Stream 0, Architecture, Layering, and DTLS

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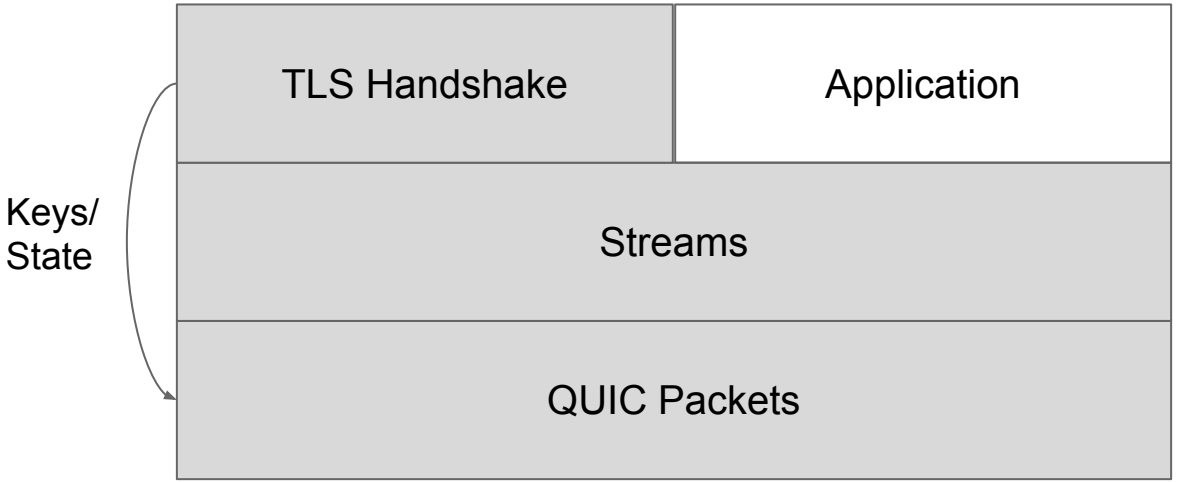
Agenda

- The current architecture (brief)
- A brief survey of stream 0 problems
- Root cause analysis
- “Crypto Stream”
- Layering

Current Layering Architecture



“Stream 0” Problems (Data)

- Partly encrypted, partly not
  - Retransmission
  - Boundary between SFIN and NST
- Very tight coupling with the TLS stack
  - Boundaries between flights
  - Is this an SH or an HRR (or a stateful versus stateless HRR go)
- Exempt from flow control during the handshake but not later
  - You can go negative
- Mismatch between QUIC and TLS 1.3 notions of 0-RTT boundaries
- Can’t bundle unencrypted and encrypted in one packet
- QUIC sure knows a lot about crypto
  - + Double encryption

“Stream 0” Problems (ACKs)

- Complicated ACK rules
  - Just a pain to reason about and implement
- Holes from unencrypted packets being ACKed in enc packets
- Contradictions between ACKs and handshake state
  - SFIN means CFIN received but might not contain ACKs
- Reliability for the CFIN

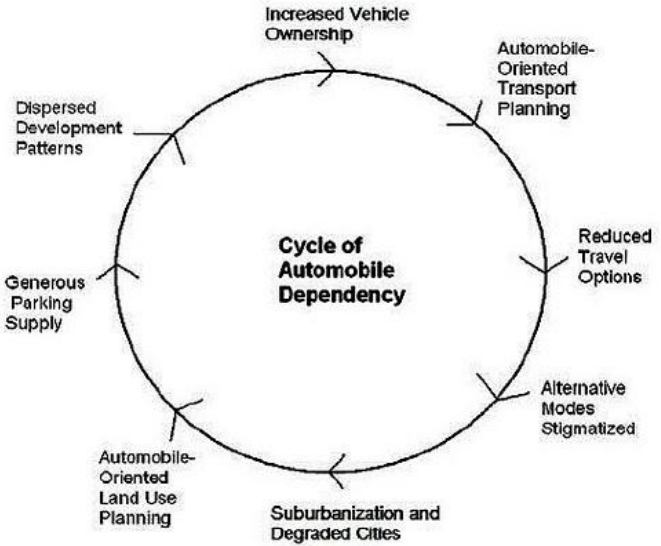
“Stream 0” Problems (code)

- Constantly special cased in people’s code

```
uint32_t
StreamPair::ResetInbound()
{
  // this is used in a very peculiar circumstance
after HRR on stream 0 only
  assert(mStreamID == 0);
  return mIn->ResetInbound();
}
```

What's the source of the problem?

