

INTERNET MESSAGE ACCESS PROTOCOL - THREAD EXTENSION

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A revised version of this draft document will be submitted to the RFC editor as a Proposed Standard for the Internet Community.

Discussion and suggestions for improvement are requested, and should be sent to ietf-imapext@IMC.ORG. This document will expire before 1 March 2001. Distribution of this memo is unlimited.

Abstract

This document describes the server-based threading extension to the IMAP4rev1 protocol. This extension provides substantial performance improvements for IMAP clients which offer threaded views.

A server which supports this extension indicates this with more or more capability names consisting of "THREAD=" followed by a supported threading algorithm name as described in this document. This provides for future upwards-compatible extensions.

Extracted Subject Text

Threading uses a version of the subject which has specific subject artifacts of deployed Internet mail software removed. Due to the complexity of these artifacts, the formal syntax for the subject extraction rules is ambiguous. The following procedure is followed to determining the actual "base subject" which is used to thread:

- (1) Convert any [RFC 2047](#) encoded-words in the subject to UTF-8. Convert all tabs and continuations to space. Convert all multiple spaces to a single space.
- (2) Remove all trailing text of the subject that matches the subj-trailer ABNF, repeat until no more matches are possible.
- (3) Remove all prefix text of the subject that matches the subj-leader ABNF.
- (4) If there is prefix text of the subject that matches the subj-blob ABNF, and removing that prefix leaves a non-empty subj-base, then remove the prefix text.
- (5) Repeat (3) and (4) until no matches remain.

Note: it is possible to defer step (2) until step (6), but this requires checking for subj-trailer in step (4).

- (6) If the resulting text begins with the subj-fwd-hdr ABNF and ends with the subj-fwd-trl ABNF, remove the subj-fwd-hdr and subj-fwd-trl and repeat from step (2).
- (7) The resulting text is the "base subject" used in threading.

All servers and disconnected clients MUST use exactly this algorithm when threading. Otherwise there is potential for a user to get inconsistent results based on whether they are running in connected or disconnected IMAP mode.

Additional Commands

This command is an extension to the IMAP4rev1 base protocol.

The section header is intended to correspond with where it would be located in the main document if it was part of the base specification.

6.3.THREAD. THREAD Command

Arguments: threading algorithm
 charset specification
 searching criteria (one or more)

Data: untagged responses: THREAD

Result: OK - thread completed
 NO - thread error: can't thread that charset or
 criteria
 BAD - command unknown or arguments invalid

The THREAD command is a variant of SEARCH with threading semantics for the results. Thread has two arguments before the searching criteria argument; a threading algorithm, and the searching charset. Note that unlike SEARCH, the searching charset argument is mandatory.

There is also a UID THREAD command which corresponds to THREAD the way that UID SEARCH corresponds to SEARCH.

The THREAD command first searches the mailbox for messages that match the given searching criteria using the charset argument for the interpretation of strings in the searching criteria. It then returns the matching messages in an untagged THREAD response, threaded according to the specified threading algorithm.

The defined threading algorithms are as follows:

ORDEREDSUBJECT

The ORDEREDSUBJECT threading algorithm is also referred to as "poor man's threading." The searched messages are sorted by subject and then by sent date, equivalent to a "SORT (SUBJECT DATE)". The messages are then split into separate threads, with each thread containing messages with the same extracted subject text. Finally, the threads are sorted by the sent date of the first message in the thread.

Note that each message in a thread is a child (as opposed to a sibling) of the previous message.

REFERENCES

The REFERENCES threading algorithm is based on the algorithm written by Jamie Zawinski which was used in "Netscape Mail and News" versions 2.0 through 3.0. For details, see <http://www.jwz.org/docs/threading.html>.

This algorithm threads the searched messages by grouping them together in parent/child relationships based on which messages are replies to others. The parent/child relationships are built using two methods: reconstructing a message's ancestry using the references contained within it; and checking the subject of a message to see if it is a reply to (or forward of) another.

The references used for reconstructing a message's ancestry are found using the following rules:

If a message contains a [\[NEWS\]](#)-style References header, then use the Message-IDs in this header as the references.

If a message does not contain a References header, or the header does not contain any Message-IDs, then use the first (if any) Message-ID found in the In-Reply-To header as the only reference (parent) for this message.

If a message does not contain an In-Reply-To header, or the header does not contain a Message-ID, then the message does not have any references (NIL).

The REFERENCES algorithm is significantly more complex than ORDEREDSUBJECT and consists of five main steps. These steps are outlined in detail below.

