so they do not demonstrate fallbacks in the absence of an extension.

## 3. Summary of the Required Support

### 3.1. Lemonade Submission Servers

Lemonade Submission Servers **MUST** provide a service as described in [SUBMIT], and **MUST** support the following. Note that the Lemonade Profile imposes further requirements for some cases, detailed in the sections cited.

SMTP extension	Reference	Requirements
8BITMIME	[SMTP-8BITMIME]	[SMTP-BURL]
AUTH	[SMTP-AUTH]	[SUBMIT]
BINARYMIME	[SMTP-BINARYMIME]	Section 4.1
BURL imap	[SMTP-BURL]	Section 8
CHUNKING	[SMTP-BINARYMIME]	Section 4.1
DSN	[SMTP-DSN]	Section 4.3
ENHANCEDSTATUSCODES	[SMTP-STATUSCODES]	Section 4.5
PIPELINING	[SMTP-PIPELINING]	Section 4.2
SIZE	[SMTP-SIZE]	Section 4.4
STARTTLS	[SMTP-TLS]	Section 4.6

### 3.2. Lemonade Message Stores

Lemonade Message Stores **MUST** provide a service as described in [IMAP], and **MUST** support the following. Note that the Lemonade Profile imposes further requirements for some cases, detailed in the sections cited.

IMAP extension	Reference	Requirements
BINARY	[IMAP-BINARY]	Section 5.2
CATENATE	[IMAP-CATENATE]	Section 5.7
COMPRESS=DEFLATE	[IMAP-COMPRESS]	Section 5.3
CONDSTORE	[IMAP-CONDSTORE]	Section 5.1
CONTEXT=SEARCH	[IMAP-CONTEXT]	Section 5.5
CONTEXT=SORT	[IMAP-CONTEXT]	Section 5.5
CONVERT	[IMAP-CONVERT]	Section 5.2
ENABLE	[IMAP-ENABLE]	Section 5.1
ESEARCH	[IMAP-ESEARCH]	Section 5.5
ESORT	[IMAP-CONTEXT]	Section 5.5
I18NLEVEL=1	[IMAP-I18N]	Section 5.8
IDLE	[IMAP-IDLE]	Section 5.4.1
LITERAL+	[IMAP-LITERAL+]	Section 5.8
NAMESPACE	[IMAP-NAMESPACE]	Section 5.6
NOTIFY	[IMAP-NOTIFY]	Section 5.4.1
QRESYNC	[IMAP-QRESYNC]	Section 5.1
SASL-IR	[IMAP-SASL-IR]	Section 5.8
SORT	[IMAP-SORT]	Section 5.5
STARTTLS	[IMAP]	-
UIDPLUS	[IMAP-UIDPLUS]	Section 5.7
URLAUTH	[IMAP-URLAUTH]	Section 5.7
URL-PARTIAL	Section 5.7.1	Section 5.7
\$Forwarded keyword	-	Section 5.9
\$SubmitPending keyword	-	Section 5.10
\$Submitted keyword	-	Section 5.10

In addition to this list, any Lemonade Message Stores MUST send the CAPABILITY response code (see Section 7.1 of [IMAP]) in the initial server greeting and after the LOGIN/AUTHENTICATE commands.

### 3.3. Lemonade Message Delivery Agents

Lemonade Message Delivery Agents **MUST** support Sieve mail filtering language as described in [SIEVE], and **MUST** support the following Sieve extensions. Note that the Lemonade Profile imposes further requirements for some cases, detailed in the sections cited.

Sieve extension	Reference	Requirements
ENOTIFY	[SIEVE-NOTIFY]	Section 6
IMAP4FLAGS	[SIEVE-IMAP4FLAGS]	Section 6
RELATIONAL	[SIEVE-RELATIONAL]	Section 6
VACATION	[SIEVE-VACATION]	Section 6
VARIABLES	[SIEVE-VARIABLES]	Section 6
comparator-i;unicode-casemap	[UNICODE-CASEMAP]	Section 6

Lemonade Message Delivery Agents should also consider supporting a Sieve script management protocol, such as [MANAGESIEVE].

## 4. Lemonade Submission Servers

All Lemonade Submission Servers implement the Mail Submission protocol described in [SUBMIT], which is in turn a specific profile of [ESMTP]. Therefore, any MUA designed to submit email via [SUBMIT] or [ESMTP] will interoperate with Lemonade Submission Servers.

In addition, Lemonade Submission Servers implement the following set of SMTP and Submission extensions to increase message submission efficiency.

### 4.1. Forward without Download

In order to optimize network usage for the typical case where message content is copied to, or sourced from, the IMAP store, Lemonade provides support for a suite of extensions collectively known as "forward without download", discussed in detail in Section 8.

Lemonade Submission Servers **MUST** support BURL [SMTP-BURL], 8BITMIME [SMTP-8BITMIME], BINARYMIME [SMTP-BINARYMIME], and CHUNKING [SMTP-BINARYMIME] SMTP extensions.

BURL **MUST** support URLAUTH type URLs [IMAP-URLAUTH], and thus **MUST** advertise the "imap" option following the BURL EHLO keyword (see [SMTP-BURL] for more details).

#### 4.2. Pipelining

Some clients regularly use networks with a relatively high latency, such as mobile or satellite-based networks. Avoidance of round trips within a transaction has a great advantage for the reduction in both bandwidth and total transaction time. For this reason, Lemonade-compliant mail Submission Servers **MUST** support the SMTP service extensions for command pipelining [SMTP-PIPELINING].

#### 4.3. DSN Support

Lemonade-compliant mail Submission Servers **MUST** support SMTP service extensions for delivery status notifications [SMTP-DSN].

#### 4.4. Message Size Declaration

There is a distinct advantage in detecting failure cases as early as possible in many cases, such as where the user is charged per octet, or where bandwidth is low. This is especially true of large message sizes.

Lemonade Submission Servers **MUST** support the SMTP service extension for message size declaration [SMTP-SIZE].

Lemonade Submission Servers **MUST** expand all BURL parts before evaluating if the supplied message size is acceptable.

A Lemonade-capable client **SHOULD** use message size declaration. In particular, the client **MUST NOT** send a message to a mail Submission Server if it knows that the message exceeds the maximal message size advertised by the Submission Server. When including a message size in the MAIL FROM command, the client **MUST** use a value that is at least as large as the size of the assembled message data after resolution of all BURL parts.

#### 4.5. Enhanced Status Code Support

Lemonade-compliant mail Submission Servers **MUST** support the SMTP service extension for returning enhanced error codes [SMTP-STATUSCODES]. These allow a client to determine the precise cause of failure.

#### 4.6. Encryption and Compression

Lemonade-compliant mail Submission Servers **MUST** support the SMTP service extension for secure SMTP over Transport Layer Security (TLS) [SMTP-TLS].



Support for the DEFLATE compression method, as described in [TLS-COMP], is RECOMMENDED.

## 5. Lemonade Message Stores

All Lemonade Message Stores implement the Internet Message Access Protocol, as defined in [IMAP]. Therefore, any MUA written to access messages using the facilities described in [IMAP] will interoperate with a Lemonade Message Store.

In addition, Lemonade Message Stores provide a set of extensions to address the limitations of some clients and networks.

### 5.1. Quick Resynchronization

Resynchronization is a costly part of an IMAP session, and mobile networks are generally more prone to unintended disconnection, which in turn makes this problem more acute. Therefore, Lemonade Message Stores provide a suite of extensions to reduce the synchronization cost.

Lemonade-compliant IMAP servers MUST support the CONDSTORE [IMAP-CONDSTORE], the QRESYNC [IMAP-QRESYNC], and the ENABLE [IMAP-ENABLE] extensions. These allow a client to quickly resynchronize any mailbox by asking the server to return all flag changes and expunges that have occurred since a previously recorded state. This can also speed up client reconnect in case the transport layer is cut, whether accidentally or as part of a change in network.

When implementing QRESYNC [IMAP-QRESYNC], client and servers need to also comply with errata submitted for this document (see Appendix A).

[IMAP-SYNC-HOWTO] details how clients perform efficient mailbox resynchronization.

### 5.2. Message Part Handling

The handling of message parts, especially attachments, represents a set of challenges to limited devices, both in terms of the bandwidth used and the capability of the device.

