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HTTP/1.1

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## Abstract

The Hypertext Transfer Protocol (HTTP) is an application-level protocol for distributed, collaborative, hypermedia information systems. HTTP has been in use by the World Wide Web global information initiative since 1990. This document is Part 5 of the seven-part specification that defines the protocol referred to as "HTTP/1.1" and, taken together, obsoletes [RFC 2616](#). Part 5 defines range-specific requests and the rules for constructing and combining responses to those requests.

## Editorial Note (To be removed by RFC Editor)

This version of the HTTP specification contains only minimal editorial changes from [[RFC2616](#)] (abstract, introductory paragraph, and authors' addresses). All other changes are due to partitioning the original into seven mostly independent parts. The intent is for readers of future drafts to be able to use draft 00 as the basis for comparison when the WG makes later changes to the specification text. This draft will shortly be followed by draft 01 (containing the first round of changes that have already been agreed to on the mailing list). There is no point in reviewing this draft other than to verify that the partitioning has been done correctly. Roy T. Fielding, Yves Lafon, and Julian Reschke will be the editors after draft 00 is submitted.

Discussion of this draft should take place on the HTTPBIS working group mailing list ([ietf-http-wg@w3.org](mailto:ietf-http-wg@w3.org)). The current issues list is at <http://www3.tools.ietf.org/wg/httpbis/trac/report/11> and related documents (including fancy diffs) can be found at <http://www3.tools.ietf.org/wg/httpbis/>.

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## 1. Introduction

This document will define aspects of HTTP related to range requests, partial responses, and the multipart/byteranges media type. Right now it only includes the extracted relevant sections of [RFC 2616](#) [RFC2616] without edit.

## 2. Range Units

HTTP/1.1 allows a client to request that only part (a range of) the response entity be included within the response. HTTP/1.1 uses range units in the Range ([Section 5.4](#)) and Content-Range ([Section 5.2](#)) header fields. An entity can be broken down into subranges according to various structural units.

```
range-unit      = bytes-unit | other-range-unit
bytes-unit      = "bytes"
other-range-unit = token
```

The only range unit defined by HTTP/1.1 is "bytes". HTTP/1.1 implementations MAY ignore ranges specified using other units.

HTTP/1.1 has been designed to allow implementations of applications that do not depend on knowledge of ranges.

## 3. Status Code Definitions

### [3.1.](#) 206 Partial Content

The server has fulfilled the partial GET request for the resource. The request **MUST** have included a Range header field ([Section 5.4](#)) indicating the desired range, and **MAY** have included an If-Range header field ([Section 5.3](#)) to make the request conditional.

The response **MUST** include the following header fields:

- o Either a Content-Range header field ([Section 5.2](#)) indicating the range included with this response, or a multipart/byteranges Content-Type including Content-Range fields for each part. If a Content-Length header field is present in the response, its value **MUST** match the actual number of OCTETs transmitted in the message-body.
  
- o Date

- o ETag and/or Content-Location, if the header would have been sent in a 200 response to the same request
  
- o Expires, Cache-Control, and/or Vary, if the field-value might differ from that sent in any previous response for the same variant

If the 206 response is the result of an If-Range request that used a strong cache validator (see Section 4 of [\[Part4\]](#)), the response **SHOULD NOT** include other entity-headers. If the response is the result of an If-Range request that used a weak validator, the response **MUST NOT** include other entity-headers; this prevents inconsistencies between cached entity-bodies and updated headers. Otherwise, the response **MUST** include all of the entity-headers that would have been returned with a 200 (OK) response to the same request.

A cache **MUST NOT** combine a 206 response with other previously cached content if the ETag or Last-Modified headers do not match exactly, see 4.

A cache that does not support the Range and Content-Range headers

MUST NOT cache 206 (Partial) responses.

### 3.2. 416 Requested Range Not Satisfiable

A server SHOULD return a response with this status code if a request included a Range request-header field ([Section 5.4](#)), and none of the range-specifier values in this field overlap the current extent of the selected resource, and the request did not include an If-Range request-header field. (For byte-ranges, this means that the first-byte-pos of all of the byte-range-spec values were greater than the current length of the selected resource.)

When this status code is returned for a byte-range request, the response SHOULD include a Content-Range entity-header field specifying the current length of the selected resource (see [Section 5.2](#)). This response MUST NOT use the multipart/byteranges content-type.

## 4. Combining Byte Ranges

A response might transfer only a subrange of the bytes of an entity-body, either because the request included one or more Range specifications, or because a connection was broken prematurely. After several such transfers, a cache might have received several ranges of the same entity-body.

