

## **JENAM TECH, LLC’S FIRST AMENDED SET OF INFRINGEMENT CONTENTIONS**

### **U.S. Patent No. 10,306,026 – Google LLC**

#### **Claims 22, 31, 32, 45, 46, 48, 51, 56, 57, 59, 60, 66, 67, and 69**

Jenam Tech, LLC (“Jenam”) provides evidence of infringement of claims 22, 31, 32, 45, 46, 48, 51, 56, 57, 59, 60, 66, 67, and 69 of U.S. Patent No. 10,306,026 (hereinafter “the ’026 patent”) by Google LLC (“Google”). In support thereof, Jenam provides the following claim charts.

“Accused Instrumentalities” as used herein refers to at least one or more websites or web addresses including, but not limited to [www.google.com](http://www.google.com), stored and/or hosted on one or more servers owned or under the control of Google. For the sake of clarity, Jenam alleges that all of Google’s various websites, products, and platforms utilizing QUIC infringe the ’026 patent, including, but not limited to Google Edge Network, Google Cloud, Chrome Enterprise, G suite, Google Play, Chrome, Android (Android Enterprise, Android Messages (RCS)), Duo, Google Ads, Adwords, Google Analytics, Youtube, Google Mobile apps, Google shopping, and Google Maps. A list of Google’s “products” can be found at [https://about.google/intl/en\\_us/products/](https://about.google/intl/en_us/products/). On information and belief, the Accused Instrumentalities referred to in the charts below are representative of Google’s use of QUIC in Google’s other websites, products and platforms. These claim charts demonstrate Google’s infringement, and provide notice of such infringement, by comparing each element of the asserted claims to corresponding components, aspects, and/or features of the Accused Instrumentalities. These claim charts are not intended to constitute an expert report on infringement. These claim charts include information provided by way of example, and not by way of limitation.

The analysis set forth below is based only upon information from publicly available resources regarding the Infringing Instrumentalities. An analysis of Google’s (or other third parties’) technical documentation and/or software source code may assist in fully identify all infringing features and functionality. Accordingly, Jenam reserves the right to supplement this infringement analysis once such information is made available to Jenam. Furthermore, Jenam reserves the right to revise this infringement analysis, as appropriate, upon issuance of a court order construing any terms recited in the asserted claims. Unless otherwise noted, Jenam contends that Google directly infringes the ’026 patent in violation of 35 U.S.C. § 271(a) by selling, offering to sell, making, using, and/or importing the Infringing Instrumentalities. The following exemplary analysis demonstrates that infringement. Unless otherwise noted, Jenam further contends that the evidence below supports a finding of indirect infringement under 35 U.S.C. §§ 271(b) and/or (c), in conjunction with other evidence of liability under one or more of those subsections. Google makes, uses, sells, imports, or offers for sale in the United States, or has made, used, sold, imported, or offered for sale in the past, without authority, or induces others to make, use, sell, import, or offer for sale in the United States, or has induced others to make, use, sell, import, or offer for sale in the past, without authority products, equipment, or services that infringe claims 22, 31, 32, 45, 46, 48, 51, 56, 57, 59, 60, 66, 67, and 69 of the ’026 patent, including without limitation, the Accused Instrumentalities.

Unless otherwise noted, Jenam believes and contends that each element of each claim asserted herein is literally met through Google’s provision of the Infringing Instrumentalities. However, to the extent that Google attempts to allege that any asserted claim

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element is not literally met, Jenam believes and contends that such elements are met under the doctrine of equivalents. More specifically, in its investigation and analysis of the Infringing Instrumentalities, Jenam did not identify any substantial differences between the elements of the patent claims and the corresponding features of the Infringing Instrumentalities, as set forth herein. In each instance, the identified feature of the Infringing Instrumentalities performs at least substantially the same function in substantially the same way to achieve substantially the same result as the corresponding claim element.

To the extent the chart of an asserted claim relies on evidence about certain specifically-identified Accused Instrumentalities, Jenam asserts that, on information and belief, any similarly-functioning instrumentalities also infringes the charted claim. Jenam reserves the right to amend this infringement analysis based on other products made, used, sold, imported, or offered for sale by Google. Jenam also reserves the right to amend this infringement analysis by citing other claims of the '026 patent, not listed in the claim chart, that are infringed by the Accused Instrumentalities. Jenam further reserves the right to amend this infringement analysis by adding, subtracting, or otherwise modifying content in the "Accused Instrumentalities" column of each chart.

| Claim 1 Elements                                                                                                                                                                     | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A method, comprising: at a node:<br><br>receiving, from another node, a transmission control protocol (TCP)-variant packet in advance of a TCP-variant connection being established; | Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including, at a node (e.g., one of a QUIC-compliant server or client, etc.): receiving, from another node (e.g., the other one of the QUIC-compliant server or client, etc.), a transmission control protocol (TCP)-variant packet in advance of a TCP-variant connection being established.<br><br>See excerpt(s) below, for example (emphasis added, if any):<br><br><b>Note:</b> Google admits that their "Google Cloud Platform" uses QUIC:<br><br>"Google Cloud Platform Blog...<br><br>we're happy to be the first major public cloud to offer QUIC support for our HTTPS load balancers."<br><a href="https://cloudplatform.googleblog.com/2018/06/Introducing-QUIC-support-for-HTTPS-load-balancing.html">https://cloudplatform.googleblog.com/2018/06/Introducing-QUIC-support-for-HTTPS-load-balancing.html</a> |

