QPACK Update

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Changes since adoption

- Name (remember QCRAM?)

- No longer wire compatible with HPACK

- Encoder and Decoder each have a unidirectional control stream

- Supports one-pass encoding

- Decoder can limit Encoder's use of unacknowledged headers

Encoder Stream

- Handles all modifications of dynamic table state

- Length-prefixed blocks of QPACK instructions
  - Insert
  - Duplicate
  - Table Size Update

Length (8+)	Instructions

- Dynamic table references are relative to most recent entry

Request/Push Streams

- HTTP frames carry a QPACK Block

- Block = Prefix + Payload

- Prefix

  - Largest Reference - table state required to process block

  - Base Index - encoding reference point

- Payload

  - Index references

  - Literals

Largest Ref (8+)
Base Delta (8+)
Instructions

Request/Push Streams

- 3 ways to make a reference / name reference
  - Static table reference
  - Dynamic table reference relative to Base Index
  - Dynamic table reference "Post-Base Index"

	Base Index		Insertion Point
	↓		↓

Absolute Index	N-4	N-3	N-2	N-1	N	
Relative Index	2	1	0	0	1	Post Base Index

Decoder Stream

- Provides feedback to the encoder

- Stream of instructions (not length prefixed)
  - Table State Synchronize
  - Header Acknowledgement

Encoding Example

Encode

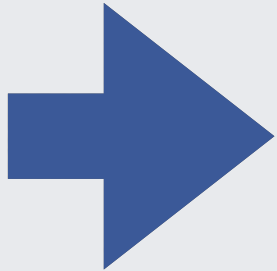**Path: /**
Host: www.foo.com

Absolute Index				
Name				
Value				
References				

Encode

Path: /
Host: www.foo.com

Absolute Index	1			
Name	:authority			
Value	www.foo.com			
References	1			

Insert :authority: www.foo.com
(insert with static name ref)

Largest Ref: 1 | Base Index: 0
:method: **GET** (static ref)
:scheme: **https** (static ref)
:authority: **www.foo.com** (dynamic ref)
:path: **/** (literal with static name ref)

Absolute Index	1			
Name	:authority			
Value	www.foo.com			
References	1			
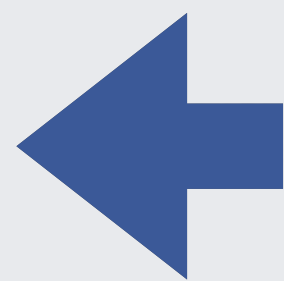
← **Header Ack: stream=4**

Largest Known Received

Absolute Index	1			
Name	:authority			
Value	www.foo.com			
References	0			
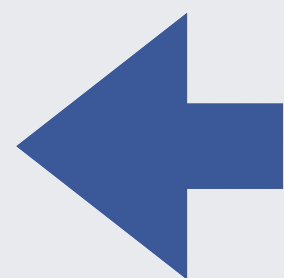
Header Ack: stream=4

Encode

Path: /about
Host: www.foo.com
Referer: /

Absolute Index	1			
Name	:authority			
Value	www.foo.com			
References	0			

Encode

Path: /about

Host: www.foo.com

Referer: /

Absolute Index	1	2		
Name	:authority	Referer		
Value	www.foo.com	/		
References	1	1		

Insert Referer: /   **Largest Ref: 2 | Base Index: 1**

...
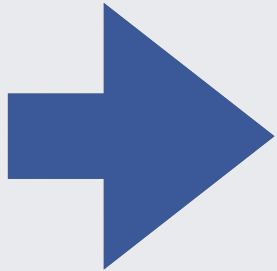
Absolute Index	1	2		
Name	:authority	Referer		
Value	www.foo.com	/		
References	1	1		
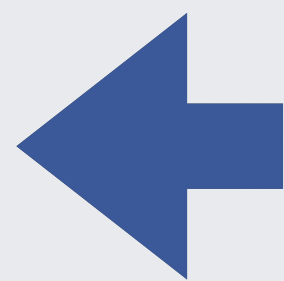
Header Ack: stream=8