Lemonade-compliant IMAP servers MUST support the BINARY [IMAP-BINARY] extension. This moves MIME body part decoding operations from the client to the server. The decoded data is equal to or less in size than the encoded representation, so this reduces bandwidth effectively.

[IMAP-BINARY] allows for servers to refuse to accept uploaded messages containing binary data, by not accepting the Binary content-transfer-encoding; however, Lemonade-compliant IMAP servers **SHALL** always accept binary encoded MIME messages in APPEND commands for any folder.

[IMAP-CONVERT] **MUST** also be supported by servers, which allows clients to request conversions between media types, and allows for scaling images, etc. This provides the ability to view attachments (and sometimes body parts) without the facility to cope with a wide range of media types, or to efficiently view attachments.

### 5.3. Compression

Lemonade Message Stores **SHOULD** support the Deflate compression algorithm for TLS, as defined in [TLS-COMP], in order to facilitate compression at as low a level as possible.

However, the working group acknowledges that for many endpoints, this is a rarely deployed technology, and as such, Lemonade Message Stores **MUST** provide [IMAP-COMPRESS] support for fallback application-level stream compression, where TLS is not actively providing compression.

### 5.4. Notifications

The addition of server-to-client notifications transforms the Lemonade Profile into an event-based synchronization protocol. Whenever an event occurs that interests the MUA, a notification can be generated. The Lemonade WG used the notifications architecture shown in [LEMONADE-NOTIFICATIONS] to develop the Lemonade Profile.

If the MUA is connected to the IMAP server, inband notifications are generated using the facilities outlined in Section 5.4.1.

When the MUA is not connected, the notification filter generates an outband notification. The notification filter may be considered as acting on a push email repository.

If the MUA is not connected, and outband notification is disabled, the client must perform a quick-sync on reconnect to determine mailbox changes, using the mechanisms outlined in Section 5.1.

#### 5.4.1. IMAP Notifications

Lemonade Message Stores **MUST** support the IDLE [IMAP-IDLE] extension. The extension allows clients to receive unsolicited notifications about changes in the selected mailbox, without needing to poll for changes. The responses forming these notifications **MUST** be sent in a timely manner when such changes happen.

Lemonade Message Stores also provide the NOTIFY extension described in [IMAP-NOTIFY], which allows clients to request specific event types to be sent immediately to the client, both for the currently selected folder and others. Such event types include message delivery and mailbox renames.

#### 5.4.2. External Notifications

Lemonade and TCP provide for long-lived idle connections between the client and mail store, allowing the server to push notifications within IMAP. Some mobile networks support dormancy, which shuts down the radio traffic channel during idle periods to conserve handset and network resources, while maintaining IP and TCP state. (See the [LEMONADE-DEPLOYMENTS] document for more information.)

However, there are environments where the email client cannot remain active indefinitely, or where it is not advisable (or even always possible) for TCP connections to the server to remain up while idle for extended periods. In these situations, a good user experience requires that when "interesting" events occur in the mail store, the client be informed so that it can connect and resynchronize. At an absolute minimum, this requires that at least the arrival of new mail generate some sort of wake-up to the email client. A number of vendors have implemented various solutions to this. As examples of what has been done, for many years (long pre-dating cellular handsets) the technique described in [FINGER-HACK] has been supported. Today, a number of email vendors include facilities to send SMS or other simple non-stream messages to clients on handsets when new mail arrives. The Open Mobile Alliance (OMA) has published a mechanism that uses WAP PUSH to send a basic message containing a URL [OMA-EMN]. The IETF is investigating ways to standardize enhanced functionality in this area.

A "push email" user experience can be achieved using any number of techniques, ranging from always-on TCP connectivity to the server and the NOTIFY extension described above, to OMA EMN, or even a non-standard trigger message over SMS. In any technique, the client learns of the existence of new mail, and decides to fetch information about it, some part of it, or all of it, and then presents this to the user.

## 5.5. Searching and View Filters

Lemonade Message Stores MUST support the ESEARCH [IMAP-ESEARCH] extension. The extension allows clients to efficiently find the first or last messages, find a count of matching messages, and obtain a list of matching messages in a considerably more compact representation.

Lemonade Message Stores also provide a mechanism for clients to avoid handling an entire mailbox, instead accessing a view of the mailbox. This technique, common in many desktop clients as a client-side capability, is useful for constrained clients to minimize the quantity of messages and notification data.

Lemonade Message Stores therefore MUST implement the CONTEXT=SEARCH, ESORT, and CONTEXT=SORT extensions defined in [IMAP-CONTEXT], as well as the SORT extension defined in [IMAP-SORT].

## 5.6. Mailbox Handling

Lemonade Message Stores MUST support the NAMESPACE [IMAP-NAMESPACE] extension. The extension allows clients to discover shared mailboxes and mailboxes belonging to other users, and provide a normalized hierarchy view of the mailboxes available.

Lemonade Message Stores MUST support the I18NLEVEL=<n> [IMAP-I18N] extension, with <n> having the value 1 or 2. It adds support for non-English (internationalized) search and sort functions. (Note that I18NLEVEL=2 implies support for I18NLEVEL=1, so a Lemonade-compliant client that makes use of this extension MUST recognize either one.)

## 5.7. Forward without Download

In order to optimize network usage for the typical case where message content is copied to, or sourced from, the IMAP store, Lemonade provides support for a suite of extensions collectively known as "forward without download", discussed in detail in Section 8.

Lemonade Message Stores MUST support CATENATE [IMAP-CATENATE], UIDPLUS [IMAP-UIDPLUS], and URLAUTH [IMAP-URLAUTH]. Lemonade Message Stores MUST also support URL-PARTIAL as described in Section 5.7.1.

### 5.7.1. Support for PARTIAL in CATENATE and URLAUTH

[IMAP-URL] introduced a new syntactic element for referencing a byte range of a message/body part. This is done using the ;PARTIAL= field. If an IMAP server supports PARTIAL in IMAP URL used in

CATENATE and URLAUTH extensions, then it MUST advertise the URL-PARTIAL capability in both the CAPABILITY response and the equivalent response-code.

## 5.8. Additional IMAP Extensions

Lemonade Message Stores MUST support the LITERAL+ [IMAP-LITERAL+] extension. The extension allows clients to save a round trip each time a non-synchronizing literal is sent.

Lemonade Message Stores MUST also implement the SASL-IR [IMAP-SASL-IR] extension, which allows clients to save a round trip during authentication, potentially pipelining the entire authentication sequence.

Lemonade-compliant IMAP servers MUST support IMAP over TLS [IMAP] as required by [IMAP]. As noted above in Section 5.3, servers SHOULD support the deflate compression algorithm for TLS, as specified in [TLS-COMP].

## 5.9. Registration of \$Forwarded IMAP Keyword

The \$Forwarded IMAP keyword is used by several IMAP clients to specify that the marked message was forwarded to another email address, embedded within or attached to a new message. A mail client sets this keyword when it successfully forwards the message to another email address. Typical usage of this keyword is to show a different (or additional) icon for a message that has been forwarded. Once set, the flag SHOULD NOT be cleared.

Lemonade Message Stores MUST be able to store the \$Forwarded keyword. They MUST preserve it on the COPY operation. The servers MUST support the SEARCH KEYWORD \$Forwarded.

## 5.10. Registration of \$SubmitPending and \$Submitted IMAP Keywords

The \$SubmitPending IMAP keyword designates the message as awaiting to be submitted. This keyword allows storing messages waiting to be submitted in the same mailbox where messages that were already submitted and/or are being edited are stored. A mail client sets this keyword when it decides that the message needs to be sent out. When a client (it might be a different client from the one that decided that the message is pending submission) starts sending the message, it atomically (using "STORE (UNCHANGEDSINCE)") adds the \$Submitted keyword. Once submission is successful, the \$SubmitPending keyword is atomically cleared. The two keywords allow messages being actively submitted (messages that have both \$Submitted and \$SubmitPending keywords set) to be distinguished from messages

awaiting to be submitted, or from messages already submitted. They also allow all messages that were supposed to be submitted to be found, if the client submitting them crashes or quits before submitting them.

