Unidirectional Streams in Minq

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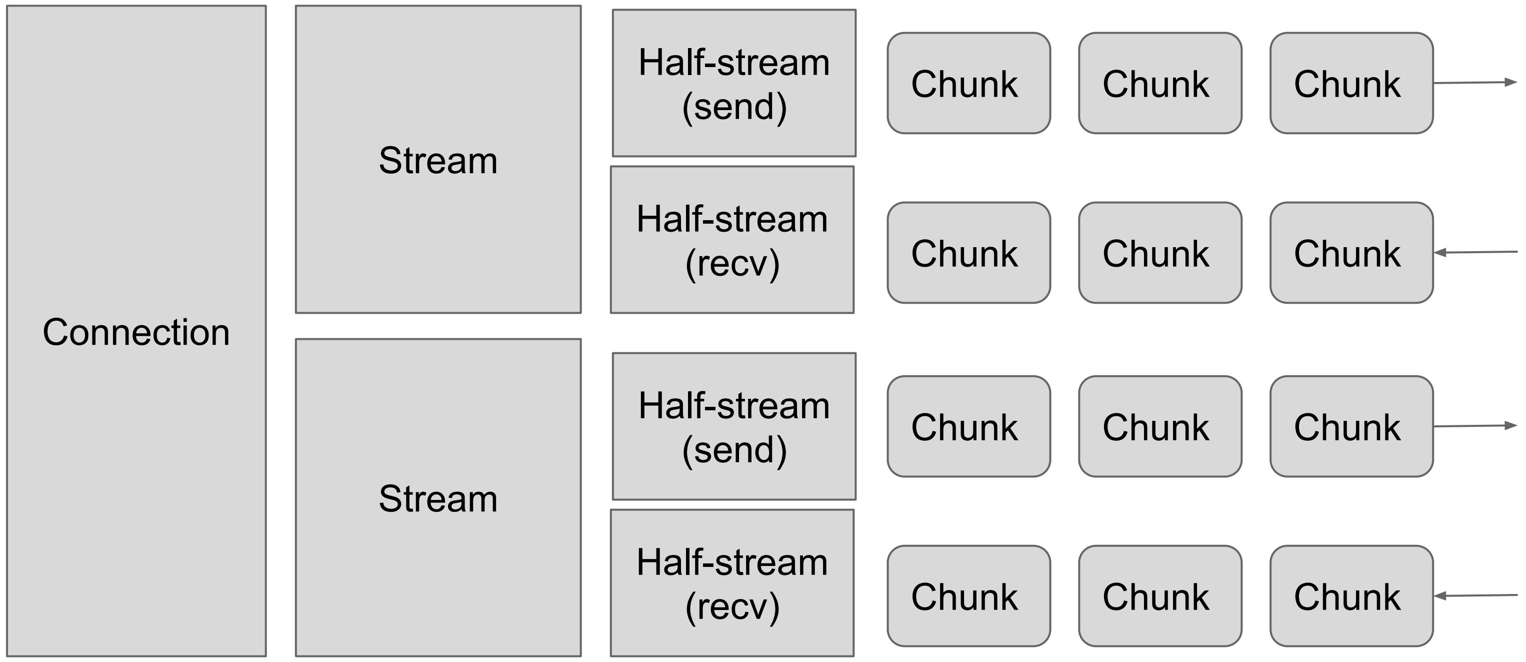
Overall Status

- Minq `master` currently implements -05
  - With HTTP/0.9
- Minq `unidirectional_streams` branch implements (QUIC-only)
  - PR #643: “Unidirectional Streams”
  - PR #720: “Add bidirectional streams on top of unidirectional”
  - A bidirectional “unified” stream API on top (nearly the same API as `master`)
- Total time investment to adapt to unidirectional: ~16 hours

