

# Internet Mail and Messaging Protocol

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## Contents

<b>1</b>	<b>Abstract</b>	<b>4</b>
<b>2</b>	<b>About this draft</b>	<b>4</b>
2.1	Conventions . . . . .	4
2.2	Terminology . . . . .	4
2.3	Design Considerations . . . . .	4
2.4	Open Questions / To Do . . . . .	5
<b>3</b>	<b>Features</b>	<b>5</b>
3.1	IMIDs instead of E-Mail Addresses . . . . .	5
3.2	Central storage (IMAP4) . . . . .	5
3.2.1	...and Shared storage . . . . .	5
3.2.2	...or Temporary storage (POP3) . . . . .	6
3.2.3	...or Push messages . . . . .	6
3.3	Message Delivery (SMTP) . . . . .	6
3.4	Publish-Subscribe Events (XMPP) . . . . .	6
3.4.1	Publishing Events . . . . .	7
3.5	Intrinsic Security . . . . .	7
3.5.1	No Plain-text passwords . . . . .	8
3.6	Pipelining On-Demand . . . . .	8
3.7	Commands . . . . .	9
3.8	Responses . . . . .	9

3.9	Push Messages . . . . .	10
3.10	Blacklisting: In Case Of Spam . . . . .	10
<b>4</b>	<b>The protocol</b>	<b>10</b>
4.1	IMIDs . . . . .	10
4.2	Using JSON . . . . .	11
4.3	The Protocol States . . . . .	11
4.4	Message Transport . . . . .	12
4.4.1	Over TCP . . . . .	12
4.4.2	Over XMPP . . . . .	12
<b>5</b>	<b>Messages</b>	<b>13</b>
5.1	Representation . . . . .	13
5.2	Encapsulation . . . . .	14
5.3	Metadata . . . . .	14
5.3.1	Outer Envelope . . . . .	14
5.3.2	Inner Envelope . . . . .	14
5.3.3	Message Content . . . . .	14
5.4	Requesting compression . . . . .	14
<b>6</b>	<b>Commands and Responses</b>	<b>15</b>
6.1	Commands . . . . .	15
6.2	Responses . . . . .	15
6.3	Examples . . . . .	15
6.3.1	Upgrading a connection . . . . .	15
6.3.2	Authentication . . . . .	16
6.3.3	Reading Mail . . . . .	16
<b>7</b>	<b>Supported Commands</b>	<b>17</b>
7.1	AUTH command . . . . .	17
7.1.1	AUTH COOKIE command . . . . .	17
7.1.2	AUTH SECRET command . . . . .	18
7.2	DATA command . . . . .	18

7.3	DELIVER command . . . . .	18
7.4	DONE command . . . . .	19
7.5	MBOX command . . . . .	19
7.5.1	MBOX CHECK command . . . . .	19
7.5.2	MBOX FETCH command . . . . .	19
7.5.3	MBOX INDEX command . . . . .	19
7.6	PUSH command . . . . .	19
7.7	PUBLISH command . . . . .	19
7.8	SUBSCRIBE command . . . . .	19
7.9	SET command . . . . .	20
7.9.1	SET GLOBAL command . . . . .	20
7.10	UNSUBSCRIBE command . . . . .	20
<b>8</b>	<b>List of Status Codes</b>	<b>20</b>
8.1	1xx codes . . . . .	20
8.2	2xx codes . . . . .	20
8.3	3xx codes . . . . .	20

# 1 Abstract

The protocols that power Internet mail today are ancient, devised back in the days long before security was a serious issue they lack in a number of aspects, mainly transport encryption and digital signing/encryption which have been added later as an afterthought.

This document proposes a new standard for sending and receiving e-mail on the Internet; IMMP - Internet Mail and Messaging Protocol.

Please **do note** that despite it's name, this protocol does not intend to replace XMPP as a messaging protocol.

This draft is maintained by NoccyLabs on GitHub:

<http://github.com/noccylibs/imp-spec/>

# 2 About this draft

## 2.1 Conventions

- The term *e-mail* is used throughout this document to reference the implementation specified in this draft unless otherwise specified.