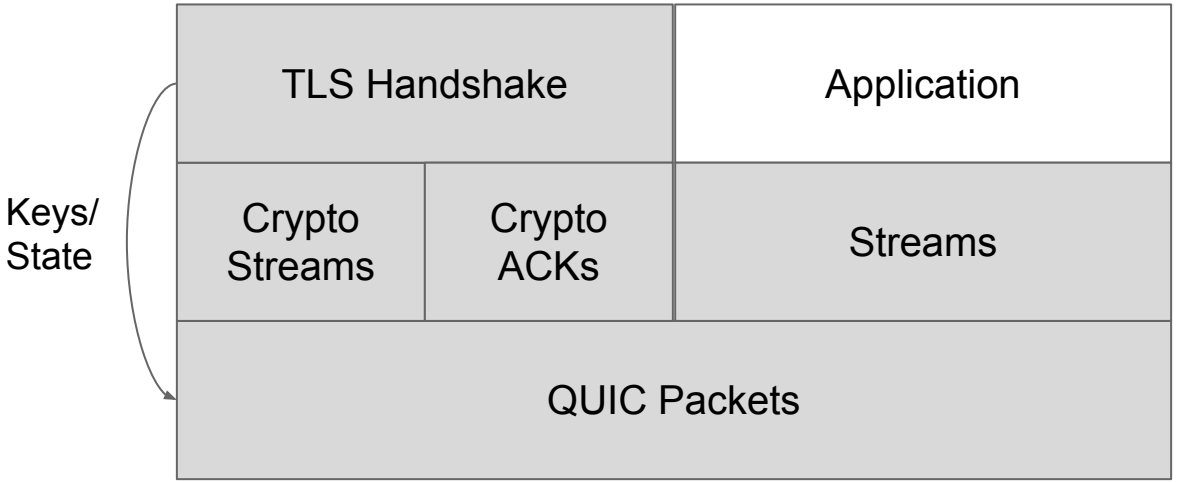
- We're to set up a reliable transport
- The reliable transport depends on keys which come from TLS
- But TLS requires a reliable transport to work



Breaking the dependency cycle

- Step 1: Separate the transport used by the crypto from the transport used by the application
- Step 2: ???
- Step 3: Profit