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|  | <p><b>Note:</b> The “Google Cloud Platform” that, as established above, uses QUIC, is also used for ALL of Google’s services:</p> <p>“Google Cloud Platform (GCP), offered by Google (company), is a suite of cloud computing services that runs on the same infrastructure that Google uses internally for its end-user products, such as Google Search, Gmail, file storage, and YouTube”<br/><a href="https://en.wikipedia.org/wiki/Google_Cloud_Platform">https://en.wikipedia.org/wiki/Google_Cloud_Platform</a></p> <p><b>Note:</b> At least a portion of the citations herein are made to the QUIC standard found at:<br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a>, and/or <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-27">https://tools.ietf.org/html/draft-ietf-quic-transport-27</a>. Based upon information and belief, the pertinent portions of such version of the QUIC standard may also be found in one or more other versions. For completeness, all of the versions below (and future iterations thereof) are hereby incorporated by reference:</p> <p><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-00">https://tools.ietf.org/html/draft-ietf-quic-transport-00</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-01">https://tools.ietf.org/html/draft-ietf-quic-transport-01</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-02">https://tools.ietf.org/html/draft-ietf-quic-transport-02</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-03">https://tools.ietf.org/html/draft-ietf-quic-transport-03</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-04">https://tools.ietf.org/html/draft-ietf-quic-transport-04</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-05">https://tools.ietf.org/html/draft-ietf-quic-transport-05</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-06">https://tools.ietf.org/html/draft-ietf-quic-transport-06</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-08">https://tools.ietf.org/html/draft-ietf-quic-transport-08</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-09">https://tools.ietf.org/html/draft-ietf-quic-transport-09</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-10">https://tools.ietf.org/html/draft-ietf-quic-transport-10</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-11">https://tools.ietf.org/html/draft-ietf-quic-transport-11</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-12">https://tools.ietf.org/html/draft-ietf-quic-transport-12</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-13">https://tools.ietf.org/html/draft-ietf-quic-transport-13</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-14">https://tools.ietf.org/html/draft-ietf-quic-transport-14</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-15">https://tools.ietf.org/html/draft-ietf-quic-transport-15</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-16">https://tools.ietf.org/html/draft-ietf-quic-transport-16</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-17">https://tools.ietf.org/html/draft-ietf-quic-transport-17</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-18">https://tools.ietf.org/html/draft-ietf-quic-transport-18</a></p> |
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|  | <p><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-19">https://tools.ietf.org/html/draft-ietf-quic-transport-19</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-20">https://tools.ietf.org/html/draft-ietf-quic-transport-20</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-21">https://tools.ietf.org/html/draft-ietf-quic-transport-21</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-23">https://tools.ietf.org/html/draft-ietf-quic-transport-23</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-24">https://tools.ietf.org/html/draft-ietf-quic-transport-24</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-25">https://tools.ietf.org/html/draft-ietf-quic-transport-25</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-26">https://tools.ietf.org/html/draft-ietf-quic-transport-26</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-27">https://tools.ietf.org/html/draft-ietf-quic-transport-27</a></p> <p><b>Note:</b> Though these contentions may refer to a specific version of the QUIC standard, the presented evidence is not exclusive to this specific version and is compliant with and/or supported by current versions of the QUIC standard, including QUIC_VERSION_IETF_RFC_V1 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34</a>), QUIC_VERSION_IETF_DRAFT_25 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-25">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-25</a>), QUIC_VERSION_IETF_DRAFT_27 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-27">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-27</a>), QUIC_VERSION_IETF_DRAFT_28 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-28">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-28</a>), QUIC_VERSION_IETF_DRAFT_29 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-29">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-29</a>), and/or QUIC_VERSION_50 which relies in part on IETF_QUIC_INVARIANTS_06 (<a href="https://tools.ietf.org/html/draft-ietf-quic-invariants-06">https://tools.ietf.org/html/draft-ietf-quic-invariants-06</a>) and/or IETF_QUIC_TRANSPORT_17 (<a href="https://tools.ietf.org/html/draft-ietf-quic-transport-17">https://tools.ietf.org/html/draft-ietf-quic-transport-17</a>), each of which, upon information and belief, has been utilized by Google LLC through its accused instrumentalities.</p> <p><b>Note:</b> Below is a web page of Google (<a href="https://www.google.com/">https://www.google.com/</a>).</p> |
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The screenshot shows a Google search for "Alameda County" on the left. On the right, the Chrome DevTools Network tab is open, displaying a list of network requests. The "Protocol" column is highlighted in red, showing that all requests are using the "http/2+quic/46" protocol. The requests include various resources like fonts, images, and scripts, all using the "http/2+quic/46" protocol.