*CV* Maybe it would be appropriate to use *e-mail* for the old-school mail, and *i-mail* for “Internet mail”? This would also indicate the paradigm change introduced by this protocol.

- In examples, **S:** is used to indicate a response from the server while **C:** indicates data sent by the client.

## 2.2 Terminology

- *mailbox* is a storage location for folders and messages.
- *account* is a primary mailbox associated with login credentials.
- *message* is one or more pieces of *data* with at least one *content* part.
- *data* is a message chunk, such as the content in HTML or Markdown format, an image or an attachment.

## 2.3 Design Considerations

The following points are key to the design of the protocol:

- All transport of messages or user information requires transport encryption.

- The protocol must be plain-text and easy to follow.
- The protocol must fill the role of the three main protocols in use today, namely SMTP for transport, and POP3/IMAP for retrieval/storage.
- The protocol must not be immediately backward compatible with the previously mentioned protocols, for the sole reason of not compromising its integrity by allowing one link of the chain to fall back on insecure transports.
- The protocol should provide a transport for high-importance push-events from previously approved source.
- The protocol should authenticate originating domains, while allowing the sender to remain anonymous.

## 2.4 Open Questions / To Do

- Are we doing everything possible to ensure transport security between endpoints? Short of using threats there is nothing we can do to make sure that a message is only ready by the recipient.
- Are we doing everything possible to ensure security for the user? Are we covering any possible exploitation paths that we are creating?

*CV* It would make sense to include PGP/GPG-support natively in the specification as a requirements before transporting the message.

## 3 Features

### 3.1 IMIDs instead of E-Mail Addresses

IMIDs are much more flexible, and can use a uniform URI system to reference mailboxes, mailing lists, published nodes etc.

### 3.2 Central storage (IMAP4)

#### 3.2.1 ...and Shared storage

Several users belonging to a group could share a mailbox, f.ex. `helpdesk@domain.com`, with each of them having their own mailboxes as `helpdesk/alice@domain.com` and `helpdesk/bob@domain.com`. The accounts can thus link to more than one mailbox.

### **3.2.2 ...or Temporary storage (POP3)**

For automated services, the ability to download messages in a fashion similar to POP3 this would be beneficial for server storage space as well as bandwidth and management costs.

### **3.2.3 ...or Push messages**

Sometimes, the purpose of a message is just to request a confirmation, or to notify the success or failure of a process. In those cases it is reasonable to bypass the inbox, and for that the message can be sent as a push message.

#### **3.2.3.1 Scenario 1. E-mail configuration**

1. Alice goes to Website.com, and registers a new account.
2. In order to validate Alice's e-mail address Website.com sends a push-notification to Alice's address containing a configuration link.
3. Alice receives this notification, and can click "Confirm" in the desktop notification she is presented with.

#### **3.2.3.2 Scenario 2. Notifications**

- Servers, SANs, NASes, and other network devices often report conditions and events by mail. With IMMP these could be handled separately from other business correspondence.

## **3.3 Message Delivery (SMTP)**

The same port and protocol that is used to read and manage the mailboxes is also used to deliver messages to mailboxes. This provides a huge advantage in configuration and management.

Additionally, filtering can be implemented as is currently for SMTP, implementing heuristic or other analysis of messages.

## **3.4 Publish-Subscribe Events (XMPP)**

In this concept borrowed from XMPP, messages and push-notifications can be subscribed to in a fashion managed by the user. The user can then manage his or her subscriptions as desired, and easily unsubscribe from undesired mailing lists.

For this reason, a subscription SHOULD BE able to be initiated via a URI handler such as this one:

`immp://newsletter/updates@website.com?subscribe`

Each subscription is assigned a unique identifier, and metadata is fetched as the subscription is created. This allows the user to easily get an overview of any current subscriptions.