Lemonade Message Stores **MUST** be able to store the \$SubmitPending and the \$Submitted keyword. Lemonade Message Stores **MUST** preserve them on the COPY operation. The servers **MUST** support the SEARCH KEYWORD \$SubmitPending and SEARCH KEYWORD \$Submitted.

## 5.11. Related IMAP Extensions

Section 5.11 is non-normative.

Server implementations targeting to fulfill OMA MEM requirements [OMA-MEM-REQ] should consider implementing the [IMAP-FILTERS], which provides a way to persist definition of virtual mailboxes on the server. They should also consider implementing the METADATA-SERVER [METADATA] extension, which provides a way of storing user-defined data associated with a user account.

## 6. Lemonade Message Delivery Agents

Lemonade Message Delivery Agents **MUST** support the [SIEVE] filtering language at the point of delivery, allowing the user to control which messages are accepted, and where they are filed.

Lemonade Message Delivery Agents **MUST** support the Sieve Vacation extension [SIEVE-VACATION], which allows the client to set up an auto-responder, typically to report being on vacation (thus the name of the Sieve extension).

Lemonade Message Delivery Agents **MUST** support the Sieve Enotify extension [SIEVE-NOTIFY], which allows a Sieve script to generate notifications (such as XMPP, SIP, or email) about received messages.

Lemonade Message Delivery Agents **MUST** support the Sieve Variables extension [SIEVE-VARIABLES], which adds support for variables to the Sieve scripting language. This extension is typically used with Sieve Enotify or Vacation to customize responses/notifications.

Lemonade Message Delivery Agents **MUST** support the Sieve Relational extension [SIEVE-RELATIONAL], which adds support for relational comparisons to the Sieve scripting language. This extension is typically used together with Sieve Enotify.

Lemonade Message Delivery Agents **MUST** support the Sieve Imap4Flags extension [SIEVE-IMAP4FLAGS], which allows a Sieve script to set IMAP flags/keywords when delivering a message to a mailbox. For example, this can be used to automatically mark certain messages as interesting, urgent, etc.

Lemonade Message Delivery Agents **MUST** support the i;unicode-casemap comparator in Sieve [UNICODE-CASEMAP], which is declared as "comparator-i;unicode-casemap" in the Sieve "require" statement. The comparator allows for case-insensitive matching of Unicode characters.

Lemonade Message Delivery Agents should consider supporting Sieve script management using the [MANAGESIEVE] protocol. If they do, they **MUST** also advertise in [MANAGESIEVE] all Sieve extensions listed in this section.

## 7. Lemonade Message User Agents

Although all existing IMAP MUAs are Lemonade compliant in as much as all Lemonade services are based on the existing [IMAP] and [SUBMIT] protocols, client implementors are encouraged to take full advantage of the facilities provided by Lemonade Submission Servers and Lemonade Message Stores, as described in 4 and 5, respectively.

When opening a connection to the Submission Server, clients **MUST** do so using port 587 unless explicitly configured to use an alternate port [RFC5068]. (Note that this requirement is somewhat stronger than the one specified in [SUBMIT], as [SUBMIT] didn't prescribe the exact procedure to be used by submission clients.) If the TCP connection to the submission server fails to open using port 587, the client **MAY** then immediately retry using a different port, such as 25. See [SUBMIT] for information on why using port 25 is likely to fail depending on the current location of the client, and may result in a failure code during the SMTP transaction.

In addition, some specifications are useful to support interoperable messaging with an enhanced user experience.

Lemonade-capable clients **SHOULD** support the Format and DelSp parameters to the text/plain media type described in [FLOWED], and generate this format for messages.

Lemonade-capable clients **SHOULD** support, and use, the \$Forwarded keyword described in Section 5.9.

## 8. Forward without Download

### 8.1. Motivations

The advent of client/server email using the [IMAP] and [SUBMIT] protocols changed what formerly were local disk operations to become repetitive network data transmissions.

Lemonade "forward without download" makes use of the [SMTP-BURL] extension to enable access to external sources during the submission of a message. In combination with the [IMAP-URLAUTH] extension, inclusion of message parts or even entire messages from the IMAP mail store is possible with a minimal trust relationship between the IMAP and SMTP SUBMIT servers.

Lemonade "forward without download" has the advantage of maintaining one submission protocol, and thus avoids the risk of having multiple parallel and possibly divergent mechanisms for submission. The client can use [SUBMIT] extensions without these being added to IMAP. Furthermore, by keeping the details of message submission in the SMTP SUBMIT server, Lemonade "forward without download" can work with other message retrieval protocols such as POP, NNTP, or whatever else may be designed in the future.

### 8.2. Message Sending Overview

The act of sending an email message can be thought of as involving multiple steps: initiation of a new draft, draft editing, message assembly, and message submission.

Initiation of a new draft and draft editing takes place in the MUA. Frequently, users choose to save more complex messages on an [IMAP] server (via the APPEND command with the \Draft flag) for later recall by the MUA and resumption of the editing process.

Message assembly is the process of producing a complete message from the final revision of the draft and external sources. At assembly time, external data is retrieved and inserted in the message.

Message submission is the process of inserting the assembled message into the [ESMTP] infrastructure, typically using the [SUBMIT] protocol.



### 8.3. Traditional Strategy

Traditionally, messages are initiated, edited, and assembled entirely within an MUA, although drafts may be saved to an [IMAP] server and later retrieved from the server. The completed text is then transmitted to a Message Submission Agent (MSA) for delivery.

There is often no clear boundary between the editing and assembly processes. If a message is forwarded, its content is often retrieved immediately and inserted into the message text. Similarly, when external content is inserted or attached, the content is usually retrieved immediately and made part of the draft.

As a consequence, each save of a draft and subsequent retrieval of the draft transmits that entire (possibly large) content, as does message submission.

In the past, this was not much of a problem, because drafts, external data, and the message submission mechanism were typically located on the same system as the MUA. The most common problem was running out of disk quota.

#### 8.4. A New Strategy

The model distinguishes between a Message User Agent (MUA), an IMAPv4Rev1 Server ([IMAP]), and an SMTP submit server ([SUBMIT]), as illustrated in Figure 1.

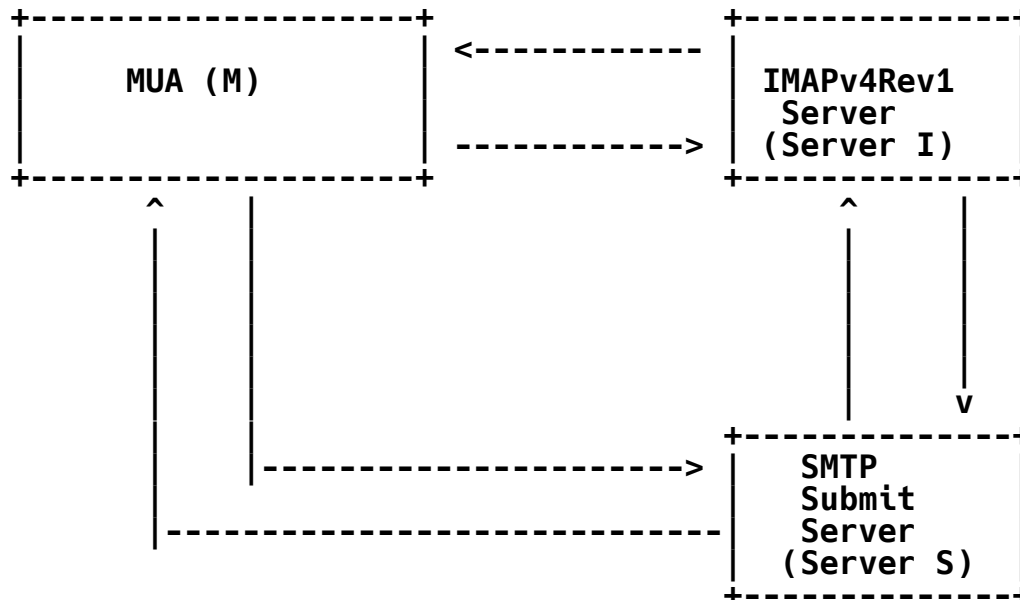


Figure 1: Lemonade "forward without download"

Lemonade "forward without download" allows a Message User Agent to compose and forward an email combining fragments that are located in an IMAP server, without having to download these fragments to the client.