| Name                      | Status | Protocol       | Domain                    | Type      | Initiator         | Size         | Time | Waterfall |
|---------------------------|--------|----------------|---------------------------|-----------|-------------------|--------------|------|-----------|
| font.gstatic.com          | 200    | http/2+quic/46 | font.gstatic.com          | font      | app/config=ht...  | (disk cac... | 6... |           |
| accounts.google.com       | 200    | http/2+quic/46 | accounts.google.com       | document  | rs=AA2YrTuis...   | 1.4 KB       | 1... |           |
| lh3.googleusercontent.com | 200    | http/2+quic/46 | lh3.googleusercontent.com | jpeg      | rs=AA2YrTuis...   | (disk cac... | 1... |           |
| lh3.googleusercontent.com | 200    | http/2+quic/46 | lh3.googleusercontent.com | jpeg      | rs=AA2YrTuis...   | (disk cac... | 1... |           |
| lh3.googleusercontent.com | 200    | http/2+quic/46 | lh3.googleusercontent.com | jpeg      | rs=AA2YrTuis...   | (disk cac... | 1... |           |
| lh3.googleusercontent.com | 200    | http/2+quic/46 | lh3.googleusercontent.com | png       | rs=AA2YrTuis...   | (disk cac... | 8... |           |
| www.gstatic.com           | 200    | http/2+quic/46 | www.gstatic.com           | script    | m=b, tp:434       | (disk cac... | 3... |           |
| www.gstatic.com           | 200    | http/2+quic/46 | www.gstatic.com           | script    | m=b, tp:434       | (disk cac... | 1... |           |
| play.google.com           | 200    | http/2+quic/46 | play.google.com           | xhr       | m=b, tp:301       | 644 B        | 1... |           |
| www.gstatic.com           | 200    | http/2+quic/46 | www.gstatic.com           | script    | m=b, tp:434       | (disk cac... | 3... |           |
| play.google.com           | 200    | http/2+quic/46 | play.google.com           | xhr       | m=b, tp:301       | 788 B        | 1... |           |
| lh3.googleusercontent.com | 200    | http/2+quic/46 | lh3.googleusercontent.com | jpeg      | search?safe=st... | 2.4 KB       | 1... |           |
| lh3.googleusercontent.com | 200    | http/2+quic/46 | lh3.googleusercontent.com | jpeg      | search?safe=st... | 2.2 KB       | 2... |           |
| lh3.googleusercontent.com | 200    | http/2+quic/46 | lh3.googleusercontent.com | jpeg      | search?safe=st... | 2.7 KB       | 1... |           |
| lh3.googleusercontent.com | 200    | http/2+quic/46 | lh3.googleusercontent.com | png       | search?safe=st... | 662 B        | 1... |           |
| www.google.com            | 204    | http/2+quic/46 | www.google.com            | text/html | rs=ACT90oFF1ed... | 40 B         | 5... |           |
| www.google.com            | 204    | http/2+quic/46 | www.google.com            | text/html | rs=ACT90oFF1ed... | 40 B         | 5... |           |
| play.google.com           | 200    | http/2+quic/46 | play.google.com           | xhr       | rs=AA2YrTuis...   | 345 B        | 5... |           |

**Note:** As set forth below, QUIC is a “variant” of TCP.

## 1. Introduction

QUIC is a multiplexed and secure transport protocol that runs on top of UDP. QUIC aims to provide a flexible set of features that allow it to be a general-purpose transport for multiple applications.

QUIC implements techniques learned from experience with TCP, SCTP and

**Note:** The following evidence is related to and/or describes the QUIC standard contained herein.

“On the surface, QUIC is very similar to TCP+TLS+HTTP/2 implemented on UDP. ...However, since QUIC is built on top of UDP, it suffers from no such limitations.” <https://www.chromium.org/quic>

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|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                          | <p><b>Note:</b> As set forth below, a QUIC negotiation packet is received by one of the nodes.</p> <p>7.4. Transport Parameters</p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.</p> <p>QUIC packet: A well-formed UDP payload that can be parsed by a QUIC receiver. QUIC packet size in this document refers to the UDP</p> <p><b>Note:</b> As set forth below, prior to a QUIC connection being established, the QUIC connection is “set up” using the aforementioned handshake.</p> <p>3.1. Low-Latency Connection Establishment</p> <p>QUIC relies on a combined cryptographic and transport handshake for setting up a secure transport connection. QUIC connections are expected to commonly use 0-RTT handshakes, meaning that for most QUIC connections, data can be sent immediately following the client handshake packet, without waiting for a reply from the server. QUIC provides a dedicated stream (Stream ID 0) to be used for performing the cryptographic handshake and QUIC options negotiation. The format of the QUIC options and parameters used during negotiation are described in this document, but the handshake protocol that runs on Stream ID 0 is described in the accompanying cryptographic handshake draft [QUIC-TLS].</p> |
| detecting an idle time period parameter field in the TCP-variant packet; | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs the method including, at the node: detecting an idle time period parameter field (e.g., idle timeout parameter field, etc.) in the TCP-variant packet (e.g., QUIC negotiation packet, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

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**Note:** As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.

7.4. Transport Parameters

During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.

| Value  | Parameter Name          | Specification |
|--------|-------------------------|---------------|
| 0x0000 | initial_max_stream_data | Section 7.4.1 |
| 0x0001 | initial_max_data        | Section 7.4.1 |
| 0x0002 | initial_max_stream_id   | Section 7.4.1 |
| 0x0003 | idle_timeout            | Section 7.4.1 |
| 0x0004 | omit_connection_id      | Section 7.4.1 |
| 0x0005 | max_packet_size         | Section 7.4.1 |
| 0x0006 | stateless_reset_token   | Section 7.4.1 |

Table 4: Initial QUIC Transport Parameters Entries

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|                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                       | <p>The format of the transport parameters is the TransportParameters struct from Figure 6. This is described using the presentation language from Section 3 of [I-D.ietf-tls-tls13].</p> <pre> uint32 QuicVersion;  enum {     initial_max_stream_data(0),     initial_max_data(1),     initial_max_stream_id(2),     idle_timeout(3),     omit_connection_id(4),     max_packet_size(5),     stateless_reset_token(6),     (65535) } TransportParameterId;                     </pre>                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>identifying metadata in the idle time period parameter field for an idle time period and, during which, no packet is communicated in the TCP-variant connection to keep the TCP-variant connection active; and</p> | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs the method including, at the node: identifying metadata (e.g., a value, etc.) in the idle time period parameter field (e.g., idle timeout parameter field, etc.) for an idle time period and, during which, no packet is communicated in the TCP-variant connection to keep the TCP-variant connection active.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, the metadata includes a value in seconds that is encoded as an unsigned 16-bit integer.</p> <pre> idle_timeout (0x0003): The idle timeout is a value in seconds that is encoded as an unsigned 16-bit integer. The maximum value is 600 seconds (10 minutes).                     </pre> |