(1) For each searched message:

(A) Using the Message-IDs in the message's references, link the corresponding messages together as parent/child. Make the first reference the parent of the second (and the second a child of the first), the second the parent of the third (and the third a child of the second), etc. The following rules govern the creation of these links:

If no reference message can be found with a given Message-ID, create a dummy message with this ID. Use this dummy message for all subsequent references to this

ID.

If a reference message already has a parent, don't change the existing link.

Do not create a parent/child link if creating that link would introduce a loop. For example, before making message A the parent of B, make sure that A is not a descendent of B.

(B) Create a parent/child link between the last reference (or NIL if there are no references) and the current message. If the current message has a parent already, break the current parent/child link before creating the new one. Note that if this message has no references, that it will now have no parent.

NOTE: The parent/child links MUST be kept consistent with one another at ALL times.

(2) Gather together all of the messages that have no parents and make them all children (siblings of one another) of a dummy parent (the "root"). These messages constitute first messages of the threads created thus far.

(3) Prune dummy messages from the thread tree. Traverse each thread under the root, and for each message:

If it is a dummy message with NO children, delete it.

If it is a dummy message with children, delete it, but promote its children to the current level. In other words, splice them in with the dummy's siblings.

Do not promote the children if doing so would make them children of the root, unless there is only one child.

(4) Gather together messages under the root that have the same extracted subject text.

(A) Create a table for associating extracted subjects with messages.

(B) Populate the subject table with one message per extracted subject. For each message under the root:

(i) Find the subject of this thread by extracting the base subject from the current message, or its first child

if the current message is a dummy.

(ii) Lookup the message associated with this extracted subject in the table.

(iii) If there is no message in the table with this subject, add the current message and the extracted subject to the subject table.

Otherwise, replace the message in the table with the current message if either of the following criteria are true:

The current message is a dummy and the one in the table is not, OR

The message in the table is a reply or forward (its original subject contains a subj-refwd part and/or a "(fwd)" subj-trailer) and the current message is not.

(C) Merge threads with the same subject. For each message under the root:

(i) Find the subject of this thread as in step 4.B.i above.

(ii) Lookup the message associated with this extracted subject in the table.

(iii) If the message in the table is the current message, skip it.

Otherwise, merge the current message with the one in the table using the following rules:

If both messages are dummies, append the current message's children to the children of the message in the table (the children of both messages become siblings), and then delete the current message.

If the message in the table is a dummy and the current message is not, make the current message a child of the message in the table (a sibling of it's children).

If the current message is a reply or forward and the message in the table is not, make the current message a child of the message in the table (a sibling of it's children).

Otherwise, create a new dummy container and make both messages children of the dummy, and replace the message in the table with the dummy message.

(5) Traverse the messages under the root and sort each set of siblings by date. In the case of an exact match on date, use the order in which they appear in the mailbox (that is, by sequence number) to determine the order. In the case of a dummy message (which can occur with top-level siblings), use the first child for sorting.

Example: C: A283 THREAD ORDEREDSUBJECT UTF-8 SINCE 5-MAR-2000
S: * THREAD (166)(167)(168)(169)(172)(170)(171)
(173)(174 175 176 178 181 180)(179)(177 183
182 188 184 185 186 187 189)(190)(191)(192)
(193)(194 195)(196 197 198)(199)(200 202)(201)
(203)(204)(205)(206 207)(208)
S: A283 OK THREAD completed
C: A284 THREAD ORDEREDSUBJECT US-ASCII TEXT "gewp"
S: * THREAD
S: A284 OK THREAD completed
C: A285 THREAD REFERENCES UTF-8 SINCE 5-MAR-2000
S: * THREAD (166)(167)(168)(169)(172)((170)(179))
(171)(173)((174)(175)(176)(178)(181)(180))
((177)(183)(182)(188 (184)(189))(185 186)(187))
(190)(191)(192)(193)((194)(195 196))(197 198)
(199)(200 202)(201)(203)(204)(205 206 207)(208)
S: A285 OK THREAD completed

Note: The line breaks in the first and third client responses are for editorial clarity and do not appear in real THREAD responses.

Additional Responses

This response is an extension to the IMAP4rev1 base protocol.

The section heading of this response is intended to correspond with where it would be located in the main document.

7.2.THREAD. THREAD Response

Data: zero or more threads

The THREAD response occurs as a result of a THREAD or UID THREAD command. It contains zero or more threads. A thread consists of a parenthesized list of thread members.