UUID	IMID <sup>1</sup>	Node	Title
...	newsletter@website.com	newsletter/updates	Updates from Website.com

### 3.4.1 Publishing Events

When a website wishes to reach out to its subscribers it turns the stake. The message is pushed to each of the subscribers, which confirm its origin and the presence of the subscription, thus defeating a bit of unsolicited e-mailing by flagging the real ones.

```
C:  PUSH TO noccy@noccyllabs.info FROM newsletter@website.com/updates +IMPORTANT
S:
```

## 3.5 Intrinsic Security

Encryption is an integral part of the protocol, as it does not under any circumstances allow any information exchange to take place before the session has been secured.

The session begins by the server indicating what methods it can use to upgrade the connections.

The proposed methods are:

- SSLv3
- TLS

The key fingerprints should be compared to previously seen ones when upgrading the connection. Messages that are flagged as **+SECURE** MUST NOT be delivered over a connection where the fingerprint failed. The administrator always be notified, and the server should retry delivery in 5 minutes and then according to a defined schedule.

---

<sup>1</sup>Internet Messaging ID

### 3.5.1 No Plain-text passwords

Passwords MUST BE saved using the key derivation algorithm specified in this draft. The output from the KDA is the effective password for the account.

Upon the client requesting authentication using a shared secret (the generated password) the server sends over two nounces, that are used by both the client and the server to calculate a key. The client sends its calculated key to the server, and the server compares the key. If the keys match, the user is logged in.

This way plain-text passwords are never transferred in the clear, and are only used for key derivation.

**CV:** This lacks in several aspects; first of all the passwords can be compromised and used to authenticate as the user. Better would be to use one of the nonce values as the salt, and have the user salt his copy as ordered by the server. Another option would be to fall back on a simpler scheme that allows for server-side hashed passwords.

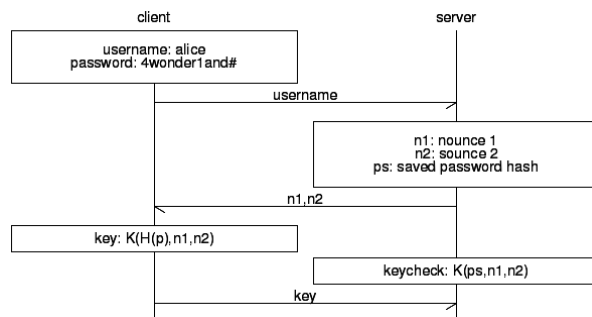


Figure 1: Authentication with Shared Secret

For **IMMP 1.0**  $H$  and  $K$  are defined as:

- $H(p)$  is the key derivation algorithm.
- $K(h,n1,n2)$  is the key generation algorithm that takes the password hash  $h$ , concatenated with  $n1$  and  $n2$  and calculates the sha1 sum of the full string.

## 3.6 Pipelining On-Demand

Any command can be pipelined, thus allowing for example several attachments to be added at the same time issuing `AS xxxx DATA ...` rather than just `DATA ...`

By chaining commands using semicolons, it would be possible to initiate several downloads at once, each in its own pipeline.



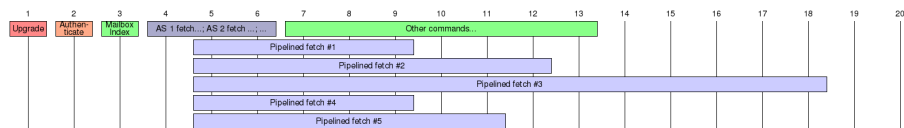


Figure 2: Pipelined session

### 3.7 Commands

Commands come in the form of one or more keywords, followed by zero or more parameters or switches:

```

AUTHENTICATE COOKIE cacabeefcacabad0 otherdomain.com
|
|
AUTHENTICATE SECRET noccy@noccylibs.info
|
|-----'
|-----'
Keywords Parameters Switches
|
|
AS beef MBOX FETCH /inbox#9507ce26-d34e-41cb-9f14-4eeff943e25e +JSON -READ
|
Pipeline ID

```

- Keywords are written in **CAPITAL LETTERS** in this document but the parsers **SHOULD NOT** be case sensitive when parsing keywords.
- Words in lower case should be replaced with the appropriate values.
- Quoted strings should be used verbatim.
- Parameters only have to be quoted if they contain spaces.
- Switches enable or disable a certain behavior of the command.
- Pipelines can be created by prefixing the keyword **AS** followed by the desired pipeline ID to use. All replies for this pipeline will have this ID followed by a colon prefixed to their status codes.