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|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                   | <p><b>7.8.2. Idle Timeout</b></p> <p>A connection that remains idle for longer than the idle timeout (see <a href="#">Section 7.4.1</a>) becomes closed. Either peer removes connection state if they have neither sent nor received a packet for this time.</p> <p>The time at which an idle timeout takes effect won't be perfectly synchronized on peers. A connection enters the draining period when the idle timeout expires. During this time, an endpoint that receives new packets MAY choose to restore the connection. Alternatively, an endpoint that receives packets MAY signal the timeout using an immediate close.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| modifying, based on the metadata, a timeout attribute associated with the TCP-variant connection. | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs the method including, at the node: modifying, based on the metadata (e.g., the value of the idle timeout parameter field, etc.), a timeout attribute associated with the TCP-variant connection.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p>idle_timeout (0x0003): The idle timeout is a value in seconds that is encoded as an unsigned 16-bit integer. The maximum value is 600 seconds (10 minutes).</p> <p><b>7.8. Connection Termination</b></p> <p>Connections should remain open until they become idle for a pre-negotiated period of time. A QUIC connection, once established, can be terminated in one of three ways:</p> |

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|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>7.8.2. Idle Timeout</p> <p>A connection that remains idle for longer than the idle timeout (see Section 7.4.1) becomes closed. Either peer removes connection state if they have neither sent nor received a packet for this time.</p> <p>The time at which an idle timeout takes effect won't be perfectly synchronized on peers. A connection enters the draining period when the idle timeout expires. During this time, an endpoint that receives new packets MAY choose to restore the connection. Alternatively, an endpoint that receives packets MAY signal the timeout using an immediate close.</p> |
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| Claim 17 Elements                                                                                                                                                   | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| <p>The method of claim 1 wherein one or more keep-alive packets are communicated, based on a keep-alive period that is, in turn, based on the idle time period.</p> | <p>Google infringes claim 1 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs the method wherein one or more keep-alive packets are communicated, based on a keep-alive period that is, in turn, based on the idle time period.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Based upon information and belief, infringement occurs, for example, at least during a packet communication scenario when a keep-alive packet starts a detected idle time period and no other keep-alives are communicated during the idle period.</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p style="text-align: center;">“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> <p>...</p> <ul style="list-style-type: none"> <li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires (Section 10.2); and</u></li> <li>• immediately close (Section 10.3) the connection.”</li> </ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |

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|  | <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the max_idle_timeouts (see Section 18.2) and three times the current Probe Timeout (PTO).</p> <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> |
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|  | <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| Claim 21 Elements                                                                                     | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| <p>The method of claim 17 wherein the keep-alive period is administered using a keep-alive timer.</p> | <p>Google infringes claim 17 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs the method wherein the keep-alive period is administered using a keep-alive timer.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, since the <code>idle_timeout</code> value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the <code>idle_timeout</code> field of the connection negotiation packet.</p> <p>“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> <p>...</p> <ul style="list-style-type: none"> <li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires (Section 10.2); and</u></li> <li>• immediately close (Section 10.3) the connection.”</li> </ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the <code>max_idle_timeouts</code> (see Section 18.2) and three times the current Probe Timeout (PTO).</p> |

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|  | <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having</p> |
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|  | <p>both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| Claim 22 Elements                                                                                                                          | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| <p>The method of claim 21 wherein the keep-alive timer is separate from an idle timer that is used to administer the idle time period.</p> | <p>Google infringes claim 21 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs the method wherein the keep-alive timer is separate from an idle timer that is used to administer the idle time period.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p>“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> <p>...</p> <ul style="list-style-type: none"> <li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires (Section 10.2); and</u></li> <li>• immediately close (Section 10.3) the connection.”</li> </ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“10.2. Idle Timeout</p> |

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|  | <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the max_idle_timeouts (see Section 18.2) and three times the current Probe Timeout (PTO).</p> <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide</p> |
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|  | <p>guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max idle timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| Claim 31 Elements                                                                                                                  | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| <p>The method of claim 1 wherein a duration of the idle time period is configured by an application via an analog of a socket.</p> | <p>Google infringes claim 1 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs the method wherein a duration of the idle time period is configured by an application via an analog of a socket (e.g., a listener socket and/or stream socket, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p>“10.2. Idle Timeout</p> <p><u>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout</u> (see Section 18.1) and three times the current Probe Timeout (PTO).”</p> <p>“The value for an idle timeout can be asymmetric. <u>The value advertised by an endpoint is only used to determine whether the connection is live at that endpoint.</u> An endpoint that sends packets near the end of the idle timeout period of a peer risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could timeout within a Probe Timeout (PTO; see Section 6.3 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> <p><b>7.4. Transport Parameters</b></p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.</p> |

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| Value  | Parameter Name          | Specification |
|--------|-------------------------|---------------|
| 0x0000 | initial_max_stream_data | Section 7.4.1 |
| 0x0001 | initial_max_data        | Section 7.4.1 |
| 0x0002 | initial_max_stream_id   | Section 7.4.1 |
| 0x0003 | idle_timeout            | Section 7.4.1 |
| 0x0004 | omit_connection_id      | Section 7.4.1 |
| 0x0005 | max_packet_size         | Section 7.4.1 |
| 0x0006 | stateless_reset_token   | Section 7.4.1 |

Table 4: Initial QUIC Transport Parameters Entries

QUIC: A UDP-Based Multiplexed and Secure Transport <https://tools.ietf.org/html/draft-ietf-quic-transport-07>

**Note:** The following evidence is related to and/or describes the QUIC standard contained herein.

“Because of the built-in stream multiplexing layer in QUIC, applications need to handle three types of logical objects: listeners, connections, and streams. These objects have different properties from the traditional UDP and TCP listeners and connections. As a result, the adaptation to socket semantics was not direct. We used three types of sockets to expose the QUIC API, with the following properties:

- **Listener sockets:** like regular TCP/UDP listeners, they bind to a port and are used to accept incoming connections. Listeners can be closed when the application no longer desires to accept new connections.