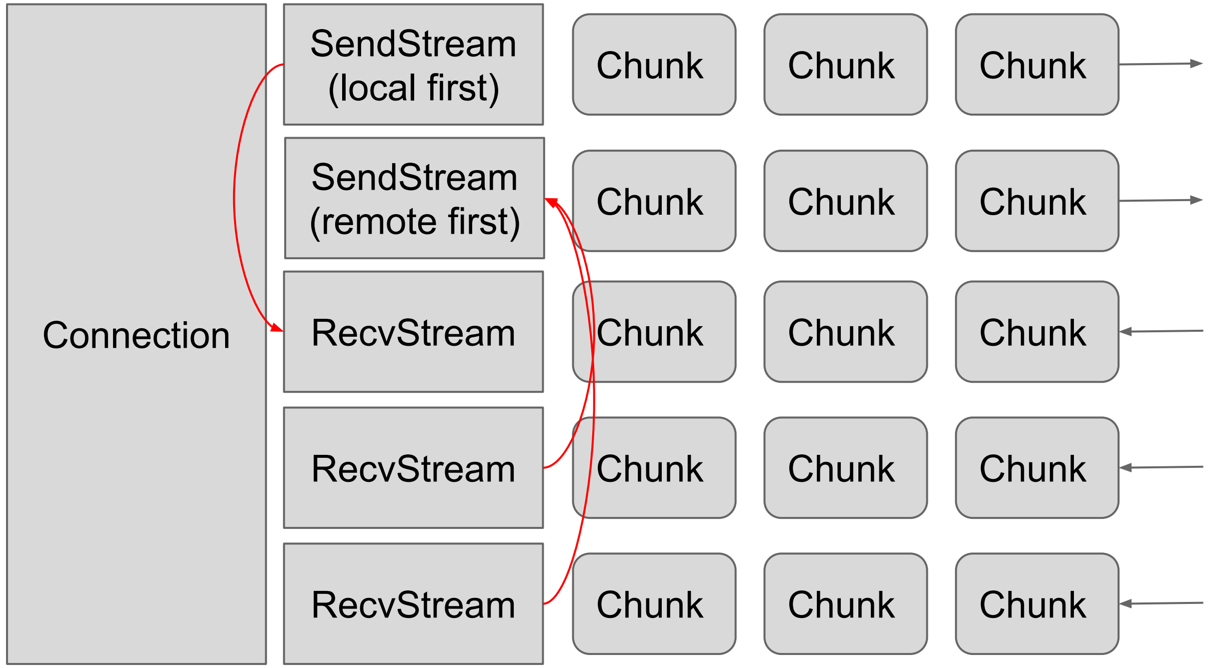
Recap: Changes under discussion

- PR#643
    - Streams are unidirectional only (initiated by sender)
    - Simplified state machine (no need to look at peer's state)
    - No odd/even semantics
    -
- PR#720
    - Streams can indicate that they are related to another existing stream in the other direction
    - Extra bits in the stream frame to carry this
    - Allows 1:N relation

Architecture for -05



Architecture for Unidirectional Streams



Bidirectional Streams API

- `Connection2` is a bidirectional wrapper for `Connection`
    - Actually, `Connection` is a mixin
- `Stream` is a pair of `SendStream` and `RecvStream`
    - API calls mostly go to the underlying directional stream
- Still working out Close()
    - But that's because we don't understand semantics
- Possible to use bidirectional streams API with a "conformant" related-streams peer (my test programs work this way)
- Note: this won't work with many-to-one related mappings

Bidirectional Streams Internals

- Streams locally created with `CreateStream()`
- Remote streams notified with `NewStream()` event
- When locally created (send first), starts with an empty `RecvStream`
  - `Read()` at this point appear to block
  - `RecvStream` automatically filled in when a related recv stream appears
- When remotely created (recv first), we secretly create a paired `SendStream`, ready for use

Impact on Applications

- Straightforward API call mapping
  - `GetReceiveStream()`, `CreateSendStream()`, `CreateRelatedSendStream()`
  - Bidirectional protocols need a bit of work
    - With remote-first streams, do `CreateRelatedSendStream()`
    - With local-first streams, `Connection` calls `NewRecvStream()` callback
- With bidirectional API, mostly just search and replace
  - `s/Connection/Connection2/`

Disadvantages of unidirectional streams

- A bit more work for bidirectional protocols
    - But bidirectional API hides this
- Semantics of closure are kind of unclear
    - What API should we provide? (`close()`, `shutdown()`)
    - What API should I use if I don't like a remotely created stream
- Easier for sides to disagree about mapping
    - Is this stream unpaired, 1:1, or 1:N?
    - It's not signalled inband right now
    - This will need to be specified in the protocol
- "Related streams" header inclusion rules are a bit awkward
    - Proposal: require in all stream packets till one ACKed

Advantages of unidirectional streams

- Was easier and more natural to implement
  - "Stream halves" don't really make sense
  - Composition let me share the common pieces
  - Simpler state machine (e.g., `Reset()` always goes to CLOSED, not sometimes to HC-Local)
  - No goofy odd/even semantics
- Clearer semantics around remote creation
  - In bidirectional, if I receive STREAM_MAX_DATA can I send?
- More flexible semantics
  - unpaired, 1:1, or 1:N mappings