Largest Known Received

↓

Absolute Index	1	2		
Name	:authority	Referer		
Value	www.foo.com	/		
References	0	0		
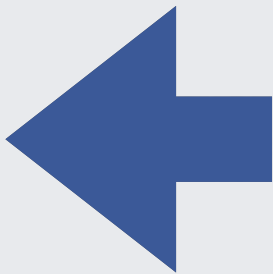
Header Ack: stream=8

Encode

Path: /
Host: dev.foo.com

Absolute Index	1	2		
Name	:authority	Referer		
Value	www.foo.com	/		
References	0	0		

Encode

Path: /
Host: dev.foo.com

Absolute Index	1	2	3	
Name	:authority	Referer	:authority	
Value	www.foo.com	/	dev.foo.com	
References	0	0	1	

↑
Min Usable

Encode

Path: /
Host: dev.foo.com

Absolute Index	1	2	3	
Name	:authority	Referer	:authority	
Value	www.foo.com	/	dev.foo.com	
References	0	0	1	

↑
Min Usable

Insert :authority: dev.foo.com   Largest Ref: 3 | Base Index: 2
...

Encode

Path: /
Host: www.foo.com

Absolute Index	1	2	3	
Name	:authority	Referer	:authority	
Value	www.foo.com	/	dev.foo.com	
References	0	0	1	

↑
Min Usable

Encode

Path: /
Host: www.foo.com

Absolute Index	1	2	3	4
Name	:authority	Referer	:authority	:authority
Value	www.foo.com	/	dev.foo.com	www.foo.com
References	0	0	1	

↑
Min Usable

Encode

Path: /
Host: www.foo.com

Absolute Index	1	2	3	4
Name	:authority	Referer	:authority	:authority
Value	www.foo.com	/	dev.foo.com	www.foo.com
References	0	0	1	

↑
Min Usable

Max Blocked: 1

Encode

Path: /
Host: www.foo.com

Absolute Index	1	2	3	4
Name	:authority	Referer	:authority	:authority
Value	www.foo.com	/	dev.foo.com	www.foo.com
References	0	0	1	0

↑
Min Usable

Max Blocked: 1

Duplicate (1)

Largest Ref: 0 | Base Index: 3
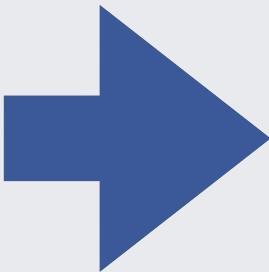
Absolute Index	1	2	3	4
Name	:authority	Referer	:authority	:authority
Value	www.foo.com	/	dev.foo.com	www.foo.com
References	0	0	1	0
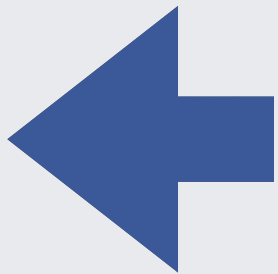
Header Ack: stream=16

Table State Sync: 2

Largest Known Received

Absolute Index	1	2	3	4
Name	:authority	Referer	:authority	:authority
Value	www.foo.com	/	dev.foo.com	www.foo.com
References	0	0	1	0
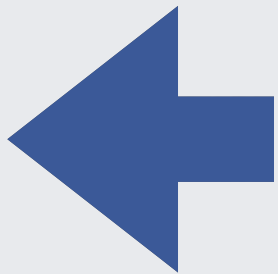
Header Ack: stream=16

Table State Sync: 2

Selected Open Issues & PRs

#904/1355 New Static Table

| Index	Name	Value
0	:path	/
1	referer	
2	content-length	0
3	date	
4	last-modified	
5	:authority	
	…	
117	access-control-request-method	get
118	purpose	prefetch
119	x-csrf-token	null
120	x-csrf-token	undefined

Too much? Not Enough? Just Right?