### 3.8 Responses

```

[ pipeline ": " ] status-code ["-"] " " message "\n"
|
|
|
|-----'-- Ends with newline
|
|-----'-- The message
|
|-----'----- Dash for continuation
|
|-----'----- The numeric status code
|-----'----- The pipeline ID as defined with "AS"

```

### 3.9 Push Messages

Push-messages place a central role in IMMP. E-mail has become the current provider of web-centered push-notifications, albeit its shortcomings and quirks. IMMP aims to fix this problem by allowing the transport of both messages and notifications.

Notifications here are simplified messages, with the body reduced to a single data block.

### 3.10 Blacklisting: In Case Of Spam

## 4 The protocol

### 4.1 IMIDs

IMID stands for Internet Mail (or Messaging) ID. Unlike e-mail addresses, IMIDs can have sub-nodes. For example:

```
domain.com
|--helpdesk@domain.com
|   |--helpdesk/alice@domain.com
|   '--helpdesk/bob@domain.com
'--admin@domain.com
```

In a similar fashion, you can direct messages to folders by appending a plus-sign followed by an existing folder name, for example:

```
alice@domain.com
|--INBOX
|   |--Receipts
|   '--Mailinglists
|--DRAFTS
|--SENT
'--JUNK
```

Alice could in this case get her mailing list subscriptions (the involuntary kind) directed to the `:inbox/Mailinglists` folder by providing her IMID as `alice+mailinglists@domain.com`. Servers implementing IMMP MUST respect the folder redirections, and websites supporting IMMP MUST respect them for any communication but ignore them for any (public) display. Default folders such as INBOX, DRAFTS, SENT and JUNK should be excluded from filtering.

Messages are references as `user@host/mailbox#messageid`:

```

alice@domain.com
|--INBOX
:   |-- 619b982c-f9b4-4263-bbc7-755afc7710dd
:   |-- 716e9a9e-7a48-4fd0-aa80-a1ac52f13cb2
:

```

In this example the full URI to the first message would be:

```
alice@domain.com/INBOX#619b982c-f9b4-4263-bbc7-755afc7710dd
```

As messages are identified using UUIDs the same message can exist in several mailbox folders at once.

## 4.2 Using JSON

JSON (JavaScript Object Notation) is a portable and well proven format for encapsulating structured data. Therefore it makes sense to include it in the protocol to make it easier for the clients to parse the data.

To enable JSON output, provide +JSON to a function that supports it. For example:

```

C:  FETCH alice@domain.com/INBOX#74d273d2-15c6-4420-81c1-1ae7edbcf3fe +JSON +PRETTY
S:  ??? Message follows (Pretty Print)
S:  {
S:    'envelope': {
S:      'from': 'bob@domain.com',
S:      'to': 'alice@domain.com',
S:      'received': {
S:      }
S:    },
S:    'parts': [
S:      { 'id': 'body', 'class': 'content', 'type': 'text/html', 'length': 1394, 'encoding': 'b
S:      { 'id': 'img_logo', 'type': 'image/png', 'length': 16354, 'encoding': 'base64', 'data
S:    ]
S:  }
S:  ...

```

## 4.3 The Protocol States

The protocol is divided up into a number of phases, or states, each allowing a specific subset of the supported commands.

1. **Unencrypted** - In this phase only commands to upgrade the transport are allowed. No messages can be delivered, and no authentication can be made.
2. **Unauthenticated** - In this phase only authentication commands (local users as well as remote cookies) or push-events are allowed.
3. **Local Authenticated** - can access mailboxes and send mail.
4. **Remotely Authenticated** - Can deliver mail to local mailboxes.

