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# The IMAP COMPRESS Extension

## Status of this Memo



## Abstract

The COMPRESS extension allows an IMAP connection to be effectively and efficiently compressed.

Table of Contents

1. Introduction and Overview .....2
2. Conventions Used in This Document .....2
3. The COMPRESS Command .....3
4. Compression Efficiency .....4
5. Formal Syntax .....6
6. Security Considerations .....6
7. IANA Considerations .....6
8. Acknowledgements .....7
9. References .....7
   9.1. Normative References .....7
   9.2. Informative References .....7

## 1. Introduction and Overview

A server which supports the COMPRESS extension indicates this with one or more capability names consisting of "COMPRESS=" followed by a supported compression algorithm name as described in this document.

The goal of COMPRESS is to reduce the bandwidth usage of IMAP.

Compared to PPP compression (see [RFC1962]) and modem-based compression (see [MNP] and [V42BIS]), COMPRESS offers much better compression efficiency. COMPRESS can be used together with Transport Security Layer (TLS) [RFC4346], Simple Authentication and Security layer (SASL) encryption, Virtual Private Networks (VPNs), etc. Compared to TLS compression [RFC3749], COMPRESS has the following (dis)advantages:

- COMPRESS can be implemented easily both by IMAP servers and clients.

- IMAP COMPRESS benefits from an intimate knowledge of the IMAP protocol's state machine, allowing for dynamic and aggressive optimization of the underlying compression algorithm's parameters.

- When the TLS layer implements compression, any protocol using that layer can transparently benefit from that compression (e.g., SMTP and IMAP). COMPRESS is specific to IMAP.

In order to increase interoperation, it is desirable to have as few different compression algorithms as possible, so this document specifies only one. The DEFLATE algorithm (defined in [RFC1951]) is standard, widely available and fairly efficient, so it is the only algorithm defined by this document.

In order to increase interoperation, IMAP servers that advertise this extension SHOULD also advertise the TLS DEFLATE compression mechanism as defined in [RFC3749]. IMAP clients MAY use either COMPRESS or TLS compression, however, if the client and server support both, it is RECOMMENDED that the client choose TLS compression.

The extension adds one new command (COMPRESS) and no new responses.

## 2. Conventions Used in This Document

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 [RFC2119].

Formal syntax is defined by [RFC4234] as modified by [RFC3501].

In the examples, "C:" and "S:" indicate lines sent by the client and server respectively. "[...]" denotes elision.

## 3. The COMPRESS Command

Arguments: Name of compression mechanism: "DEFLATE".

Responses: None

Result: OK The server will compress its responses and expects the client to compress its commands.
NO Compression is already active via another layer.
BAD Command unknown, invalid or unknown argument, or COMPRESS already active.

The COMPRESS command instructs the server to use the named compression mechanism ("DEFLATE" is the only one defined) for all commands and/or responses after COMPRESS.

The client MUST NOT send any further commands until it has seen the result of COMPRESS. If the response was OK, the client MUST compress starting with the first command after COMPRESS. If the server response was BAD or NO, the client MUST NOT turn on compression.

If the server responds NO because it knows that the same mechanism is active already (e.g., because TLS has negotiated the same mechanism), it MUST send COMPRESSIONACTIVE as resp-text-code (see [RFC3501], Section 7.1), and the resp-text SHOULD say which layer compresses.

If the server issues an OK response, the server MUST compress starting immediately after the CRLF which ends the tagged OK response. (Responses issued by the server before the OK response will, of course, still be uncompressed.) If the server issues a BAD or NO response, the server MUST NOT turn on compression.

For DEFLATE (as for many other compression mechanisms), the compressor can trade speed against quality. When decompressing there isn’t much of a tradeoff. Consequently, the client and server are both free to pick the best reasonable rate of compression for the data they send.

When COMPRESS is combined with TLS (see [RFC4346]) or SASL (see [RFC4422]) security layers, the sending order of the three extensions MUST be first COMPRESS, then SASL, and finally TLS. That is, before data is transmitted it is first compressed. Second, if a SASL security layer has been negotiated, the compressed data is then signed and/or encrypted accordingly. Third, if a TLS security layer has been negotiated, the data from the previous step is signed and/or

encrypted accordingly. When receiving data, the processing order MUST be reversed. This ensures that before sending, data is compressed before it is encrypted, independent of the order in which the client issues COMPRESS, AUTHENTICATE, and STARTTLS.