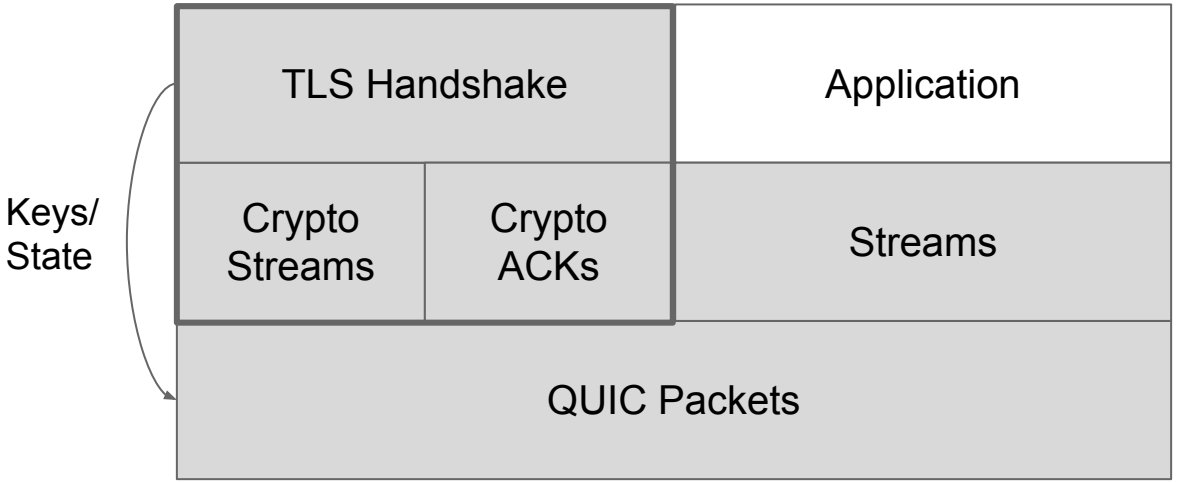
Crypto Streams and Crypto ACKs



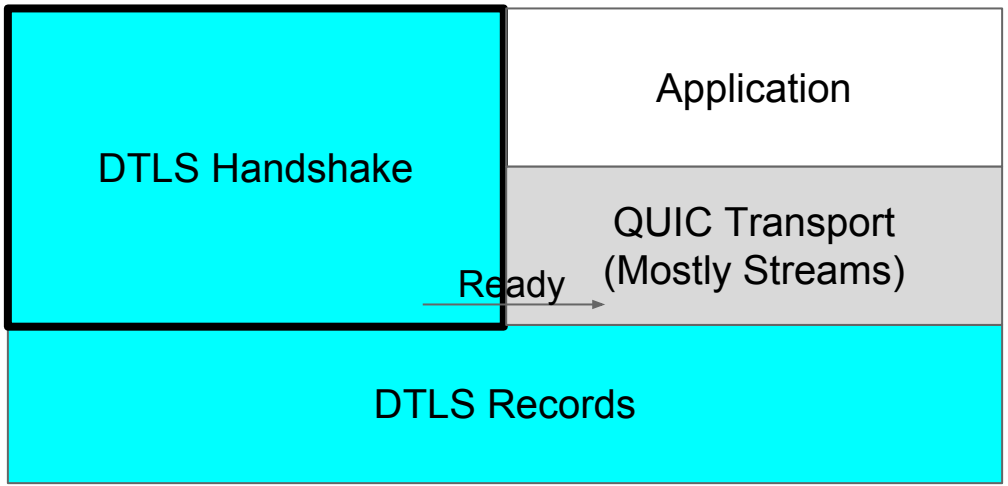
Crypto Streams Implications

- Probably the minimal change that does anything
- Solves some of the problems
  - Flow control
  - Clarity about what's encrypted and what's not (at cost of widening the TLS interface further)
  - Holes from unencrypted packets
  - ACK rules
- Need some solutions for the other problems
  - HANDSHAKE_DONE for CFIN?
  - Or live with them….

Crypto Streams and Crypto ACKs



Layer over DTLS



DTLS Implications

- Bigger change to QUIC
  - Exempts crypto from flow control entirely (reverts previous decision)
  - Mostly deletions!
- Some small changes to DTLS 1.3
  - Mostly stealing QUIC packet formats and connection ID structure (which came from DTLS actually)
- Solves effectively all these problems

DTLS Impact (I)

- Bigger change to QUIC
  - But mostly deletions!
- Small changes to DTLS 1.3
  - Primarily importing features from SIP (more later)
  - Conveniently the I-D is still open
- Solves effectively all these problems
- Implementation experience shows a significant net simplification in the QUIC code

DTLS Impact (II)

- DTLS becomes the QUIC wire image
  - We have flexibility because the I-D isn't done
  - Ultimately could mostly graft QUIC packet formats onto DTLS 1.3
- Small amount of packet expansion (maybe?)
- ACKs require QUIC having
  - access to DTLS packet #s
  - Epochs require changing ACKs a bit
    - Something like this is also required by crypto streams
- DTLS 1.3 spec and implementations less mature than TLS 1.3

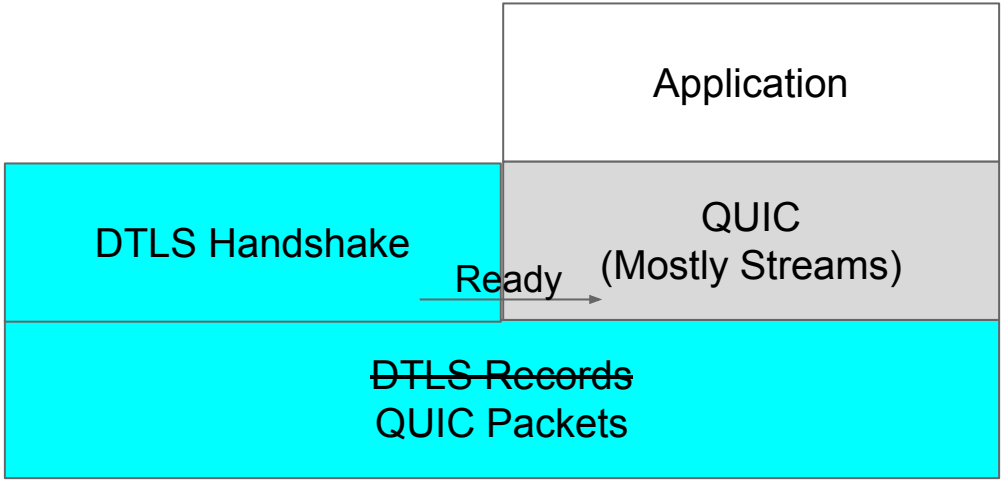
Discussion

What is the right **architecture** for QUIC?

How do we evaluate the alternatives?

Backup slides

An Alternative for the Schedule Sensitive



Alternative

- (Somewhat) bigger change to QUIC
  - But mostly deletions!
- Solves effectively all these problems
- Challenges
  - Need to write a document describing how to carry DTLS data over QUIC records
    - Straightforward mapping to DTLS records
  - ~~Small amount of packet expansion (maybe?)~~
  - ~~DTLS epochs require changing ACKs a bit~~
    - ~~Though this is also required by crypto streams~~
  - DTLS implementations less mature