#1343 Static table negotiation

- Is this "unnecessary feature creep or useful future proofing"

- If we want this, how should it work? All proposals have drawbacks
  - Use instructions to switch tables
  - Use SETTINGS
  - Use Transport Params
  - Use Alt-Svc
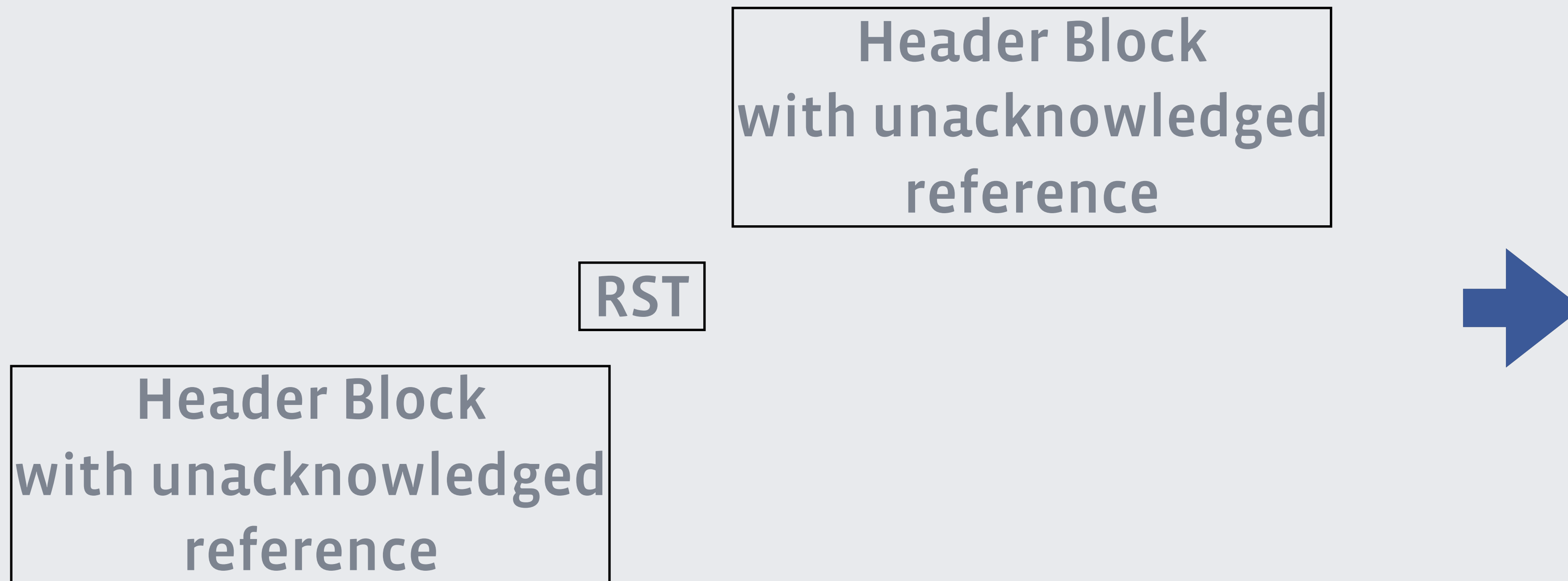
#1371 Tracking header blocks for reset stream

- When can an encoder discard state for a reset stream?

