Chunked Oblivious HTTP Messages

draft-ohai-chunked-ohttp

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Are we done with OHTTP?

Are we done?

RFC 9458 is published! 🎉

...but there is a functional gap that we can fill in.

OHTTP	Complete messages ✅	😐
Binary HTTP	Known-length messages ✅	Indeterminate messages ✅
HPKE	One-shot messages ✅	Multiple messages ✅

Chunked OHTTP

Chunked OHTTP allows encrypting and decrypting requests and responses in separate chunks

- Allows the use of Binary HTTP's "indeterminate" mode
- Takes advantage of HPKE's support for multiple messages
- Still is a **single** HTTP request-and-response transaction

What are the use cases?

Example use case #1

Database query that can fetch potentially large responses

- Response can be processed incrementally
- Response might be slow to return

Example use case #2

Generative content

- Content being generated by servers on-the-fly in response to a request
- Response might be slow to generate, and *sometimes* (perhaps not always) large
- Clients can start processing or displaying the content incrementally

Example use case #3

Large uploads to a server

Currently, OHTTP has no maximum size, so a server that is willing to accept large requests is forced to buffer unbounded messages before knowing if they can be decrypted, or if they will be served

Chunking allows the server to validate the HPKE encryption and request headers in the first chunk before accepting the rest of the request

Chunking also allows endpoints to write data out after decrypting, instead of holding the entire message in memory

Example use case #4

Informational responses

- Support 100-continue from servers so that clients can check that a server is willing to receive a body before they send it
  (Warning: server can measure latency to client if the client reaction to a 1xx leaks evident into the request through timing)
- Be able to open 1xx responses without waiting for the entire response

To OHTTP, or not to OHTTP

When to use OHTTP

Chunked OHTTP optimizes applications that are already good candidates for OHTTP

> This should not replace use cases that would be better served by MASQUE, or other ways to proxy end-to-end TLS streams
>
> There are pros and cons to both approaches, that apply whether or not chunks are used

Comparing options

OHTTP	*Proxied TLS (MASQUE)*
Cooperating gateway servers	Unmodified target servers
Single request/response pair	Bidirectional data stream
Connection reuse between relay and gateway	Port/IP allocation for each proxied connection
Per-request decoupling without added latency	Decoupling transactions requires a new TLS handshake
Gateway cannot measure latency to client (100-continue?)	Target can measure latency to client to infer location
No replay protection (Date field)	Replay protection
No PFS until key rotation	PFS

When to use OHTTP

Don't use OHTTP for:

- Back-and-forth streaming of data
- Cases where setup latency is relatively unimportant (long-lived streaming, web browsing sessions where you share cookies, etc)
- Cases where replaying the request is dangerous

Do use OHTTP for:

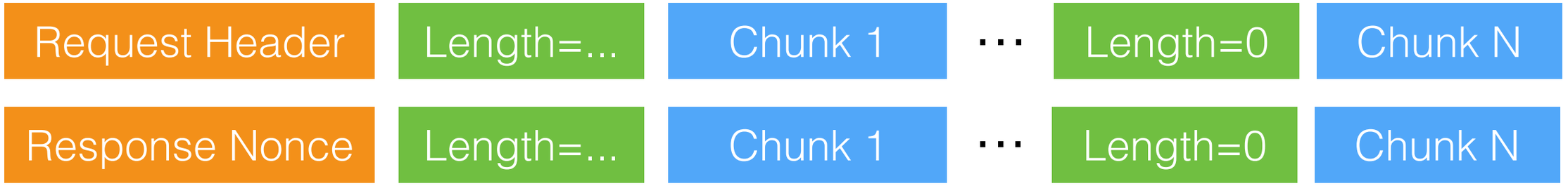
- Cases where you want decoupling between HTTP transactions
- Cases where you don't want the server to be able to determine client location based on latency (although `Expect: 100-continue` can undermine this benefit)
- Cases where servers need to scale to handle requests from large numbers of clients

The technical bits

How to chunk OHTTP

Add a varint "length" field before each chunk

Final chunk is indicated by length=0, and extends to the end of the outer stream



Prevents reordering of chunks and truncation by removing chunks

New media types

`message/ohttp-chunked-req`
`message/ohttp-chunked-res`

Chunked HPKE Requests

```
hdr = concat(encode(1, key_id),
             encode(2, kem_id),
             encode(2, kdf_id),
             encode(2, aead_id))
info = concat(encode_str("message/bhttp chunked request"),
              encode(1, 0),
              hdr)
enc, sctxt = SetupBaseS(pkR, info)
enc_request_hdr = concat(hdr, enc)

for chunk in chunks_except_final:
  sealed_chunk = sctxt.Seal("", chunk)
  sealed_chunk_len = varint_encode(len(sealed_chunk))
  non_final_chunk = concat(sealed_chunk_len, sealed_chunk)

sealed_final_chunk = sctxt.Seal("final", chunk)
sealed_final_chunk_len = varint_encode(len(sealed_final_chunk))
final_chunk = concat(sealed_final_chunk_len, sealed_final_chunk)
```

Chunked AEAD Responses

```
entropy = max(Nn, Nk)
response_nonce = random(entropy)

secret = context.Export("message/bhttp chunked response", entropy)
response_nonce = random(entropy)
salt = concat(enc, response_nonce)
prk = Extract(salt, secret)
aead_key = Expand(prk, "key", Nk)
aead_nonce = Expand(prk, "nonce", Nn)

counter = 0

for chunk in chunks_except_final:
  chunk_nonce = aead_nonce XOR encode(Nn, counter)
  sealed_chunk = Seal(aead_key, chunk_nonce, "", chunk)
  sealed_chunk_len = varint_encode(len(sealed_chunk))
  non_final_chunk = concat(sealed_chunk_len, sealed_chunk)
  counter++

chunk_nonce = aead_nonce XOR encode(Nn, counter)
sealed_final_chunk = Seal(aead_key, chunk_nonce, "final", chunk)
sealed_final_chunk_len = varint_encode(len(sealed_final_chunk))
final_chunk = concat(sealed_final_chunk_len, sealed_final_chunk)
```

Interesting questions

Any negotiation or indication of support?

- Many uses of OHTTP are some a priori configuration
  - Implications for discovered support (SVCB)

Should we add prohibitions on sending request chunks after receiving response chunks?

Next steps

Should we adopt?