This section informatively describes two ways to perform "forward without download" based on where the message assembly takes place. The first uses the extended APPEND command [IMAP-CATENATE] to edit a draft message in the message store and cause the message assembly on the IMAP server. This is most often used when a copy of the message is to be retained on the IMAP server, as discussed in Section 8.6.

The second uses a succession of BURL and BDAT commands to submit and assemble through concatenation, message data from the client and external data fetched from the provided URL. The two subsequent sections provide step-by-step instructions on how "forward without download" is achieved.

#### 8.4.1. Message Assembly Using IMAP CATENATE Extension

In the [SMTP-BURL]/[IMAP-CATENATE] variant of the Lemonade "forward without download" strategy, messages are initially composed and edited within an MUA. The [IMAP-CATENATE] extension to [IMAP] is then used to create the messages on the IMAP server by transmitting new text and assembling them. The UIDPLUS [IMAP-UIDPLUS] IMAP extension is used by the client in order to learn the UID of the created messages. Finally, an [IMAP-URLAUTH] format URL is given to a [SUBMIT] server for submission using the BURL [SMTP-BURL] extension.

The flow involved to support such a use case consists of:

M: {to I -- Optional} The client connects to the IMAP server, optionally starts TLS (if data confidentiality is required), authenticates, opens a mailbox ("INBOX" in the example below), and fetches body structures (see [IMAP]).

Example:

```
M: A0051 UID FETCH 25627 (UID BODYSTRUCTURE)
I: * 161 FETCH (UID 25627 BODYSTRUCTURE (("TEXT" "PLAIN"
      ("CHARSET" "US-ASCII") NIL NIL "7BIT" 1152 23)(
      "TEXT" "PLAIN" ("CHARSET" "US-ASCII" "NAME"
      "trip.txt")
      "<960723163407.20117h@washington.example.com>"
      "Your trip details" "BASE64" 4554 73) "MIXED"))
I: A0051 OK completed
```

M: {to I} The client invokes CATENATE (see [IMAP-CATENATE] for details of the semantics and steps) -- this allows the MUA to create messages on the IMAP server using new data combined with one or more message parts already present on the IMAP server.

Note that the example for this step doesn't use the LITERAL+ [IMAP-LITERAL+] extension. Without LITERAL+ the new message is constructed using three round trips. If LITERAL+ is used, the new message can be constructed using one round trip.

```

M: A0052 APPEND Sent FLAGS (\Draft \Seen $MDNSent)
  CATENATE (TEXT {475})
I: + Ready for literal data
M: Message-ID: <419399E1.6000505@caernarfon.example.org>
M: Date: Thu, 12 Nov 2004 16:57:05 +0000
M: From: Bob Ar <bar@example.org>
M: MIME-Version: 1.0
M: To: foo@example.net
M: Subject: About our holiday trip
M: Content-Type: multipart/mixed;
M:     boundary="-----030308070208000400050907"
M:
M: -----030308070208000400050907
M: Content-Type: text/plain; format=flowed
M:
M: Our travel agent has sent the updated schedule.
M:
M: Cheers,
M: Bob
M: -----030308070208000400050907
M:  URL "/INBOX;UIDVALIDITY=385759045/;
  UID=25627//;Section=2.MIME" URL "/INBOX;
  UIDVALIDITY=385759045//;UID=25627//;Section=2" TEXT {44}
I: + Ready for literal data
M:
M: -----030308070208000400050907--
M: )
I: A0052 OK [APPENDUID 387899045 45] CATENATE Completed

```

M: {to I} The client uses the GENURLAUTH command to request a URLAUTH URL (see [IMAP-URLAUTH]).

I: {to M} The IMAP server returns a URLAUTH URL suitable for later retrieval with URLFETCH (see [IMAP-URLAUTH] for details of the semantics and steps).

```

M: A0053 GENURLAUTH "imap://bob.ar@example.org/Sent;
  UIDVALIDITY=387899045//;uid=45;expire=2005-10-
  28T23:59:59Z;urlauth=submit+bob.ar" INTERNAL
I: * GENURLAUTH "imap://bob.ar@example.org/Sent;
  UIDVALIDITY=387899045//;uid=45;expire=
  2005-10-28T23:59:59Z;urlauth=submit+bob.ar:
  internal:91354a473744909de610943775f92038"
I: A0053 OK GENURLAUTH completed

```

M: {to S} The client connects to the mail Submission Server and starts a new mail transaction. It uses BURL to let the SMTP submit server fetch the content of the message from the IMAP server (see [IMAP-URLAUTH] for details of the semantics and steps -- this allows

the MUA to authorize the SMTP submit server to access the message composed as a result of the CATENATE step). Note that the second EHLO command is required after a successful STARTTLS command. Also note that there might be a third required EHLO command if the second EHLO response doesn't list any BURL options. Section 8.4.2 demonstrates this.

```
S: 220 owlry.example.org ESMTP
M: EHLO potter.example.org
S: 250-owlry.example.com
S: 250-8BITMIME
S: 250-BINARYMIME
S: 250-PIPELINING
S: 250-BURL imap
S: 250-CHUNKING
S: 250-AUTH PLAIN
S: 250-DSN
S: 250-SIZE 10240000
S: 250-STARTTLS
S: 250 ENHANCEDSTATUSCODES
M: STARTTLS
S: 220 Ready to start TLS
...TLS negotiation, subsequent data is encrypted...
M: EHLO potter.example.org
S: 250-owlry.example.com
S: 250-8BITMIME
S: 250-BINARYMIME
S: 250-PIPELINING
S: 250-BURL imap
S: 250-CHUNKING
S: 250-AUTH PLAIN
S: 250-DSN
S: 250-SIZE 10240000
S: 250 ENHANCEDSTATUSCODES
M: AUTH PLAIN aGFycnkAaGFycnkAYWNjaW8=
M: MAIL FROM:<bob.ar@example.org>
M: RCPT TO:<foo@example.net>
S: 235 2.7.0 PLAIN authentication successful.
S: 250 2.5.0 Address Ok.
S: 250 2.1.5 foo@example.net OK.
M: BURL imap://bob.ar@example.org/Sent;UIDVALIDITY=387899045/;
uid=45/;urlauth=submit+bar:internal:
91354a473744909de610943775f92038 LAST
```

S: {to I} The mail Submission Server uses URLFETCH to fetch the message to be sent. (See [IMAP-URLAUTH] for details of the semantics and steps. The so-called "pawn-ticket" authorization mechanism uses a URI that contains its own authorization credentials.)

I: {to S} Provides the message composed as a result of the CATENATE step).

The mail Submission Server opens an IMAP connection to the IMAP server:

```
I: * OK [CAPABILITY IMAP4REV1 STARTTLS NAMESPACE LITERAL+
    CATENATE URLAUTH UIDPLUS CONDSTORE IDLE] imap.example.com
    IMAP server ready
S: a000 STARTTLS
I: a000 Start TLS negotiation now
...TLS negotiation, if successful - subsequent data
    is encrypted...
S: a001 LOGIN submitserver secret
I: a001 OK submitserver logged in
S: a002 URLFETCH "imap://bob.ar@example.org/Sent;
    UIDVALIDITY=387899045/;uid=45/;urlauth=submit+bob.ar:
    internal:91354a473744909de610943775f92038"
I: * URLFETCH "imap://bob.ar@example.org/Sent;
    UIDVALIDITY=387899045/;uid=45/;urlauth=submit+bob.ar:
    internal:91354a473744909de610943775f92038" {15065}
...message body follows...
I: a002 OK URLFETCH completed
S: a003 LOGOUT
I: * BYE See you later
I: a003 OK Logout successful
```

Note that if data confidentiality is not required, the mail Submission Server may omit the STARTTLS command before issuing the LOGIN command.