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|  | <ul style="list-style-type: none"><li>• <b>Connection sockets:</b> these sockets are created by connect or accept calls. Unlike TCP or UDP sockets, however, these sockets cannot be used to send or receive data and are only used to manage the streams belonging to the connection.</li><li>• <b>Stream sockets:</b> these are the sockets that provide send and receive functions so peers can <u>exchange data</u>. They can be <u>created either by accepting on a connection socket (for streams opened by the peer), or by calling connect on the connection socket to create a new, locally initiated stream</u>. Streams can be closed by either peer at any point during the connection.”<br/><a href="https://blogs.cisco.com/cloud/building-fast-quic-sockets-in-vpp">https://blogs.cisco.com/cloud/building-fast-quic-sockets-in-vpp</a> (emphasis added)</li></ul> |
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| Claim 32 Elements                                                                                     | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| The method of claim 1 wherein the metadata is identified by an application via an analog of a socket. | <p>Google infringes claim 1 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs the method wherein the metadata (e.g. the value, etc.) is identified by an application via an analog of a socket (e.g., a listener socket and/or stream socket, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p>“10.2. Idle Timeout</p> <p><u>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout</u> (see Section 18.1) and three times the current Probe Timeout (PTO).”</p> <p>“The value for an idle timeout can be asymmetric. <u>The value advertised by an endpoint is only used to determine whether the connection is live at that endpoint.</u> An endpoint that sends packets near the end of the idle timeout period of a peer risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could timeout within a Probe Timeout (PTO; see Section 6.3 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> |

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7.4. Transport Parameters

During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.

| Value  | Parameter Name          | Specification |
|--------|-------------------------|---------------|
| 0x0000 | initial_max_stream_data | Section 7.4.1 |
| 0x0001 | initial_max_data        | Section 7.4.1 |
| 0x0002 | initial_max_stream_id   | Section 7.4.1 |
| 0x0003 | idle_timeout            | Section 7.4.1 |
| 0x0004 | omit_connection_id      | Section 7.4.1 |
| 0x0005 | max_packet_size         | Section 7.4.1 |
| 0x0006 | stateless_reset_token   | Section 7.4.1 |

Table 4: Initial QUIC Transport Parameters Entries

QUIC: A UDP-Based Multiplexed and Secure Transport <https://tools.ietf.org/html/draft-ietf-quic-transport-07>

**Note:** The following evidence is related to and/or describes the QUIC standard contained herein.

“Because of the built-in stream multiplexing layer in QUIC, applications need to handle three types of logical objects: listeners, connections, and streams. These objects have different properties from the

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|  | <p>traditional UDP and TCP listeners and connections. As a result, the adaptation to socket semantics was not direct. <u>We used three types of sockets to expose the QUIC API</u>, with the following properties:</p> <ul style="list-style-type: none"><li>• <b><u>Listener sockets</u></b>: like regular TCP/UDP listeners, they bind to a port and are used to accept <u>incoming connections</u>. Listeners can be closed when the application no longer desires to accept new connections.</li><li>• <b><u>Connection sockets</u></b>: these sockets are created by connect or accept calls. Unlike TCP or UDP sockets, however, these sockets cannot be used to send or receive data and are only used to manage the streams belonging to the connection.</li><li>• <b><u>Stream sockets</u></b>: these are the sockets that provide send and receive functions so peers can <u>exchange data</u>. They can be <u>created either by accepting on a connection socket (for streams opened by the peer), or by calling connect on the connection socket to create a new, locally initiated stream</u>. Streams can be closed by either peer at any point during the connection.”</li></ul> <p><a href="https://blogs.cisco.com/cloud/building-fast-quic-sockets-in-vpp">https://blogs.cisco.com/cloud/building-fast-quic-sockets-in-vpp</a> (emphasis added)</p> |
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| Claim 33 Elements                                                                                                                                                                                                                                    | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>A method, comprising: at a node: receiving idle information for detecting an idle time period, during which, no packet is communicated in a transmission control protocol (TCP)-variant connection to keep the TCP-variant connection active;</p> | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method comprising: at a node: receiving idle information for detecting an idle time period, during which, no packet is communicated in a transmission control protocol (TCP)-variant connection (e.g., the QUIC connection, etc.) to keep the TCP-variant connection active.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Google admits that their “Google Cloud Platform” uses QUIC:</p> <p>"Google Cloud Platform Blog...</p> <p>we’re happy to be the first major public cloud to offer QUIC support for our HTTPS load balancers."<br/> <a href="https://cloudplatform.googleblog.com/2018/06/Introducing-QUIC-support-for-HTTPS-load-balancing.html">https://cloudplatform.googleblog.com/2018/06/Introducing-QUIC-support-for-HTTPS-load-balancing.html</a></p> <p><b>Note:</b> The “Google Cloud Platform” that, as established above, uses QUIC, is also used for ALL of Google’s services:</p> <p>“Google Cloud Platform (GCP), offered by Google (company), is a suite of cloud computing services that runs on the same infrastructure that Google uses internally for its end-user products, such as Google Search, Gmail, file storage, and YouTube”<br/> <a href="https://en.wikipedia.org/wiki/Google_Cloud_Platform">https://en.wikipedia.org/wiki/Google_Cloud_Platform</a></p> <p><b>Note:</b> At least a portion of the citations herein are made to the QUIC standard found at:<br/> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a>, and/or <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-27">https://tools.ietf.org/html/draft-ietf-quic-transport-27</a>. Based upon information and belief, the pertinent portions of such version of the QUIC standard may also be found in one or more other versions. For completeness, all of the versions below (and future iterations thereof) are hereby incorporated by reference:</p> <p><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-00">https://tools.ietf.org/html/draft-ietf-quic-transport-00</a></p> |

