Background - QUIC

- QUIC is a new UDP-based multiplexed and secure transport protocol defined in RFC 9000.
  https://datatracker.ietf.org/wg/quic/about/
  - Low latency
  - Encrypted transport
  - Resilient connections (18-byte connection IDs)

- Multiple streams can be multiplexed onto an underlying connection
  Each stream is a separate “ordered stream of bytes.
  Stream flow control limits bytes sent on a stream.
Why BGP over QUIC

• High Resiliency
  With multi-channel channel BGP support:
  each channel can be reset independently without impacting other channels. draft-ietf-idr-bgp-multisession defines BGP over multiple TCP sessions but achieved very limited implementation and deployment.
  Allowing each channel to transmit data concurrently. This helps avoid head-of-line blocking and improve overall performance.

• Enhanced Security
  QUIC provides transport security with build-in encryption and authentication. This helps protect against spoofing attacks etc.

• Connection Migration
  QUIC supports seamless migration of connections between different network interfaces or IP addresses.
Terminologies

• BoQ, Multi-channel BGP using QUIC: Running the BGP protocol over multiple QUIC streams as defined in this document.

• QUIC connection: A transport-layer connection between two endpoints using QUIC [RFC9000].

• QUIC streams: A bidirectional or unidirectional byte stream provided by the QUIC transport [RFC9000].

• BGP channel: Instance of BGP protocol state machine mapped to specific QUIC stream.

• BGP control channel: a channel dedicated to transmitting the session control data, which is implemented as a bidirectional stream.

• BGP function channel: BGP per AFI/SAFI channel, which is implemented asymmetrically as unidirectional streams.
Establish BoQ Connection

• Establish a transport layer connection. TLS 1.3 is integrated with QUIC. The TLS authentication parameters used for this connection are out of scope.

  A BoQ speaker MUST select the Application-Layer Protocol Negotiation (ALPN) [RFC7301] token "boq" in the TLS handshake. Support for other application-layer protocols MUST NOT be offered in the same handshake.

• Establish a BoQ session over this transport connection. Defined in the draft.
Control Channel

• In one BoQ session, there is one control channel and multiple function channels.

• The control channel is a client-initiated *bidirectional QUIC stream* with stream ID 0. The capabilities carried in the OPEN message for the control channel are the BoQ connection specific parameter, such as BGP Role Capability.
Function Channels

• Per-AFI/SAFI function channels are used to exchange routing information. They are \textit{unidirectional streams} and can be client or server initiated. Only one function channel per AFI/SAFI exists from one BoQ speaker to another.

• Function channels are \textit{asymmetrically} created after the control channel reaches established state. A BoQ peer, each can create a function channel to implement symmetric route advertisements.

• Each function channel is created independently and can be \textit{reset in case of error without impacting other channels}.
BoQ Framing Layer

- BoQ messages are carried by QUIC STREAM frames.
- There are BoQ messages sent in the control channel that are meant for a function channel and need to have the corresponding function channel/stream ID.
- The following frame types are defined with the frame payload carries the BGP message.

```plaintext
BoQ Data Frame {
  Type (16) = 0,
  Length (16),
  Frame Payload (..)
}

BoQ Control Data Frame {
  Type (16) = 1,
  Length (16),
  Stream ID (62),
  Padding (2) = 0,
  Frame Payload (..)
}
```
Channel Reset and Coordination

- NOTIFICATIONs are always sent over the control channel.
- Hold timer in the control channel SHOULD be smaller than those in function channels.
- QUIC doesn’t guarantee transmission and delivery orders across streams. AFI/SAFI coordination must be accomplished through BGP.

  Function channels for critical routing information should be given higher priority compared to non-routing information.
BGP over QUIC Capability

• QUIC supports connection migration, a feature considered for BoQ in the future. However, only the client side can move.

• An explicit configuration is needed to identify a BoQ speaker's role: a QUIC client, a QUIC server, or any (Don’t care). The default value is "any".

• A new ”BGP over QUIC” capability is defined below to signal whether the BoQ speaker is a QUIC client, a QUIC server, or any (Don’t care).

Detail and conflict resolution are defined in the draft.
To-dos on the Roadmap

• Finite State Machine
• Graceful Restart
• Connection Migrations
• Channel Prioritization
• Operational Considerations for TLS certificate
• ...

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Next Steps

• Reviews and comments are welcome
• GitHub Repository: github.com

Thanks!