S: {to M} Submission server assembles the complete message; if the assembly succeeds, it returns OK to the MUA:

```
S: 250 2.5.0 Ok.
```

M: {to I} The client marks the message containing the forwarded attachment on the IMAP server.

```
M: A0054 UID STORE 25627 +FLAGS.SILENT ($Forwarded)
I: * 215 FETCH (UID 25627 MODSEQ (12121231000))
I: A0054 OK STORE completed
```

Note: the UID STORE command shown above will only work if the marked message is in the currently selected mailbox; otherwise, it requires a SELECT. This command can be omitted, as it simply changes non-operational metadata not essential to client operations or

interoperability. The untagged FETCH response is due to [IMAP-CONDSTORE]. The \$Forwarded IMAP keyword is described in Section 5.9.

#### 8.4.2. Message Assembly Using SMTP CHUNKING and BURL Extensions

In the [IMAP-URLAUTH]/[SMTP-BURL] variant of the Lemonade "forward without download" strategy, messages are initially composed and edited within an MUA. During submission [SUBMIT], BURL [SMTP-BURL] and BDAT [SMTP-BINARYMIME] commands are used to create the messages from multiple parts. New body parts are supplied using BDAT commands, while existing body parts are referenced using [IMAP-URLAUTH] format URLs in BURL commands.

The flow involved to support such a use case consists of:  
M: {to I -- Optional} The client connects to the IMAP server, optionally starts TLS (if data confidentiality is required), authenticates, opens a mailbox ("INBOX" in the example below), and fetches body structures (see [IMAP]).

Example:

```
M: B0051 UID FETCH 25627 (UID BODYSTRUCTURE)
I: * 161 FETCH (UID 25627 BODYSTRUCTURE (("TEXT" "PLAIN"
  ("CHARSET" "US-ASCII") NIL NIL "7BIT" 1152 23)(
  "TEXT" "PLAIN" ("CHARSET" "US-ASCII" "NAME"
  "trip.txt")
  "<960723163407.20117h@washington.example.com>"
  "Your trip details" "BASE64" 4554 73) "MIXED"))
I: B0051 OK completed
```

M: {to I} The client uses the GENURLAUTH command to request URLAUTH URLs (see [IMAP-URLAUTH]) referencing pieces of the message to be assembled.

I: {to M} The IMAP server returns URLAUTH URLs suitable for later retrieval with URLFETCH (see [IMAP-URLAUTH] for details of the semantics and steps).

```

M: B0052 GENURLAUTH "imap://bob.ar@example.org/INBOX;
  UIDVALIDITY=385759045/;UID=25627/;Section=2.MIME;
  expire=2006-10-28T23:59:59Z;urlauth=submit+bob.ar"
  INTERNAL "imap://bob.ar@example.org/INBOX;
  UIDVALIDITY=385759045/;UID=25627/;Section=2;
  expire=2006-10-28T23:59:59Z;urlauth=submit+bob.ar" INTERNAL
I: * GENURLAUTH "imap://bob.ar@example.org/INBOX;
  UIDVALIDITY=385759045/;UID=25627/;Section=2.MIME;
  expire=2006-10-28T23:59:59Z;urlauth=submit+bob.ar:
  internal:A0DEAD473744909de610943775f9BEEF"
  "imap://bob.ar@example.org/INBOX;
  UIDVALIDITY=385759045/;UID=25627/;Section=2;
  expire=2006-10-28T23:59:59Z;urlauth=submit+bob.ar:
  internal:BEEFA0DEAD473744909de610943775f9"
I: B0052 OK GENURLAUTH completed

```

M: {to S} The client connects to the mail Submission Server and starts a new mail transaction. It uses BURL to instruct the SMTP submit server to fetch from the IMAP server pieces of the message to be sent (see [SMTP-BURL] for details of the semantics and steps).

Note that the second EHLO command is required after a successful STARTTLS command. The third EHLO command is required if and only if the second EHLO response doesn't list any BURL options. See Section 8.4.1 for an example of submission where the third EHLO command/response is not present.

```

S: 220 owlry.example.org ESMTP
M: EHLO potter.example.org
S: 250-owlry.example.com
S: 250-8BITMIME
S: 250-BINARYMIME
S: 250-PIPELINING
S: 250-BURL
S: 250-CHUNKING
S: 250-AUTH DIGEST-MD5
S: 250-DSN
S: 250-SIZE 10240000
S: 250-STARTTLS
S: 250 ENHANCEDSTATUSCODES
M: STARTTLS
S: 220 Ready to start TLS
...TLS negotiation, subsequent data is encrypted...
M: EHLO potter.example.org
S: 250-owlry.example.com
S: 250-8BITMIME
S: 250-BINARYMIME
S: 250-PIPELINING

```



S: 250-BURL  
S: 250-CHUNKING  
S: 250-AUTH DIGEST-MD5 CRAM-MD5 PLAIN EXTERNAL  
S: 250-DSN  
S: 250-SIZE 10240000  
S: 250 ENHANCEDSTATUSCODES  
M: AUTH PLAIN aGFycnkAaGFycnkAYWNjaW8=  
S: 235 2.7.0 PLAIN authentication successful.  
M: EHLO potter.example.org  
S: 250-owlry.example.com  
S: 250-8BITMIME  
S: 250-BINARYMIME  
S: 250-PIPELINING  
S: 250-BURL imap imap://imap.example.org  
S: 250-CHUNKING  
S: 250-AUTH DIGEST-MD5 CRAM-MD5 PLAIN EXTERNAL  
S: 250-DSN  
S: 250-SIZE 10240000  
S: 250 ENHANCEDSTATUSCODES  
M: MAIL FROM:<bob.ar@example.org> BODY=BINARY  
S: 250 2.5.0 Address Ok.  
M: RCPT TO:<foo@example.net>  
S: 250 2.1.5 foo@example.net OK.  
M: BDAT 475  
M: Message-ID: <419399E1.6000505@caernarfon.example.org>  
M: Date: Thu, 12 Nov 2004 16:57:05 +0000  
M: From: Bob Ar <bar@example.org>  
M: MIME-Version: 1.0  
M: To: foo@example.net  
M: Subject: About our holiday trip  
M: Content-Type: multipart/mixed;  
M:     boundary="-----030308070208000400050907"  
M:  
M: -----030308070208000400050907  
M: Content-Type: text/plain; format=flowed  
M:  
M: Our travel agent has sent the updated schedule.  
M:  
M: Cheers,  
M: Bob  
M: -----030308070208000400050907  
S: 250 2.5.0 OK  
M: BURL imap://bob.ar@example.org/INBOX;  
   UIDVALIDITY=385759045/;UID=25627/;Section=2.MIME;  
   expire=2006-10-28T23:59:59Z;urlauth=submit+bob.ar:  
   internal:A0DEAD473744909de610943775f9BEEF  
S: 250 2.5.0 OK  
M: BURL imap://bob.ar@example.org/INBOX;

```

UIDVALIDITY=385759045/;UID=25627/;Section=2;
expire=2006-10-28T23:59:59Z;urlauth=submit+bob.ar:
internal:BEEFA0DEAD473744909de610943775f9
S: 250 2.5.0 OK
M: BDAT 44 LAST
M:
M: -----030308070208000400050907--

```

S: {to I} The mail Submission Server uses URLFETCH to fetch the pieces of the message to be sent. (See [SMTP-BURL] for details of the semantics and steps. The so-called "pawn-ticket" authorization mechanism uses a URI which contains its own authorization credentials.).

I: {to S} Returns the requested body parts.

The mail Submission Server opens an IMAP connection to the IMAP server:

```

I: * OK [CAPABILITY IMAP4REV1 STARTTLS NAMESPACE LITERAL+
    CATENATE URLAUTH UIDPLUS CONDSTORE IDLE] imap.example.com
    IMAP server ready
S: b000 STARTTLS
I: b000 Start TLS negotiation now
...TLS negotiation, if successful - subsequent data
    is encrypted...
S: b001 LOGIN submitserver secret
I: b001 OK submitserver logged in
S: b002 URLFETCH "imap://bob.ar@example.org/INBOX;
    UIDVALIDITY=385759045/;UID=25627/;Section=2.MIME;
    expire=2006-10-28T23:59:59Z;urlauth=submit+bob.ar:
    internal:A0DEAD473744909de610943775f9BEEF" "imap://
    bob.ar@example.org/INBOX;
    UIDVALIDITY=385759045/;UID=25627/;Section=2;
    expire=2006-10-28T23:59:59Z;urlauth=submit+bob.ar:
    internal:BEEFA0DEAD473744909de610943775f9"
I: * URLFETCH "imap://bob.ar@example.org/INBOX;
    UIDVALIDITY=385759045/;UID=25627/;Section=2.MIME;
    expire=2006-10-28T23:59:59Z;urlauth=submit+bob.ar:
    internal:A0DEAD473744909de610943775f9BEEF" {84}
...message section follows...
    "imap://bob.ar@example.org/INBOX;
    UIDVALIDITY=385759045/;UID=25627/;Section=2;
    expire=2006-10-28T23:59:59Z;urlauth=submit+bob.ar:
    internal:BEEFA0DEAD473744909de610943775f9" {15065}
...message section follows...
I: b002 OK URLFETCH completed
S: b003 LOGOUT
I: * BYE See you later

```

I: b003 OK Logout successful

Note that if data confidentiality is not required, the mail Submission Server may omit the STARTTLS command before issuing the LOGIN command.