If a cache has a stored non-empty set of subranges for an entity, and an incoming response transfers another subrange, the cache MAY combine the new subrange with the existing set if both the following conditions are met:

- o Both the incoming response and the cache entry have a cache validator.
- o The two cache validators match using the strong comparison function (see Section 4 of [\[Part4\]](#)).

If either requirement is not met, the cache MUST use only the most recent partial response (based on the Date values transmitted with every response, and using the incoming response if these values are equal or missing), and MUST discard the other partial information.

## [5.](#) Header Field Definitions

This section defines the syntax and semantics of all standard HTTP/1.1 header fields. For entity-header fields, both sender and recipient refer to either the client or the server, depending on who sends and who receives the entity.

### [5.1.](#) Accept-Ranges

The Accept-Ranges response-header field allows the server to indicate its acceptance of range requests for a resource:

```
Accept-Ranges      = "Accept-Ranges" ":" acceptable-ranges
acceptable-ranges = 1#range-unit | "none"
```

Origin servers that accept byte-range requests MAY send

```
Accept-Ranges: bytes
```

but are not required to do so. Clients MAY generate byte-range requests without having received this header for the resource involved. Range units are defined in [Section 2](#).

Servers that do not accept any kind of range request for a resource MAY send

```
Accept-Ranges: none
```

to advise the client not to attempt a range request.

### [5.2.](#) Content-Range

The Content-Range entity-header is sent with a partial entity-body to specify where in the full entity-body the partial body should be applied. Range units are defined in [Section 2](#).

```
Content-Range = "Content-Range" ":" content-range-spec
```

```

content-range-spec      = byte-content-range-spec
byte-content-range-spec = bytes-unit SP
                        byte-range-resp-spec "/"
                        ( instance-length | "*" )

byte-range-resp-spec = (first-byte-pos "-" last-byte-pos)
                       | "*"
instance-length      = 1*DIGIT

```

The header SHOULD indicate the total length of the full entity-body, unless this length is unknown or difficult to determine. The asterisk "\*" character means that the instance-length is unknown at the time when the response was generated.

Unlike byte-ranges-specifier values (see [Section 5.4.1](#)), a byte-range-resp-spec MUST only specify one range, and MUST contain absolute byte positions for both the first and last byte of the range.

A byte-content-range-spec with a byte-range-resp-spec whose last-byte-pos value is less than its first-byte-pos value, or whose instance-length value is less than or equal to its last-byte-pos value, is invalid. The recipient of an invalid byte-content-range-spec MUST ignore it and any content transferred along with it.

A server sending a response with status code 416 (Requested range not satisfiable) SHOULD include a Content-Range field with a byte-range-resp-spec of "\*". The instance-length specifies the current length of the selected resource. A response with status code 206 (Partial Content) MUST NOT include a Content-Range field with a byte-range-resp-spec of "\*".

Examples of byte-content-range-spec values, assuming that the entity contains a total of 1234 bytes:

- o The first 500 bytes:

```
bytes 0-499/1234
```

- o The second 500 bytes:



bytes 500-999/1234

- o All except for the first 500 bytes:

bytes 500-1233/1234

- o The last 500 bytes:

bytes 734-1233/1234

When an HTTP message includes the content of a single range (for example, a response to a request for a single range, or to a request for a set of ranges that overlap without any holes), this content is transmitted with a Content-Range header, and a Content-Length header showing the number of bytes actually transferred. For example,

```
HTTP/1.1 206 Partial content
Date: Wed, 15 Nov 1995 06:25:24 GMT
Last-Modified: Wed, 15 Nov 1995 04:58:08 GMT
Content-Range: bytes 21010-47021/47022
Content-Length: 26012
Content-Type: image/gif
```

When an HTTP message includes the content of multiple ranges (for example, a response to a request for multiple non-overlapping ranges), these are transmitted as a multipart message. The multipart media type used for this purpose is "multipart/byteranges" as defined in [Appendix A](#). See [Appendix B](#) for a compatibility issue.

A response to a request for a single range MUST NOT be sent using the multipart/byteranges media type. A response to a request for multiple ranges, whose result is a single range, MAY be sent as a multipart/byteranges media type with one part. A client that cannot decode a multipart/byteranges message MUST NOT ask for multiple byte-ranges in a single request.

When a client requests multiple byte-ranges in one request, the server SHOULD return them in the order that they appeared in the request.

If the server ignores a byte-range-spec because it is syntactically invalid, the server SHOULD treat the request as if the invalid Range header field did not exist. (Normally, this means return a 200 response containing the full entity).

If the server receives a request (other than one including an If-

---

Range request-header field) with an unsatisfiable Range request-header field (that is, all of whose byte-range-spec values have a first-byte-pos value greater than the current length of the selected resource), it SHOULD return a response code of 416 (Requested range not satisfiable) ([Section 3.2](#)).

