Exchanging Congestion Control Data in QUIC

draft-yuan-quic-congestion-data-00

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Background

- Careful Resume provides uses remembered congestion control parameters to warm up the slow-start phase.
- The most reliable and direct information will be the samples during the cc, such as congestion window size and probe bandwidth.
- Clients often connect to a manageable number of servers and can retain such state, servers typically service orders of magnitude more clients and cannot feasibly retain such information.

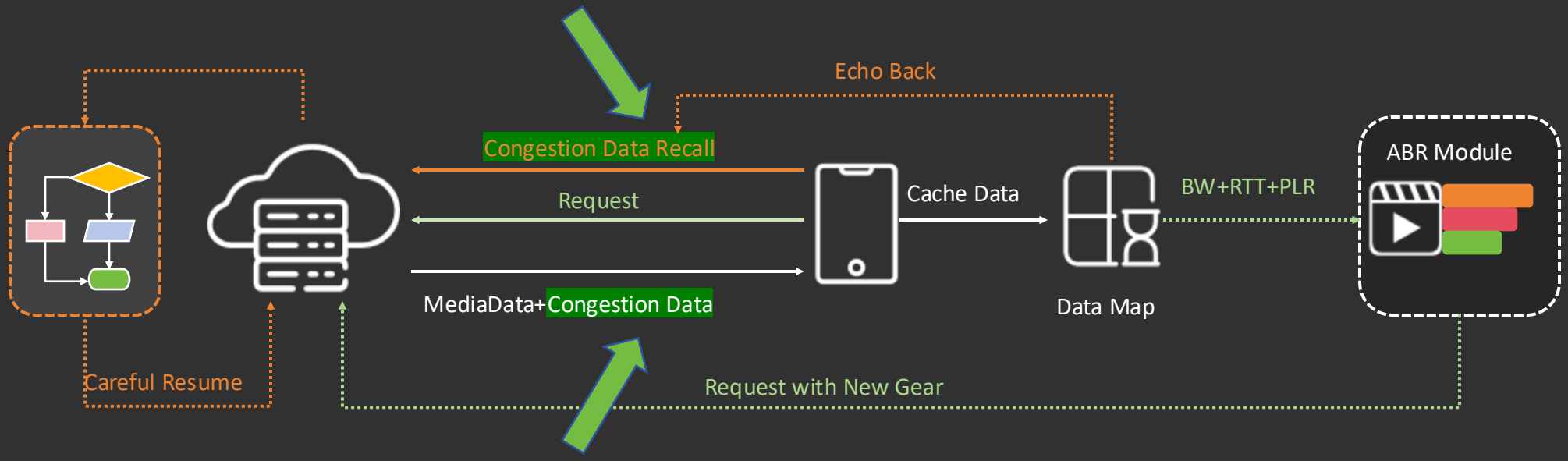
How to achieve distributed storage and interaction of congestion information?

Mechanism

- This draft provides a mechanism to organize these cc informations as two new QUIC Frames:
  - *CONGESTION_DATA Frame:* Allow the sender to export its cc state in an integrity-protected manner
  - *CONGESTION_DATA_RECALL Frame:* Assist its peer to recall the information necessary to perform Careful Resume

CONGESTION_DATA Frame is not encrypted, so it can be exposed to application layer for more scenarios (like ABR).

Introduction



Transport Parameter

- support_congestion_data(i): A variable-length integer
  - *CONSUME (0x01)*:The sender is interested in receiving *CONGESTION_DATA* frames for its own uses during the current connection, independent of the receiver's ability to reuse the data in the future.
  - *CACHE (0x02)*: The sender is willing to receive *CONGESTION_DATA* frames and potentially return the contents in a *CONGESTION_DATA_RECALL* frame on a subsequent connection.
  - *CONSIDER (0x04)*:The sender is willing to have values it may have provided on a previous connection returned to it in a *CONGESTION_DATA_RECALL* frame.

Network Statistics

```
Network Statistic structure {
    Type (i),
    Length (i),
    Value (..)
 }
```

- *Type*: The statistic being offered.
- *Length*: The length of the Value field in bytes.
- *Value*: A Type-specific value carrying the payload of the indicated statistic.