S: {to M} Submission Server assembles the complete message; if the assembly succeeds, it acknowledges acceptance of the message by sending 250 response to the last BDAT command:

S: 250 2.5.0 Ok, message accepted.

M: {to I} The client marks the message containing the forwarded attachment on the IMAP server.

M: B0053 UID STORE 25627 +FLAGS.SILENT (\$Forwarded)

I: \* 215 FETCH (UID 25627 MODSEQ (12121231000))

I: B0053 OK STORE completed

Note: the UID STORE command shown above will only work if the marked message is in the currently selected mailbox; otherwise, it requires a SELECT. As in the previous example, this command is not critical, and can be omitted. The untagged FETCH response is due to [IMAP-CONDSTORE]. The \$Forwarded IMAP keyword is described in Section 5.9.

## 8.5. Security Considerations for Pawn-Tickets

The so-called "pawn-ticket" authorization mechanism uses a URI, which contains its own authorization credentials using [IMAP-URLAUTH]. The advantage of this mechanism is that the SMTP submit [SUBMIT] server cannot access any data on the [IMAP-URLAUTH] server without a "pawn-ticket" created by the client.

The "pawn-ticket" grants access only to the specific data that the SMTP submit [SUBMIT] server is authorized to access, can be revoked by the client, and can have a time-limited validity.

## 8.6. Copies of Sent Messages: The fcc Problem

The "fcc problem" refers to delivering a copy of a message to a mailbox, or "file carbon copy". By far, the most common case of fcc is a client leaving a copy of outgoing mail in a "Sent Mail" or "Outbox" mailbox.

In the traditional strategy, the MUA duplicates the effort spent in transmitting to the MSA by writing the message to the fcc destination in a separate step. This may be a write to a local disk file or an

APPEND to a mailbox on an IMAP server. The latter is one of the "repetitive network data transmissions" that represents the "problem" aspect of the "fcc problem".

The BURL [SMTP-BURL] extension can be used to eliminate the additional transmission. The final message is uploaded to the mailbox designed for outgoing mail by the APPEND command of [IMAP]. Note that when doing so, the client ought to use the \$SubmitPending and \$Submitted IMAP keywords described in Section 5.10. Also note that APPEND, including when enhanced by [IMAP-CATENATE], can only create a single copy of the message and this is only of use on the server that stages the outgoing message for submission. Additional copies of the message on the same server can be created by using one or more COPY commands.

## 9. Deployment Considerations

Deployment considerations are discussed extensively in [LEMONADE-DEPLOYMENTS].

## 10. Security Considerations

Implementors are advised to examine the security considerations of all the referenced documents. This section merely highlights these, and advises implementors on specific issues relating to the combination of extensions.

Security considerations on Lemonade "forward without download" are discussed throughout Section 8. Additional security considerations can be found in [IMAP], [SUBMIT], [SIEVE], and other documents describing other SMTP, IMAP, and Sieve extension comprising the Lemonade Profile.

Note that the mandatory-to-implement authentication mechanism for SMTP submission is described in [SMTP-AUTH]. The mandatory-to-implement authentication mechanism for IMAP is described in [IMAP].

### 10.1. Confidentiality Protection of Submitted Messages

When clients submit new messages, link protection such as [TLS] guards against an eavesdropper seeing the contents of the submitted message. It is worth noting, however, that even if TLS is not used, the security risks are no worse if BURL is used to reference the text than if the text is submitted directly. If BURL is not used, an eavesdropper gains access to the full text of the message. If BURL is used, the eavesdropper may or may not be able to gain such access,

depending on the form of BURL used. For example, some forms restrict use of the URL to an entity authorized as a Submission Server or a specific user.

## 10.2. TLS

When Lemonade clients use the BURL extension for mail submission, an extension that requires sending a URLAUTH token to the mail Submission Server, such a token should be protected from interception to avoid a replay attack that may disclose the contents of the message to an attacker. [TLS]-based encryption of both the IMAP session that issues GENURLAUTH and the mail submission path will provide protection against this attack.

Lemonade-compliant mail Submission Servers SHOULD use TLS-protected IMAP connections when fetching message content using the URLAUTH token provided by the Lemonade client.

When a client uses SMTP STARTTLS to send a BURL command that references non-public information, there is a user expectation that the entire message content will be treated confidentially. To meet this expectation, the message Submission Server SHOULD use STARTTLS or a mechanism providing equivalent data confidentiality when fetching the content referenced by that URL.

## 10.3. Additional Extensions and Deployment Models

This specification provides no additional security measures beyond those in the referenced Internet Mail and Lemonade documents.

We note, however, the security risks associated with:

- o Outband notifications
- o Server configuration by client
- o Client configuration by server
- o Presence of proxy servers
- o Presence of servers as intermediaries
- o In general, the deployment models considered by OMA MEM that are not conventional IETF deployment models
- o Measures to address a perceived need to traverse firewalls and mobile network intermediaries

Deployments that provide these additional services or operate in these environments need to consult the security considerations for the relevant standards and organizational security practices.

## 11. IANA Considerations

IMAP4 capabilities are registered by IETF Review, as defined in [RFC5226]. This document defines the URL-PARTIAL IMAP capability (Section 5.7.1). IANA added this extension to the IANA IMAP Capability registry.

## 12. Changes since RFC 4550

When compared to RFC 4550, this document adds the following additional requirements on a Lemonade compliant IMAP server:

IMAP extensions: BINARY, COMPRESS=DEFLATE, CONTEXT=SEARCH, CONTEXT=SORT, CONVERT, ENABLE, ESEARCH, ESORT, I18NLEVEL=1, NOTIFY, QRESYNC, SASL-IR, SORT, URL-PARTIAL;

IMAP keywords: \$SubmitPending, \$Submitted.

Other requirements: Require any Lemonade compliant IMAP server to support the CAPABILITY response code.

When compared to RFC 4550, this document adds the following new requirements on a Lemonade compliant Message Delivery Agents:

Support for the Sieve filtering language, together with the following Sieve extensions:

ENOTIFY, IMAP4FLAGS, RELATIONAL, VACATION, VARIABLES, comparator-  
i;unicode-casemap.

When compared to RFC 4550, this document recommends use of the DEFLATE compression method for TLS. All other requirements remain the same.

Additionally, the following changes/improvements were done to RFC 4550 (the list might be incomplete):

A new section with some additional requirements on Lemonade Mail User Agents was added, in particular they are required to support Format=flowed parameter to the text/plain media type.

Usage of the \$Forwarded IMAP keyword was clarified.

Forward-without-download examples were corrected and extended.

Added a new section describing in-band and out-of-band notifications from a Lemonade compliant mailstore.

### 13. Acknowledgements

The editors acknowledge and appreciate the work and comments of the IETF Lemonade working group and the OMA MEM working group.

In particular, the editors would like to thank Eric Burger, Glenn Parsons, Randall Gellens, Filip Navara, Zoltan Ordogh, Greg Vaudreuil, and Fan Xiaohui for their comments and reviews.