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|  | <p><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-01">https://tools.ietf.org/html/draft-ietf-quic-transport-01</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-02">https://tools.ietf.org/html/draft-ietf-quic-transport-02</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-03">https://tools.ietf.org/html/draft-ietf-quic-transport-03</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-04">https://tools.ietf.org/html/draft-ietf-quic-transport-04</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-05">https://tools.ietf.org/html/draft-ietf-quic-transport-05</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-06">https://tools.ietf.org/html/draft-ietf-quic-transport-06</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-08">https://tools.ietf.org/html/draft-ietf-quic-transport-08</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-09">https://tools.ietf.org/html/draft-ietf-quic-transport-09</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-10">https://tools.ietf.org/html/draft-ietf-quic-transport-10</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-11">https://tools.ietf.org/html/draft-ietf-quic-transport-11</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-12">https://tools.ietf.org/html/draft-ietf-quic-transport-12</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-13">https://tools.ietf.org/html/draft-ietf-quic-transport-13</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-14">https://tools.ietf.org/html/draft-ietf-quic-transport-14</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-15">https://tools.ietf.org/html/draft-ietf-quic-transport-15</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-16">https://tools.ietf.org/html/draft-ietf-quic-transport-16</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-17">https://tools.ietf.org/html/draft-ietf-quic-transport-17</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-18">https://tools.ietf.org/html/draft-ietf-quic-transport-18</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-19">https://tools.ietf.org/html/draft-ietf-quic-transport-19</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-20">https://tools.ietf.org/html/draft-ietf-quic-transport-20</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-21">https://tools.ietf.org/html/draft-ietf-quic-transport-21</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-23">https://tools.ietf.org/html/draft-ietf-quic-transport-23</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-24">https://tools.ietf.org/html/draft-ietf-quic-transport-24</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-25">https://tools.ietf.org/html/draft-ietf-quic-transport-25</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-26">https://tools.ietf.org/html/draft-ietf-quic-transport-26</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-27">https://tools.ietf.org/html/draft-ietf-quic-transport-27</a></p> <p><b>Note:</b> Though these contentions may refer to a specific version of the QUIC standard, the presented evidence is not exclusive to this specific version and is compliant with and/or supported by current versions of the QUIC standard, including QUIC_VERSION_IETF_RFC_V1 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34</a>), QUIC_VERSION_IETF_DRAFT_25 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-25">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-25</a>), QUIC_VERSION_IETF_DRAFT_27 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-27">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-27</a>)</p> |
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(<https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-27>), QUIC\_VERSION\_IETF\_DRAFT\_28 (<https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-28>), QUIC\_VERSION\_IETF\_DRAFT\_29 (<https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-29>), and/or QUIC\_VERSION\_50 which relies in part on IETF\_QUIC\_INVARIANTS\_06 (<https://tools.ietf.org/html/draft-ietf-quic-invariants-06>) and/or IETF\_QUIC\_TRANSPORT\_17 (<https://tools.ietf.org/html/draft-ietf-quic-transport-17>), each of which, upon information and belief, has been utilized by Google LLC through its accused instrumentalities.

**Note:** Below is a web page of Google (<https://www.google.com/>).

The screenshot shows a Google search page with the Network tab open in the developer tools. The Network tab displays a list of requests, with the 'Protocol' column highlighted in red. The requests are for various Google services, including accounts, photos, and search results. The 'Protocol' column shows 'http/2+quic/46' for many requests, indicating the use of QUIC.

| Name                   | St... | Protocol       | Domain                     | Type      | Initiator           | Size         | Ti... | Waterfall |
|------------------------|-------|----------------|----------------------------|-----------|---------------------|--------------|-------|-----------|
| KfOmCnqEu92fr1...      | 200   | http/2+quic/46 | tonts.gstatic.com          | tont      | app/origin=http...  | (disk cac... | 6 ... |           |
| ListAccounts?listPa... | 200   | http/2+quic/46 | accounts.google.com        | document  | rs=AA2YrTuismE...   | 1.4 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...   | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...   | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...   | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | png       | rs=AA2YrTuismE...   | (disk cac... | 8 ... |           |
| m=wmwg8b               | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_ tp:434        | (disk cac... | 3 ... |           |
| m=A7fCU,BVgquf,...     | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_ tp:434        | (disk cac... | 1...  |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | m= b_ tp:301        | 644 B        | 1...  |           |
| m=FCpbqb,OJUrv...      | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_ tp:434        | (disk cac... | 3 ... |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | m= b_ tp:301        | 788 B        | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=stic... | 2.4 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=stic... | 2.2 KB       | 2...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=stic... | 2.7 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | png       | search?safe=stic... | 662 B        | 1...  |           |
| gen_204?atyp=i&e...    | 204   | http/2+quic/46 | www.google.com             | text/html | rs=ACT90oFF1ed...   | 40 B         | 5...  |           |
| gen_204?atyp=csi...    | 204   | http/2+quic/46 | www.google.com             | text/html | rs=ACT90oFF1ed...   | 40 B         | 5...  |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | rs=AA2YrTuismE...   | 345 B        | 5...  |           |