Note: clients cannot depend on servers to send a 416 (Requested range not satisfiable) response instead of a 200 (OK) response for an unsatisfiable Range request-header, since not all servers implement this request-header.

### [5.3.](#) If-Range

If a client has a partial copy of an entity in its cache, and wishes to have an up-to-date copy of the entire entity in its cache, it could use the Range request-header with a conditional GET (using either or both of If-Unmodified-Since and If-Match.) However, if the condition fails because the entity has been modified, the client would then have to make a second request to obtain the entire current entity-body.

The If-Range header allows a client to "short-circuit" the second request. Informally, its meaning is 'if the entity is unchanged, send me the part(s) that I am missing; otherwise, send me the entire new entity'.

If-Range = "If-Range" ":" ( entity-tag | HTTP-date )

If the client has no entity tag for an entity, but does have a Last-Modified date, it MAY use that date in an If-Range header. (The server can distinguish between a valid HTTP-date and any form of entity-tag by examining no more than two characters.) The If-Range header SHOULD only be used together with a Range header, and MUST be ignored if the request does not include a Range header, or if the server does not support the sub-range operation.

If the entity tag given in the If-Range header matches the current entity tag for the entity, then the server SHOULD provide the specified sub-range of the entity using a 206 (Partial content) response. If the entity tag does not match, then the server SHOULD return the entire entity using a 200 (OK) response.

### [5.4.](#) Range

#### [5.4.1.](#) Byte Ranges

Since all HTTP entities are represented in HTTP messages as sequences of bytes, the concept of a byte range is meaningful for any HTTP

entity. (However, not all clients and servers need to support byte-range operations.)

Byte range specifications in HTTP apply to the sequence of bytes in the entity-body (not necessarily the same as the message-body).

A byte range operation MAY specify a single range of bytes, or a set of ranges within a single entity.

```
ranges-specifier = byte-ranges-specifier
byte-ranges-specifier = bytes-unit "=" byte-range-set
byte-range-set = 1#( byte-range-spec | suffix-byte-range-spec )
byte-range-spec = first-byte-pos "-" [last-byte-pos]
first-byte-pos = 1*DIGIT
last-byte-pos = 1*DIGIT
```

The first-byte-pos value in a byte-range-spec gives the byte-offset of the first byte in a range. The last-byte-pos value gives the byte-offset of the last byte in the range; that is, the byte positions specified are inclusive. Byte offsets start at zero.

If the last-byte-pos value is present, it MUST be greater than or equal to the first-byte-pos in that byte-range-spec, or the byte-range-spec is syntactically invalid. The recipient of a byte-range-set that includes one or more syntactically invalid byte-range-spec values MUST ignore the header field that includes that byte-range-set.

If the last-byte-pos value is absent, or if the value is greater than or equal to the current length of the entity-body, last-byte-pos is taken to be equal to one less than the current length of the entity-body in bytes.

By its choice of last-byte-pos, a client can limit the number of bytes retrieved without knowing the size of the entity.

```
suffix-byte-range-spec = "-" suffix-length
suffix-length = 1*DIGIT
```

A suffix-byte-range-spec is used to specify the suffix of the entity-body, of a length given by the suffix-length value. (That is, this form specifies the last N bytes of an entity-body.) If the entity is shorter than the specified suffix-length, the entire entity-body is used.

If a syntactically valid byte-range-set includes at least one byte-range-spec whose first-byte-pos is less than the current length of the entity-body, or at least one suffix-byte-range-spec with a non-

zero suffix-length, then the byte-range-set is satisfiable. Otherwise, the byte-range-set is unsatisfiable. If the byte-range-set is unsatisfiable, the server SHOULD return a response with a status of 416 (Requested range not satisfiable). Otherwise, the server SHOULD return a response with a status of 206 (Partial Content) containing the satisfiable ranges of the entity-body.

Examples of byte-ranges-specifier values (assuming an entity-body of length 10000):

- o The first 500 bytes (byte offsets 0-499, inclusive): bytes=0-499
- o The second 500 bytes (byte offsets 500-999, inclusive): bytes=500-999
- o The final 500 bytes (byte offsets 9500-9999, inclusive): bytes=-500
- o Or bytes=9500-
- o The first and last bytes only (bytes 0 and 9999): bytes=0-0,-1
- o Several legal but not canonical specifications of the second 500 bytes (byte offsets 500-999, inclusive):  
bytes=500-600,601-999  
bytes=500-700,601-999

#### [5.4.2. Range Retrieval Requests](#)

HTTP retrieval requests using conditional or unconditional GET methods MAY request one or more sub-ranges of the entity, instead of the entire entity, using the Range request header, which applies to

the entity returned as the result of the request:

Range = "Range" ":" ranges-specifier

A server MAY ignore the Range header. However, HTTP/1.1 origin servers and intermediate caches ought to support byte ranges when possible, since Range supports efficient recovery from partially failed transfers, and supports efficient partial retrieval of large entities.