## 4.4 Message Transport

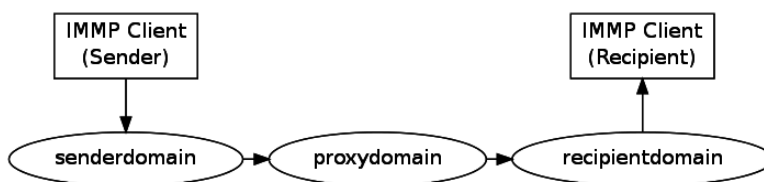


Figure 3: Message transport over the Internet

### 4.4.1 Over TCP

Over TCP it is suggested that IMMP use a port such as 1025, hinting at the old SMTP port number.

The TCP transport is the primary focus of this draft.

### 4.4.2 Over XMPP

This is a thrilling new use of XMPP as the middleman in delivering messages between two IMMP servers. XMPP already has a number of advantages over IMMP in this aspect, such as:

- **Persistent Connections** - Connections between XMPP-servers are in many cases persistent, especially when between a bigger XMPP service provider and another server. This could be great for IMMP as it would remove the overhead of establishing a connection and upgrading a session. The problem would be if a server upstream would lack encryption. This can however be solved by armoring the message with encryption before sending over an XMPP transport.
- **Encryption** - Encryption is well defined and readily used to secure XMPP connections already. This adds to the transport security.

## 5 Messages

Messages in IMMP generally consist of an outer envelope, an inner envelope and the message content. The outer envelope is always unencrypted (not considering the transport encryption) in the message. The inner envelope is encrypted with the receiving servers' public key to guarantee anonymity up until the point that the message is delivered to the recipient.

The outer envelope contains enough information to address the recipient's server. Imagine `alice@adomain.com` sends a message to `bob@bdomain.com`. In this case the outer envelope would be addressed to `bdomain.com` and signed with the private key of `adomain.com`. The inner envelope would be addressed to `bob@bdomain.com` and encrypted with the public key of `bdomain.com`.

The advantages of this solution includes:

1. Verification of the sending domain (which might be different than the delivering servers domain in the case of forwarding or proxies).
2. The final destination exposed in plain text does not point to an account or mailbox, but rather a domain. Only that domain can resolve the mailbox. Thus full anonymity of the sender and the recipient is ensured, even when relaying servers are involved.
3. Messages can not be easily tampered with, and even if they could the outer envelope does not provide enough information to cherry-pick a specific message without additional knowledge about the exact circumstances.

### 5.1 Representation

Message headers are stored as JSON format. Additional compression capabilities can be requested with the `SET` command.

```
{
  "envelope":{
    "immp-origin": "adomain.com",
    "immp-destination": "bdomain.com",
    "immp-recipient": [
      // ...base64-encoded inner envelope(s)...
    ],
    "received-from": {
      "domain": "mail.cdomain.com"
      "timestamp": "2013-10-29T02:40:28+01:00",
    },
    "received-via": [
      {
        "domain": "mail.cdomain.com",
```

```

        "timestamp": "2013-10-29T02:40:26+01:00"
    }
    // ...list of routing servers and timestamps
]
}
}

```

## 5.2 Encapsulation

*CV Something PGP-like to ensure only the sender and the recipient can read the message?*

## 5.3 Metadata

### 5.3.1 Outer Envelope

- Information on the origin domain
- Information on the destination domain
- Encrypted inner envelopes with information about the recipients
- Routing information (received from, via)

### 5.3.2 Inner Envelope

- Recipient information
- Additional metadata

### 5.3.3 Message Content

## 5.4 Requesting compression

Compression is controlled via the setting `compression`.

```

C: SET COMPRESSION
S: xxx-COMPRESSION=NONE
S: xxx NONE, GZIP, BZIP2, XZIP
C: SET COMPRESSION=GZIP
S: xxx COMPRESSION=GZIP

```

## 6.1 Commands

```

AUTHENTICATE COOKIE cacabeefcacabad0 otherdomain.com
      |               |               |
AUTHENTICATE SECRET noccy@noccylabs.info             |
      |               |-----'
      |               |
    Keywords         Parameters           Switches
      |               |               |-----'
AS beef MBOX FETCH /inbox#9507ce26-d34e-41cb-9f14-4eeff943e25e +JSON -READ
      |
    Pipeline ID