### 14. References

#### 14.1. Normative References

- [FLOWED] Gellens, R., "The Text/Plain Format and DelSp Parameters", RFC 3676, February 2004.
- [IMAP] Crispin, M., "INTERNET MESSAGE ACCESS PROTOCOL - VERSION 4rev1", RFC 3501, March 2003.
- [IMAP-BINARY] Nerenberg, L., "IMAP4 Binary Content Extension", RFC 3516, April 2003.
- [IMAP-CATENATE] Resnick, P., "Internet Message Access Protocol (IMAP) CATENATE Extension", RFC 4469, April 2006.
- [IMAP-COMPRESS] Gulbrandsen, A., "The IMAP COMPRESS Extension", RFC 4978, August 2007.
- [IMAP-CONDSTORE] Melnikov, A. and S. Hole, "IMAP Extension for Conditional STORE Operation or Quick Flag Changes Resynchronization", RFC 4551, June 2006.
- [IMAP-CONTEXT] Cridland, D. and C. King, "Contexts for IMAP4", RFC 5267, July 2008.
- [IMAP-CONVERT] Melnikov, A. and P. Coates, "Internet Message Access Protocol - CONVERT Extension", RFC 5259, July 2008.

**[IMAP-ENABLE]**

Gulbrandsen, A. and A. Melnikov, "The IMAP ENABLE Extension", RFC 5161, March 2008.

**[IMAP-ESEARCH]**

Melnikov, A. and D. Cridland, "IMAP4 Extension to SEARCH Command for Controlling What Kind of Information Is Returned", RFC 4731, November 2006.

**[IMAP-I18N]**

Newman, C., Gulbrandsen, A., and A. Melnikov, "Internet Message Access Protocol Internationalization", RFC 5255, June 2008.

**[IMAP-IDLE]**

Leiba, B., "IMAP4 IDLE command", RFC 2177, June 1997.

**[IMAP-LITERAL+]**

Myers, J., "IMAP4 non-synchronizing literals", RFC 2088, January 1997.

**[IMAP-NAMESPACE]**

Gahrns, M. and C. Newman, "IMAP4 Namespace", RFC 2342, May 1998.

**[IMAP-NOTIFY]**

Gulbrandsen, A., King, C., and A. Melnikov, "The IMAP NOTIFY Extension", RFC 5465, February 2009.

**[IMAP-QRESYNC]**

Melnikov, A., Cridland, D., and C. Wilson, "IMAP4 Extensions for Quick Mailbox Resynchronization", RFC 5162, March 2008.

**[IMAP-SASL-IR]**

Siemborski, R. and A. Gulbrandsen, "IMAP Extension for Simple Authentication and Security Layer (SASL) Initial Client Response", RFC 4959, September 2007.

**[IMAP-SORT]**

Crispin, M. and K. Murchison, "Internet Message Access Protocol - SORT and THREAD Extensions", RFC 5256, June 2008.

**[IMAP-UIDPLUS]**

Crispin, M., "Internet Message Access Protocol (IMAP) - UIDPLUS extension", RFC 4315, December 2005.



**[IMAP-URL]**

Melnikov, A. and C. Newman, "IMAP URL Scheme", RFC 5092, November 2007.

**[IMAP-URLAUTH]**

Crispin, M., "Internet Message Access Protocol (IMAP) - URLAUTH Extension", RFC 4467, May 2006.

**[KEYWORDS]**

Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

**[SIEVE]**

Guenther, P. and T. Showalter, "Sieve: An Email Filtering Language", RFC 5228, January 2008.

**[SIEVE-IMAP4FLAGS]**

Melnikov, A., "Sieve Email Filtering: Imap4flags Extension", RFC 5232, January 2008.

**[SIEVE-NOTIFY]**

Melnikov, A., Leiba, B., Segmuller, W., and T. Martin, "Sieve Email Filtering: Extension for Notifications", RFC 5435, January 2009.

**[SIEVE-RELATIONAL]**

Segmuller, W. and B. Leiba, "Sieve Email Filtering: Relational Extension", RFC 5231, January 2008.

**[SIEVE-VACATION]**

Showalter, T. and N. Freed, "Sieve Email Filtering: Vacation Extension", RFC 5230, January 2008.

**[SIEVE-VARIABLES]**

Homme, K., "Sieve Email Filtering: Variables Extension", RFC 5229, January 2008.

**[SMTP-8BITMIME]**

Klensin, J., Freed, N., Rose, M., Stefferud, E., and D. Crocker, "SMTP Service Extension for 8bit-MIMEtransport", RFC 1652, July 1994.

**[SMTP-AUTH]**

Siemborski, R. and A. Melnikov, "SMTP Service Extension for Authentication", RFC 4954, July 2007.

**[SMTP-BINARYMIME]**

Vaudreuil, G., "SMTP Service Extensions for Transmission of Large and Binary MIME Messages", RFC 3030, December 2000.

**[SMTP-BURL]**

Newman, C., "Message Submission BURL Extension", RFC 4468, May 2006.

**[SMTP-DSN]**

Moore, K., "Simple Mail Transfer Protocol (SMTP) Service Extension for Delivery Status Notifications (DSNs)", RFC 3461, January 2003.

**[SMTP-PIPELINING]**

Freed, N., "SMTP Service Extension for Command Pipelining", STD 60, RFC 2920, September 2000.

**[SMTP-SIZE]**

Klensin, J., Freed, N., and K. Moore, "SMTP Service Extension for Message Size Declaration", STD 10, RFC 1870, November 1995.

**[SMTP-STATUSCODES]**

Freed, N., "SMTP Service Extension for Returning Enhanced Error Codes", RFC 2034, October 1996.

**[SMTP-TLS]**

Hoffman, P., "SMTP Service Extension for Secure SMTP over the Transport Layer Security", RFC 3207, February 2002.

**[SUBMIT]**

Gellens, R. and J. Klensin, "Message Submission for Mail", RFC 4409, April 2006.

**[TLS]**

Dierks, T. and E. Rescorla, "The Transport Layer Security (TLS) Protocol Version 1.2", RFC 5246, August 2008.

**[TLS-COMP]**

Hollenbeck, S., "Transport Layer Security Protocol Compression Methods", RFC 3749, May 2004.

**[UNICODE-CASEMAP]**

Crispin, M., "i;unicode-casemap - Simple Unicode Collation Algorithm", RFC 5051, October 2007.

## 14.2. Informative References

- [ESMTP] Klensin, J., "Simple Mail Transfer Protocol", RFC 5321, October 2008.
- [Err1807] RFC Errata, Errata ID 1807, RFC 5162, <<http://www.rfc-editor.org>>.
- [Err1808] RFC Errata, Errata ID 1808, RFC 5162, <<http://www.rfc-editor.org>>.
- [Err1809] RFC Errata, Errata ID 1809, RFC 5162, <<http://www.rfc-editor.org>>.
- [Err1810] RFC Errata, Errata ID 1810, RFC 5162, <<http://www.rfc-editor.org>>.
- [FINGER-HACK]  
Gellens, R., "Simple New Mail Notification", RFC 4146, August 2005.
- [IMAP-FILTERS]  
Melnikov, A. and C. King, "IMAP4 Extension for Named Searches (Filters)", RFC 5466, February 2009.
- [IMAP-SYNC-HOWTO]  
Melnikov, A., "Synchronization Operations for Disconnected IMAP4 Clients", RFC 4549, June 2006.
- [LEMONADE-ARCH]  
Burger, E. and G. Parsons, "LEMONADE Architecture - Supporting Open Mobile Alliance (OMA) Mobile Email (MEM) Using Internet Mail", RFC 5442, March 2009.
- [LEMONADE-DEPLOYMENTS]  
Gellens, R., "Deployment Considerations for Lemonade-Compliant Mobile Email", BCP 143, RFC 5383, October 2008.
- [LEMONADE-NOTIFICATIONS]  
Gellens, R., Ed., "Lemonade Notifications Architecture", RFC 5551, August 2009.
- [MANAGESIEVE]  
Melnikov, A. and T. Martin, "A Protocol for Remotely Managing Sieve Scripts", Work in Progress, September 2008.

**[METADATA]**

Daboo, C., "The IMAP METADATA Extension", RFC 5464, February 2009.

**[OMA-EMN]** Open Mobile Alliance, "Open Mobile Alliance Email Notification Version 1.0", OMA [http://www.openmobilealliance.org/Technical/release\\_program/emn\\_v10.aspx](http://www.openmobilealliance.org/Technical/release_program/emn_v10.aspx), October 2007.