If the server supports the Range header and the specified range or ranges are appropriate for the entity:

- o The presence of a Range header in an unconditional GET modifies what is returned if the GET is otherwise successful. In other words, the response carries a status code of 206 (Partial Content)

instead of 200 (OK).

- o The presence of a Range header in a conditional GET (a request using one or both of If-Modified-Since and If-None-Match, or one or both of If-Unmodified-Since and If-Match) modifies what is returned if the GET is otherwise successful and the condition is true. It does not affect the 304 (Not Modified) response returned if the conditional is false.

In some cases, it might be more appropriate to use the If-Range header (see [Section 5.3](#)) in addition to the Range header.

If a proxy that supports ranges receives a Range request, forwards the request to an inbound server, and receives an entire entity in reply, it SHOULD only return the requested range to its client. It SHOULD store the entire received response in its cache if that is consistent with its cache allocation policies.

## [6.](#) IANA Considerations

TBD.

## [7.](#) Security Considerations

No additional security considerations have been identified beyond those applicable to HTTP in general [[Part1](#)].

## [8.](#) Acknowledgments

Most of the specification of ranges is based on work originally done by Ari Luotonen and John Franks, with additional input from Steve Zilles.

Based on an XML translation of [RFC 2616](#) by Julian Reschke.

## [9.](#) References

[Part1] Fielding, R., Ed., Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and T. Berners-Lee, "HTTP/1.1, part 1: URIs, Connections, and Message Parsing", [draft-ietf-httpbis-p1-messaging-00](#) (work in progress), December 2007.

[Part4] Fielding, R., Ed., Gettys, J., Mogul, J., Frystyk, H.,

Fielding, et al.

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Masinter, L., Leach, P., and T. Berners-Lee, "HTTP/1.1, part 4: Conditional Requests", [draft-ietf-httpbis-p4-conditional-00](#) (work in progress), December 2007.

[RFC2046] Freed, N. and N. Borenstein, "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types", [RFC 2046](#), November 1996.

[RFC2616] Fielding, R., Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and T. Berners-Lee, "Hypertext Transfer Protocol -- HTTP/1.1", [RFC 2616](#), June 1999.

## [Appendix A.](#) Internet Media Type multipart/byteranges

When an HTTP 206 (Partial Content) response message includes the content of multiple ranges (a response to a request for multiple non-

overlapping ranges), these are transmitted as a multipart message-body. The media type for this purpose is called "multipart/byteranges".

The multipart/byteranges media type includes two or more parts, each with its own Content-Type and Content-Range fields. The required boundary parameter specifies the boundary string used to separate each body-part.

Media Type name: multipart

Media subtype name: byteranges

Required parameters: boundary

Optional parameters: none

Encoding considerations: only "7bit", "8bit", or "binary" are permitted

Security considerations: none

For example:

```
HTTP/1.1 206 Partial Content
Date: Wed, 15 Nov 1995 06:25:24 GMT
Last-Modified: Wed, 15 Nov 1995 04:58:08 GMT
Content-type: multipart/byteranges; boundary=THIS_STRING_SEPARATES

--THIS_STRING_SEPARATES
Content-type: application/pdf
Content-range: bytes 500-999/8000
```

```
...the first range...
--THIS_STRING_SEPARATES
Content-type: application/pdf
Content-range: bytes 7000-7999/8000
```

```
...the second range
--THIS_STRING_SEPARATES--
```

Notes:

1. Additional CRLFs may precede the first boundary string in the entity.
2. Although [RFC 2046](#) [[RFC2046](#)] permits the boundary string to be quoted, some existing implementations handle a quoted boundary string incorrectly.
3. A number of browsers and servers were coded to an early draft of the byteranges specification to use a media type of multipart/x-byteranges, which is almost, but not quite compatible with the version documented in HTTP/1.1.

#### [Appendix B](#). Changes from [RFC 2068](#)

There are situations where a server (especially a proxy) does not know the full length of a response but is capable of serving a byterange request. We therefore need a mechanism to allow byteranges with a content-range not indicating the full length of the message. ([Section 5.2](#))

Range request responses would become very verbose if all meta-data were always returned; by allowing the server to only send needed headers in a 206 response, this problem can be avoided.

Fix problem with unsatisfiable range requests; there are two cases: syntactic problems, and range doesn't exist in the document. The 416

status code was needed to resolve this ambiguity needed to indicate an error for a byte range request that falls outside of the actual contents of a document. ([Section 3.2](#), 5.2)



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