```

- Keywords are written in **CAPITAL LETTERS** in this document but the parsers SHOULD NOT be case sensitive when parsing keywords.
- Words in lower case should be replaced with the appropriate values.
- Quoted strings should be used verbatim.
- Parameters only have to be quoted if they contain spaces.
- Switches enable or disable a certain behavior of the command.
- Pipelines can be created by prefixing the keyword **AS** followed by the desired pipeline ID to use. All replies for this pipeline will have this ID followed by a colon prefixed to their status codes.

```
[ pipeline ": " ] status-code ["-"] " " message "\n"
```

				'-- Ends with newline
				'-- The message
				'----- Dash for continuation
				'----- The numeric status code
				'----- The pipeline ID as defined with "AS"

### 6.3.1 Upgrading a connection

15

```

S: 100- Please upgrade the connection to one of the following:
S: 100      TLS2 TLS3
S: 101 p=IMMP v=1.0 d=noccyllabs.info
C: UPGRADE TLS3
S: 204 Upgrading to TLS3.
      //
      Handshake
      //
      Encrypted Transport

```

### 6.3.2 Authentication

The authentication in IMMP is very different from previously implemented algorithms in existing mail protocols. In IMMP both servers and clients must authenticate. However, the servers authenticate by providing a cookie, thus providing verification of the origin domain.

```

C: AUTH COOKIE c2a9ff172404b21391cbaffbd9 mydomain.com
S: 301 Cookie authentication request initiated.
S: 210 Authentication accepted for mailer-daemon@mydomain.com

```

And authentication with a shared secret:

```

C: AUTH SECRET noccy@noccyllabs.info "Desktop Computer (Mail Client)"
S: 302 Shared secret authentication request initiated.
S: 303 n1=24c17bb6-11ef-4cfa-8c5c-440ceadc8431 n2=1381978910
C: AUTH RESPONSE 8843d7f92416211de9ebb963ff4ce28125932878
S: 210 Authentication accepted for noccy@noccyllabs.info

```

### 6.3.3 Reading Mail

```

C: MBOX CHECK /inbox:* +RECURSIVE
S: 240- /inbox:* u=24 t=1194
S: 240- /inbox/lists:* u=9 t=502
S: 240 /inbox/receipts:* u=1 t=105
C: AS f9ca MBOX INDEX /inbox::unread +JSON
C: AS ab34 MBOX INDEX /inbox/lists::unread +JSON
..

```

*Here pipelined transactions begin, we will follow the f9ca pipeline*

```

S: f9ca: 250- { "_id":"mydomain_com.4933a1ff", "from":"bob@mydomain.com", ... }
S: f9ca: 250

```



## 7 Supported Commands

The commands are designed to be obvious and easily readable.

- **AUTH COOKIE** - Authenticate the sender with a cookie
- **AUTH SECRET** - Authenticate a user with a shared secret
- **DATA** - Begins a data block transfer, for what is comparable to a MIME part of a multipart message.
- **DELIVER TO** - Deliver a message to a IMID
- **DONE** - Sends the message initiated with **DELIVER TO** and composed with **DATA**.
- **MBOX CHECK** - Check the status of a mailbox
- **MBOX FETCH** - Retrieve the contents of a mailbox, or a single message
- **MBOX INDEX** - Retrieve the index of a mailbox
- **PUSH** - Deliver a push-notification to an IMID
- **PUBLISH** - Publish to a node or create a new published node
- **SUBSCRIBE** - Subscribe to a published node or list the current subscriptions
- **SET** - Set a configuration value for the session
- **SET GLOBAL** - Set a configuration value for the account
- **UNSUBSCRIBE** - Unsubscribe to a published node

### 7.1 AUTH command

```
AUTH COOKIE <cookie> <issuer>
AUTH SECRET <account> [<devicename>]
```

Cookie authentication allows for the mailer daemon to authenticate the remote host. This authentication method is only available for domains. Users have to use Shared Secret authentication.

The purpose of Cookie authentication is not to authenticate the sender per se, but rather to authenticate the sending domain in order to be sure that the sending domain is who it says it is.