Header Block referencing oldest dynamic entry

RST

Insert triggering eviction
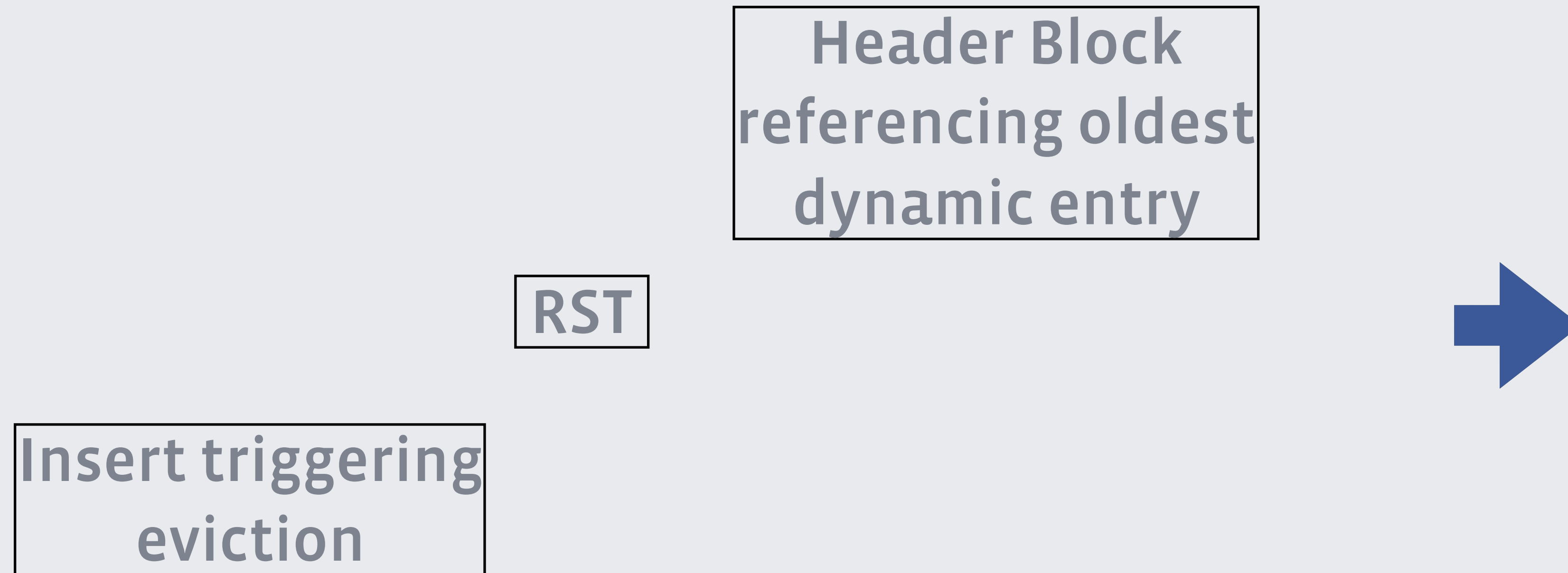
Current Draft: If insert arrives before block, fail the stream

#1371 Tracking header blocks for reset stream

- When can an encoder discard state for a reset stream?

Header Block
with unacknowledged
reference

RST

Header Block
with unacknowledged
reference

If second block arrives before reset - connection error 😔
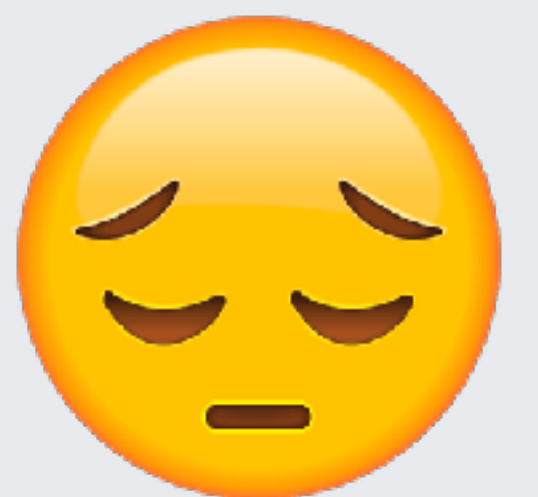
#1371 Tracking header blocks for reset stream

- Option #1 - Application level ack for RST_STREAM

- Option #2 - Replace MAX_BLOCKED_STREAMS with boolean

Interop?

Offline Interop Proposal

- Encode a HAR file with a fixed set of parameters
  - Table size, blocking options, ack mode
- Output a simple binary file
- Encoder can shuffle encoded streams to simulate reordering

- Decoder decodes the file and compares to HAR

Stream ID (8)	Length (4)
QPACK Block	