**Note:** As set forth below, a QUIC is a “variant” of TCP.

**Note:** The following evidence is related to and/or describes the QUIC standard contained herein.

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|  | <p>“1. Introduction</p> <p>QUIC is a new multiplexed and secure transport atop UDP. QUIC builds on decades of transport and security experience, and implements mechanisms that make it attractive as a modern general-purpose transport. The QUIC protocol is described in [QUIC-TRANSPORT].</p> <p>QUIC implements the spirit of existing TCP loss recovery mechanisms, described in RFCs, various Internet-drafts, and also those prevalent in the Linux TCP implementation. This document describes QUIC congestion control and loss recovery, and where applicable, attributes the TCP equivalent in RFCs, Internet-drafts, academic papers, and/or TCP implementations.”</p> <p><i>QUIC Loss Detection and Congestion Control</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-recovery-22">https://tools.ietf.org/html/draft-ietf-quic-recovery-22</a></p> <p><b>Note:</b> As set forth below, the metadata includes a value in seconds that is encoded as an unsigned 16-bit integer.</p> <p>“idle_timeout (0x0001): The idle timeout is a value in milliseconds that is encoded as an integer; see (Section 10.2). If this parameter is absent or zero then the idle timeout is disabled.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout (see Section 18.1) and three times the current Probe Timeout (PTO).”</p> <p>“The value for an idle timeout can be asymmetric. The value advertised by an endpoint is only used to determine whether the connection is live at that endpoint. An endpoint that sends packets near the end of the idle timeout period of a peer risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could timeout within a Probe Timeout (PTO; see Section 6.3 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried</p> |
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|                                                                                                                                                                | <p>safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“19.2. PING Frame</p> <p>Endpoints can use PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out. An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><b>A connection will time out if no packets are sent or received for a period longer than the time specified in the idle_timeout transport parameter (see Section 10).</b> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |
| generating a TCP-variant packet including an idle time period parameter field identifying metadata for the idle time period based on the idle information; and | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including generating a TCP-variant packet (e.g., QUIC negotiation packet, etc.) including an idle time period parameter field (e.g., idle_timeout parameter field, etc.) identifying metadata (e.g., a value, etc.) for the idle time period based on the idle information.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> <p>“7.3. Transport Parameters</p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |
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| Value  | Parameter Name                      | Specification |
|--------|-------------------------------------|---------------|
| 0x0000 | original_connection_id              | Section 18.1  |
| 0x0001 | idle_timeout                        | Section 18.1  |
| 0x0002 | stateless_reset_token               | Section 18.1  |
| 0x0003 | max_packet_size                     | Section 18.1  |
| 0x0004 | initial_max_data                    | Section 18.1  |
| 0x0005 | initial_max_stream_data_bidi_local  | Section 18.1  |
| 0x0006 | initial_max_stream_data_bidi_remote | Section 18.1  |
| 0x0007 | initial_max_stream_data_uni         | Section 18.1  |
| 0x0008 | initial_max_streams_bidi            | Section 18.1  |
| 0x0009 | initial_max_streams_uni             | Section 18.1  |
| 0x000a | ack_delay_exponent                  | Section 18.1  |
| 0x000b | max_ack_delay                       | Section 18.1  |
| 0x000c | disable_migration                   | Section 18.1  |
| 0x000d | preferred_address                   | Section 18.1  |
| 0x000e | active_connection_id_limit          | Section 18.1  |

Table 6: Initial QUIC Transport Parameters Entries

*QUIC: A UDP-Based Multiplexed and Secure Transport* <https://tools.ietf.org/html/draft-ietf-quic-transport-22>

“18. Transport Parameter Encoding

The format of the transport parameters is the TransportParameters struct from Figure 15. This is described using the presentation language from Section 3 of [TLS13].

```
enum {
```

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|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <pre>original_connection_id(0), idle_timeout(1), stateless_reset_token(2), max_packet_size(3), initial_max_data(4), initial_max_stream_data_bidi_local(5), initial_max_stream_data_bidi_remote(6), initial_max_stream_data_uni(7), initial_max_streams_bidi(8), initial_max_streams_uni(9), ack_delay_exponent(10), max_ack_delay(11), disable_migration(12), preferred_address(13), active_connection_id_limit(14), (65535) } TransportParameterId;"</pre> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>“19.2. PING Frame</b></p> <p>Endpoints can use PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out. An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><b>A connection will time out if no packets are sent or received for a period longer than the time specified in the <code>idle_timeout</code> transport parameter (see Section 10).</b> However, state in middleboxes</p> |
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|                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                         | <p>might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>sending, from the node to another node, the TCP-variant packet in advance of the TCP-variant connection being established to provide the metadata for the idle time period to the another node, for use by the another node in modifying, based on the metadata, a timeout attribute associated with the TCP-variant connection.</p> | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including sending, from the node (e.g., one of a QUIC-compliant server or client, etc.) to another node (e.g., the other one of the QUIC-compliant server or client, etc.), the TCP-variant packet (e.g., QUIC negotiation packet, etc.) in advance of the TCP-variant connection (e.g., QUIC connection, etc.) being established to provide the metadata (e.g., the value, etc.) for the idle time period to the another node, for use by the another node in modifying, based on the metadata, a timeout attribute associated with the TCP-variant connection.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p>“The initial handshake packet from the client needs to fit in a single packet (#338)”<br/> <i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“QUIC packet: A complete processable unit of QUIC that can be encapsulated in a UDP datagram. Multiple QUIC packets can be encapsulated in a single UDP datagram.”<br/> <i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, prior to a QUIC connection being established, the QUIC connection is “set up” using the aforementioned handshake.</p> <p>“5.2.2. Server Packet Handling<br/>         ...<br/>         If the packet is an Initial packet fully conforming with the specification, the server proceeds with the handshake (Section 7). This commits the server to the version that the client selected.<br/>         ...</p> |