#### 7.1.1 AUTH COOKIE command

1. **alice@a.com** sends a message to **bob@b.com**.
2. **a.com** connects to **b.com** and generates a cookie which it sends over with the domain name.
3. **b.com** connects back to 'a.com' and verifies the cookie.
4. **a.com** authenticates the sending agent (note: not necessarily the sending user)

### 7.1.2 AUTH SECRET command

## 7.2 DATA command

Transfers a data block from the client to the server.

**Syntax:**

```
DATA [NAME name] [TYPE mime-type] [LENGTH size] [+BASE64] [+CONTENT]
```

**Parameters:**

- *name* - The name of the data block, f.ex. "image.jpg".
- *mime-type* - The mime-type of the data block, f.ex. "image/jpeg".
- LENGTH defines the length of the content if present.
- +BASE64 indicates that the data is base64-encoded.
- +CONTENT indicates that this is the content data block of the message.

## 7.3 DELIVER command

Deliver a message to a mailbox.

**Syntax:**

```
DELIVER TO account [+/-IMPORTANT] [+MULTIPART]
```

**Parameters:**

- *account* - The account to which to deliver. It does not have to be on the local system.
- +IMPORTANT indicates high priority, -IMPORTANT indicates low priority. Not specifying either indicates normal priority
- +MULTIPART indicates a multipart message.

**Notes:**

Upon receiving this command the server will announce it being ready to receive the message, or indicate an error if the message can not be delivered. The client should then go on and send the message as a data block:

```
C: DELIVER TO noccy+analytics@noccylibs.info +IMPORTANT +MULTIPART
S: 270 Ok, ready to deliver. Give me your DATA.
C: DATA logo.jpg TYPE image/jpeg +BASE64
S: 271 logo.jpg Saving part
```

```

::
Client sends base64-encoded data, ends it with two blank lines.
::
S: 272 logo.jpg Part saved
C: DATA index.html TYPE text/html LENGTH 1742 +CONTENT
S: 271 index.html Saving content part
::
S: 272 index.html Part saved
C: DONE
S:

```

## 7.4 DONE command

Indicates that the client is done sending data for the delivery

## 7.5 MBOX command

### 7.5.1 MBOX CHECK command

### 7.5.2 MBOX FETCH command

### 7.5.3 MBOX INDEX command

## 7.6 PUSH command

## 7.7 PUBLISH command

## 7.8 SUBSCRIBE command

Subscribe to a publisher, allowing the publisher to PUSH notifications. To unsubscribe use the UNSUBSCRIBE command.

### Syntax:

```

SUBSCRIBE TO feed@domain
SUBSCRIBE LIST

```

### Example:

```

C: SUBSCRIBE TO noccyllabs/imp-spec@github.com
S: 380 Subscribing to publisher
S: 280 Subscribed to: Notifications for noccyllabs/imp-spec
C: SUBSCRIBE LIST
S: 281 33af50bc-4841-4426-b27f-793186b52171 noccyllabs/imp-spec
S: 282 1 subscriptions.

```

## 7.9 SET command

### 7.9.1 SET GLOBAL command

## 7.10 UNSUBSCRIBE command

Removes a subscription

# 8 List of Status Codes

- 1xx is informative
- 2xx is success messages
- 3xx is progress updates pending a 2xx or 4xx
- 4xx is error messages
- 7xx is server or protocol error messages

## 8.1 1xx codes

- 100 Logon info text
- 101 Server info: p=**protocol** v=**version** d=**domain**

## 8.2 2xx codes

- 204 Upgrading transport with encryption
- 210 Authentication accepted
- 240 Mailbox status: u=**unread**, t=**total**
- 250 Message download in JSON format
- 251 Message download in MIME Multipart format
- 270 Awaiting DATA
- 271 Awaiting content for part
- 272 Part saved
- 280 Subscription successful
- 281 Subscription list item (uuid and info)
- 282 End of subscription list

## 8.3 3xx codes

- 301 Cookie authentication initiated
- 302 Shared secret authentication request initiated
- 303 Shared secret nonces: n1=**nonce1** n2=**nonce2**
- 380 Trying to subscribe