**[OMA-MEM-ARCH]**

Open Mobile Alliance, "Mobile Email Architecture Document", OMA (Work in Progress), <http://www.openmobilealliance.org/>, October 2005.

**[OMA-MEM-REQ]**

Open Mobile Alliance, "Mobile Email Requirements Document", OMA [http://www.openmobilealliance.org/release\\_program/docs/RD/OMA-RD-MobileEmail-V1\\_0\\_20051018-C.pdf](http://www.openmobilealliance.org/release_program/docs/RD/OMA-RD-MobileEmail-V1_0_20051018-C.pdf), Oct 2005.

**[RFC5068]** Hutzler, C., Crocker, D., Resnick, P., Allman, E., and T. Finch, "Email Submission Operations: Access and Accountability Requirements", BCP 134, RFC 5068, November 2007.

**[RFC5226]** Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 5226, May 2008.

**[RFC5598]** Crocker, D., "Internet Mail Architecture", RFC 5598, July 2009.

## Appendix A. Errata

Errata ID: 1807 [Err1807]

Status: Verified

Type: Technical

Reported By: Timo Sirainen

Date Reported: 2009-07-14

Verifier Name: Alexey Melnikov

Date Verified: 2009-07-18

Section 1 says:

It should say:

Once a "CONDSTORE enabling command" is issued by the client, the server MUST automatically include both UID and mod-sequence data in all subsequent untagged FETCH responses (until the connection is closed), whether they were caused by a regular STORE/UID STORE, a STORE/UID STORE with UNCHANGEDSINCE modifier, or an external agent. Note that this rule doesn't affect untagged FETCH responses caused by a FETCH command that doesn't include UID and/or MODSEQ FETCH data item, or UID FETCH without the MODSEQ FETCH data item.

Notes:

Rationale:

It's very difficult for clients to make use of unsolicited FETCH responses without the UID field. This is made even worse by the text that says "servers SHOULD NOT send UIDs for previously expunged messages [in VANISHED replies]". Since it's not a MUST NOT, a conversation with an RFC compliant server could be for example:

```
A1 NOOP
* 0 EXISTS
A1 OK
A2 NOOP
* 10 EXISTS
* VANISHED 1000:2000
* 3 FETCH (FLAGS (\Seen) MODSEQ (14749))
* 5 FETCH (FLAGS (\Seen) MODSEQ (14749))
* VANISHED 2000:3000
A2 OK NOOP Completed
```

The client couldn't do anything with the information from FETCH replies, because it can't know what messages they refer to.

Errata ID: 1808 [Err1808]

Status: Verified  
Type: Technical

Reported By: Timo Sirainen  
Date Reported: 2009-07-14  
Verifier Name: Alexey Melnikov  
Date Verified: 2009-07-18

Section 3.4 says:

If at least one message got expunged, the server MUST send the updated per-mailbox modification sequence using the HIGHESTMODSEQ response code (defined in [CONDSTORE]) in the tagged OK response.

Example: C: A202 CLOSE  
S: A202 OK [HIGHESTMODSEQ 20010715194045319] done

It should say:

The server MUST NOT send the updated per-mailbox modification sequence using the HIGHESTMODSEQ response code (defined in [CONDSTORE]) in the tagged OK response, as this might cause loss of synchronization on the client.

Example: C: A202 CLOSE  
S: A202 OK done

Notes:

Rationale:

The HIGHESTMODSEQ can't be used reliably unless server sends to client all changes done by other clients. Even then it's difficult for both clients and servers to implement this. For example:

C1: 2 STORE 1 +FLAGS.SILENT \Deleted  
S1: \* 1 FETCH (MODSEQ 1)  
S1: 2 OK

C2: 1 STORE 2 +FLAGS.SILENT \Deleted  
S1: \* 2 FETCH (MODSEQ 2)  
S2: 1 OK

C1: 3 CLOSE  
S1: 3 [HIGHESTMODSEQ 3]

The client probably thought that only message 1 was expunged, so it doesn't register the second expunge. And it probably never will if it uses QRESYNC to find out only about new expunges.

And even worse example would be if the second client had also removed the \Deleted flag from message 1. Then the first client would have registered wrong message to be expunged.

Errata ID: 1809 [Err1809]

Status: Verified

Type: Technical

Reported By: Timo Sirainen

Date Reported: 2009-07-14

Verifier Name: Alexey Melnikov

Date Verified: 2009-07-18

Section 5 says:

After completing a full synchronization, the client MUST also take note of any unsolicited MODSEQ FETCH data items received from the server. Whenever the client receives a tagged response to a command, it calculates the highest value among all MODSEQ FETCH data items received since the last tagged response. If this value is bigger than the client's copy of the HIGHESTMODSEQ value, then the client MUST use this value as its new HIGHESTMODSEQ value.

Note: It is not safe to update the client's copy of the HIGHESTMODSEQ value with a MODSEQ FETCH data item value as soon as it is received because servers are not required to send MODSEQ FETCH data items in increasing modsequence order. This can lead to the client missing some changes in case of connectivity loss.

It should say:

After completing a full synchronization, the client MUST also take note of any unsolicited MODSEQ FETCH data items and HIGHESTMODSEQ response codes received from the server. Whenever the client receives a tagged response to a command, it checks the received unsolicited responses to calculate the new HIGHESTMODSEQ value. If the HIGHESTMODSEQ response code is received, the client MUST use it even if it has seen higher mod-sequences. Otherwise, the client calculates the highest value among all MODSEQ FETCH data items received since the last tagged response. If this value is bigger than the client's copy of the HIGHESTMODSEQ value, then the client MUST use this value as its new HIGHESTMODSEQ value.

Example:

```
C: A1 STORE 1:2 (UNCHANGEDSINCE 96) +FLAGS.SILENT \Seen
S: * 1 FETCH (UID 6 MODSEQ (103))
S: * 2 FETCH (UID 7 MODSEQ (101))
S: * OK [HIGHESTMODSEQ 99] VANISHED reply with
    MODSEQ 100 is delayed
S: A1 OK [MODIFIED 3] done

C: A2 STORE 3 +FLAGS.SILENT \Seen
S: * 3 FETCH (UID 8 MODSEQ (104))
S: A2 OK [HIGHESTMODSEQ 99] Still delaying VANISHED

C: A3 NOOP
S: * VANISHED 8
S: A3 OK [HIGHESTMODSEQ 104] done
```

Note: It is not safe to update the client's copy of the HIGHESTMODSEQ value with a MODSEQ FETCH data item value as soon as it is received because servers are not required to send MODSEQ FETCH data items in increasing modsequence order. Some commands may also delay EXPUNGE (or VANISHED) replies with smaller mod-sequences. These can lead to the client missing some changes in case of connectivity loss.

Notes:

Rationale:

Otherwise clients could lose changes in case of connectivity loss.

Errata ID: 1810 [Err1810]

Status: Verified

Type: Technical

Reported By: Timo Sirainen

Date Reported: 2009-07-14

Verifier Name: Alexey Melnikov

Date Verified: 2009-07-18

Section 1 says:

It should say:

Server implementing QRESYNC MUST send untagged events to client in a way that client doesn't lose any changes in case of connectivity loss. In particular this means that if server sends MODSEQ FETCH data items while EXPUNGE (or VANISHED) replies with lower mod-sequences are being delayed, the server MUST send HIGHESTMODSEQ response code with a lower value than the EXPUNGE's mod-sequence. See example in section 5.



**Notes:**

This is related to the other errata in section 5, which describes what the client's behavior should be. This describes what the server's behavior should be. Would have been nice to put them into the same section, but that probably would require larger changes.

**Authors' Addresses**

Dave Cridland (editor)  
Isode Limited  
5 Castle Business Village  
36 Station Road  
Hampton, Middlesex TW12 2BX  
UK

EMail: dave.cridland@isode.com

Alexey Melnikov (editor)  
Isode Limited  
5 Castle Business Village  
36 Station Road  
Hampton, Middlesex TW12 2BX  
UK

EMail: Alexey.Melnikov@isode.com

Stephane H. Maes (editor)  
Oracle  
MS 40p634, 500 Oracle Parkway  
Redwood Shores, CA 94539  
USA

Phone: +1-203-300-7786  
EMail: stephane.maes@oracle.com