The following example illustrates how commands and responses are compressed during a simple login sequence:

```
S: * OK [CAPABILITY IMAP4REV1 STARTTLS COMPRESS=DEFLATE]
C: a starttls
S: a OK TLS active

    From this point on, everything is encrypted.

C: b login arnt tnra
S: b OK Logged in as arnt
C: c compress deflate
S: d OK DEFLATE active

    From this point on, everything is compressed before being
    encrypted.
```

The following example demonstrates how a server may refuse to compress twice:

```
S: * OK [CAPABILITY IMAP4REV1 STARTTLS COMPRESS=DEFLATE]
[...]
C: c compress deflate
S: c NO [COMPRESSIONACTIVE] DEFLATE active via TLS
```

## 4. Compression Efficiency

This section is informative, not normative.

IMAP poses some unusual problems for a compression layer.

Upstream is fairly simple. Most IMAP clients send the same few commands again and again, so any compression algorithm that can exploit repetition works efficiently. The APPEND command is an exception; clients that send many APPEND commands may want to surround large literals with flushes in the same way as is recommended for servers later in this section.

Downstream has the unusual property that several kinds of data are sent, confusing all dictionary-based compression algorithms.

One type is IMAP responses. These are highly compressible; zlib using its least CPU-intensive setting compresses typical responses to 25-40% of their original size.

Another type is email headers. These are equally compressible, and benefit from using the same dictionary as the IMAP responses.

A third type is email body text. Text is usually fairly short and includes much ASCII, so the same compression dictionary will do a good job here, too. When multiple messages in the same thread are read at the same time, quoted lines etc. can often be compressed almost to zero.

Finally, attachments (non-text email bodies) are transmitted, either in binary form or encoded with base-64.

When attachments are retrieved in binary form, DEFLATE may be able to compress them, but the format of the attachment is usually not IMAP-like, so the dictionary built while compressing IMAP does not help. The compressor has to adapt its dictionary from IMAP to the attachment's format, and then back. A few file formats aren't compressible at all using deflate, e.g., .gz, .zip, and .jpg files.

When attachments are retrieved in base-64 form, the same problems apply, but the base-64 encoding adds another problem. 8-bit compression algorithms such as deflate work well on 8-bit file formats, however base-64 turns a file into something resembling 6-bit bytes, hiding most of the 8-bit file format from the compressor.

When using the zlib library (see [RFC1951]), the functions deflateInit2(), deflate(), inflateInit2(), and inflate() suffice to implement this extension. The windowBits value must be in the range -8 to -15, or else deflateInit2() uses the wrong format. deflateParams() can be used to improve compression rate and resource use. The Z_FULL_FLUSH argument to deflate() can be used to clear the dictionary (the receiving peer does not need to do anything).

A client can improve downstream compression by implementing BINARY (defined in [RFC3516]) and using FETCH BINARY instead of FETCH BODY. In the author's experience, the improvement ranges from 5% to 40% depending on the attachment being downloaded.

A server can improve downstream compression if it hints to the compressor that the data type is about to change strongly, e.g., by sending a Z_FULL_FLUSH at the start and end of large non-text literals (before and after '*CHAR8' in the definition of literal in RFC 3501, page 86). Small literals are best left alone. A possible boundary is 5k.

A server can improve the CPU efficiency both of the server and the client if it adjusts the compression level (e.g., using the deflateParams() function in zlib) at these points, to avoid trying to compress incompressible attachments. A very simple strategy is to change the level to 0 at the start of a literal provided the first two bytes are either 0x1F 0x8B (as in deflate-compressed files) or 0xFF 0xD8 (JPEG), and to keep it at 1-5 the rest of the time. More complex strategies are possible.

## 5. Formal Syntax

The following syntax specification uses the Augmented Backus-Naur Form (ABNF) notation as specified in [RFC4234]. This syntax augments the grammar specified in [RFC3501]. [RFC4234] defines SP and [RFC3501] defines command-auth, capability, and resp-text-code.

Except as noted otherwise, all alphabetic characters are case-insensitive. The use of upper or lower case characters to define token strings is for editorial clarity only. Implementations MUST accept these strings in a case-insensitive fashion.

```
command-auth =/ compress

compress    = "COMPRESS" SP algorithm

capability  =/ "COMPRESS=" algorithm
                 ;; multiple COMPRESS capabilities allowed

algorithm   = "DEFLATE"

resp-text-code =/ "COMPRESSIONACTIVE"
```

Note that due the syntax of capability names, future algorithm names must be atoms.

## 6. Security Considerations

As for TLS compression [RFC3749].

## 7. IANA Considerations

The IANA has added COMPRESS=DEFLATE to the list of IMAP capabilities.

## 8. Acknowledgements

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