Type	Name
0xc8	Timestamp
0xca	Path Tuple
0xcb	Slow Start Status
0xcc	Network Type
0xcd	Maximum Congestion Window
0xce	Maximum In-Flight Data
0xcf	Smoothed RTT
0xd0	Minimum RTT
0xd1	RTT Variance
0xd2	Latest Bandwidth
0xd3	Maximum Bandwidth
0xd4	Throughput
0xd5	Send Rate
0xd6	Receive Rate
0xd7	Input Rate
0xd8	Loss Rate
0xd9	Buffer Length

Table 3

CONGESTION_DATA Frame

```
CONGESTION_DATA Frame {
    Type (i) = TBD1,
    Protected Count (i),
    Protected Network Statistics (..) ...,
     [Integrity Tag (1..)],
     Unprotected Count (i),
    Unprotected Network Statistics (..) ...,
}
```

- *(Un)Protected Count*: The number of *Network Statistics* in the *(Un)Protected Network Statistics* field.
- *(Un)Protected Network Statistics*: A sequence of *Network Statistics* objects whose length is given by the *(Un)Protected Count*.
- *Integrity Tag*: A message integrity check

CONGESTION_DATA Frame

- *CONGESTION_DATA* frame is not retransmittable
- *CONGESTION_DATA* frame can be sent at any point in the connection after 0-RTT or 1-RTT keys have been established
- *CONGESTION_DATA* frame MUST NOT be received in an Initial or Handshake packet
- If one endpoint set *CONSIDER* flag and the other set *CACHE* flag, the endpoint SHOULD put its desired recall statics into the *Protected Network Statistics field*, and use calculate a *Integrity Tag*.
- Receiver of the *CONGESTION_DATA* frames can parse these frames and extract the protection field as the *CONGESTION_DATA_RECALL* frame.

CONGESTION_DATA_RECALL Frame

```
CONGESTION_DATA Frame {
    Type (i) = TBD2,
    Protected Count (i),
    Protected Network Statistics (..) ...,
    Integrity Tag (1..),
}
```

- *CONGESTION_DATA_RECALL* frame contain a list of *Network Statistics* values which the sender received from the recipient during a previous connection.
- This frame SHOULD be sent as early as possible in the connection once 0-RTT or 1-RTT keys are available.
- Receiver MUST check the *Integrity Tag* before use its value for Careful Resume

Security Considerations

- Address validation tokens are opaque and can containany data the server might wish to recall, the statistics being transported by this mechanism are visible to the clients
- Implementations MAY choose not to send *CONGESTION_DATA_RECALL* frames which contain statistics they cannot interpret.
- Clients SHOULD NOT send *CONGESTION_DATA_RECALL* frames on connections where they would not have sent an Address Validation token if one were available
- Clients SHOULD discard stored network statistics when other potential tracking mechanisms (e.g. HTTP Cookies) are cleared by the user.

Next Steps

- Probably need to make some changes ☺
- Seeking WG adoption.

Citations

- [CAREFUL-RESUME]:Kuhn, N., Stephan, E., Fairhurst, G., Secchi, R., and C.Huitema, "Convergence of Congestion Control from Retained State", Work in Progress, Internet-Draft, draft-ietf-tsvwg-careful-resume-24, 1 October 2025, <https://datatracker.ietf.org/doc/html/draft-ietf-tsvwg- careful-resume-24>.
- [COOKIES]: Barth, A., "HTTP State Management Mechanism", RFC 6265, DOI 10.17487/RFC6265, April 2011, <https://www.rfc-editor.org/rfc/rfc6265>.
- [RFC2104] Krawczyk, H., Bellare, M., and R. Canetti, "HMAC: Keyed-Hashing for Message Authentication", RFC 2104, DOI 10.17487/RFC2104, February 1997, <https://www.rfc-editor.org/rfc/rfc2104>.
- [STUN] Rosenberg, J., Mahy, R., Matthews, P., and D. Wing, "Session Traversal Utilities for NAT (STUN)", RFC 5389, DOI 10.17487/RFC5389, October 2008, <https://www.rfc-editor.org/rfc/rfc5389>.