Thread members consist of zero or more message numbers, delimited by spaces, indicating successive parent and child. This continues until the thread splits into multiple sub-threads, at which point the thread nests into multiple sub-threads with the first member of each subthread being siblings at this level. There is no limit to the nesting of threads.

The messages numbers refer to those messages that match the search criteria. For THREAD, these are message sequence numbers; for UID THREAD, these are unique identifiers.

Example: S: * THREAD (2)(3 6 (4 23)(44 7 96))

The first thread consists only of message 2. The second thread consists of the messages 3 (parent) and 6 (child), after which it splits into two subthreads; the first of which contains messages 4 (child of 6, sibling of 44) and 23 (child of 4), and the second of which contains messages 44 (child of 6, sibling of 4), 7 (child of 44), and 96 (child of 7). Since some later messages are parents of earlier messages, the messages were probably moved from some other mailbox at different times.

```
-- 2
```

```
-- 3
```

```
  \-- 6
```

```
    |-- 4
```

```
      |  \-- 23
```

```
      |
```

```
      \-- 44
```

```
        \-- 7
```

```
          \-- 96
```


Example: S: * THREAD ((3)(5))

In this example, 3 and 5 are siblings of a parent which does not exist in the mailbox; however they are members of the same thread.

Formal Syntax of THREAD commands and Responses

```
thread-data      = "THREAD" [SP 1*thread-list]
thread-list      = "(" thread-members / thread-nested ")"
thread-members   = nz-number *(SP nz-number) [SP thread-nested]
thread-nested    = 2*thread-list
thread           = ["UID" SP] "THREAD" SP thread-algorithm
                  SP search-charset 1*(SP search-key)
thread-algorithm = "ORDEREDSUBJECT" / "REFERENCES" / atom
```

The following syntax describes subject extraction rules (2)-(6):

```
subject          = *subj-leader [subj-middle] *subj-trailer
subj-refwd       = ("re" / ("fw" ["d"])) *WSP [subj-blob] ":"
subj-blob        = "[" *BLOBCHAR "]" *WSP
subj-fwd         = subj-fwd-hdr subject subj-fwd-trl
subj-fwd-hdr     = "[fwd:"
subj-fwd-trl     = "]"
subj-leader      = (*subj-blob subj-refwd) / WSP
subj-middle      = *subj-blob (subj-base / subj-fwd)
                  ; last subj-blob is subj-base if subj-base would
                  ; otherwise be empty
subj-trailer     = "(fwd)" / WSP
subj-base        = NONWSP *([*WSP] NONWSP)
                  ; can be a subj-blob
BLOBCHAR         = %x01-5a / %x5c / %x5e-7f
                  ; any CHAR except '[' and ']'
NONWSP           = %x01-08 / %x0a-1f / %x21-7f
                  ; any CHAR other than WSP
```


Security Considerations

Security issues are not discussed in this memo.

Internationalization Considerations

By default, strings are threaded according to the "minimum sorting collation algorithm". All implementations of THREAD MUST implement the minimum sorting collation algorithm.

In the minimum sorting collation algorithm, the 26 Latin alphabets are sorted in a case-insensitive fashion; that is, "A" and "a" are treated as exact equals. All other characters are sorted according to their octet values, as expressed in UTF-8. No attempt is made to treat composed characters specially.

Other sorting collations, and the ability to change the sorting collation, will be defined in a separate document dealing with IMAP internationalization.

It is anticipated that there will be a generic Unicode sorting collation, which will provide generic case-insensitivity for alphabetic scripts, specification of composed character handling, and language-specific sorting collations. A server which implements non-default sorting collations will modify its sorting behavior according to the selected sorting collation.

Non-English translations of "Re" or "Fw"/"Fwd" are not specified for removal in the extracted subject text process. By specifying that only the English forms of the prefixes are used, it becomes a simple display time task to localize the prefix language for the user. If, on the other hand, prefixes in multiple languages are permitted, the result is a geometrically complex, and ultimately unimplementable, task. In order to improve the ability to support non-English display in Internet mail clients, only the English form of these prefixes should be transmitted in Internet mail messages.

A. References

[ABNF] Crocker, D., and Overell, P. "Augmented BNF for Syntax Specifications: ABNF", [RFC 2234](#), November 1997.

[NEWS] Horton, M., and Adams, R., "Standard for interchange of USENET messages", [RFC-1036](#), AT&T Bell Laboratories and Center for Seismic Studies, December, 1987.

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