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|  | <p>If the packet is a 0-RTT packet, the server MAY buffer a limited number of these packets in anticipation of a late-arriving Initial packet. Clients are not able to send Handshake packets prior to receiving a server response, so servers SHOULD ignore any such packets.</p> <p>...</p> <p>7. Cryptographic and Transport Handshake</p> <p>QUIC relies on a combined cryptographic and transport handshake to minimize connection establishment latency. QUIC uses the CRYPTO frame Section 19.6 to transmit the cryptographic handshake. Version 0x00000001 of QUIC uses TLS as described in [QUIC-TLS]; a different QUIC version number could indicate that a different cryptographic handshake protocol is in use.</p> <p>QUIC provides reliable, ordered delivery of the cryptographic handshake data. QUIC packet protection is used to encrypt as much of the handshake protocol as possible.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> <p>“7.3. Transport Parameters</p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |
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| Value  | Parameter Name                      | Specification |
|--------|-------------------------------------|---------------|
| 0x0000 | original_connection_id              | Section 18.1  |
| 0x0001 | idle_timeout                        | Section 18.1  |
| 0x0002 | stateless_reset_token               | Section 18.1  |
| 0x0003 | max_packet_size                     | Section 18.1  |
| 0x0004 | initial_max_data                    | Section 18.1  |
| 0x0005 | initial_max_stream_data_bidi_local  | Section 18.1  |
| 0x0006 | initial_max_stream_data_bidi_remote | Section 18.1  |
| 0x0007 | initial_max_stream_data_uni         | Section 18.1  |
| 0x0008 | initial_max_streams_bidi            | Section 18.1  |
| 0x0009 | initial_max_streams_uni             | Section 18.1  |
| 0x000a | ack_delay_exponent                  | Section 18.1  |
| 0x000b | max_ack_delay                       | Section 18.1  |
| 0x000c | disable_migration                   | Section 18.1  |
| 0x000d | preferred_address                   | Section 18.1  |
| 0x000e | active_connection_id_limit          | Section 18.1  |

Table 6: Initial QUIC Transport Parameters Entries

QUIC: A UDP-Based Multiplexed and Secure Transport <https://tools.ietf.org/html/draft-ietf-quic-transport-22>

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|  | <p><b>"18. Transport Parameter Encoding</b></p> <p>The format of the transport parameters is the TransportParameters struct from Figure 15. This is described using the presentation language from Section 3 of [TLS13].</p> <pre>enum {<br/>    original_connection_id(0),<br/>    idle_timeout(1),<br/>    stateless_reset_token(2),<br/>    max_packet_size(3),<br/>    initial_max_data(4),<br/>    initial_max_stream_data_bidi_local(5),<br/>    initial_max_stream_data_bidi_remote(6),<br/>    initial_max_stream_data_uni(7),<br/>    initial_max_streams_bidi(8),<br/>    initial_max_streams_uni(9),<br/>    ack_delay_exponent(10),<br/>    max_ack_delay(11),<br/>    disable_migration(12),<br/>    preferred_address(13),<br/>    active_connection_id_limit(14),<br/>    (65535)<br/>} TransportParameterId;"</pre> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p>"idle_timeout (0x0001): The idle timeout is a value in milliseconds that is encoded as an integer; see (Section 10.2). If this parameter is absent or zero then the idle timeout is disabled."</p> |
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|  | <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“10. Connection Termination</p> <p>An established QUIC connection can be terminated in one of three ways:</p> <ul style="list-style-type: none"> <li>• idle timeout (Section 10.2)</li> <li>• immediate close (Section 10.3)</li> <li>• stateless reset (Section 10.4)</li> </ul> <p>An endpoint MAY discard connection state if it does not have a validated path on which it can send packets (see Section 8.2).”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout (see Section 18.1) and three times the current Probe Timeout (PTO).”</p> <p>“The value for an idle timeout can be asymmetric. The value advertised by an endpoint is only used to determine whether the connection is live at that endpoint. An endpoint that sends packets near the end of the idle timeout period of a peer risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could timeout within a Probe Timeout (PTO; see Section 6.3 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“19.2. PING Frame</p> <p>Endpoints can use PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> |
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|  | <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out. An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><b>A connection will time out if no packets are sent or received for a period longer than the time specified in the idle_timeout transport parameter (see Section 10).</b> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |
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| Claim 43 Elements                                                                                                                                                    | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| <p>The method of claim 33 wherein one or more keep-alive packets are communicated, based on a keep-alive period that is, in turn, based on the idle time period.</p> | <p>Google infringes claim 33 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein one or more keep-alive packets are communicated, based on a keep-alive period that is, in turn, based on the idle time period.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Based upon information and belief, infringement occurs, for example, at least during a packet communication scenario when a keep-alive packet starts a detected idle time period and no other keep-alives are communicated during the idle period.</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p style="padding-left: 40px;">“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> <p>...</p> <ul style="list-style-type: none"> <li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires (Section 10.2); and</u></li> <li>• immediately close (Section 10.3) the connection.”</li> </ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“10.2. Idle Timeout</p> |

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|  | <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the max_idle_timeouts (see Section 18.2) and three times the current Probe Timeout (PTO).</p> <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p style="text-align: center;">“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance</p> |
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|  | <p>about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| Claim 45 Elements                                                                                                            | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The method of claim 43 wherein the keep-alive period is not configurable, while the idle time period is configurable.</p> | <p>Google infringes claim 43 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein the keep-alive period is not configurable, while the idle time period is configurable.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Based on the list of negotiable parameters (see Section 18.2), the keep-alive period is not configurable during connection setup. Based upon information and belief, the keep-alive period is constrained by the idle time period, which is negotiated at connection setup.</p> <p>The duration for an idle time period includes negotiation/configuration via a max_idle_timeout transport parameter. See, for example, section 10.1.2 of the QUIC transport draft at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2spec">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2spec</a> and section 18.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-18.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-18.2</a>). It is also clear from the list of negotiable parameters in section 18.2 that the keep-alive period is not negotiable/configurable during connection setup. Further, the keep-alive period is constrained by the idle time period as described in section 19.2 and 10.1.2. See section 10.1.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1</a> and section 19.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2</a>.</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p style="padding-left: 40px;">“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> <p>...</p> |

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|  | <ul style="list-style-type: none"><li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires (Section 10.2); and</u></li><li>• immediately close (Section 10.3) the connection.”</li></ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the max_idle_timeouts (see Section 18.2) and three times the current Probe Timeout (PTO).</p> <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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|  | <p>“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| Claim 46 Elements                                                                                                                                                                         | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| <p>The method of claim 43 wherein the keep-alive period is administered using a keep-alive timer that is separate from an idle timer that is used to administer the idle time period.</p> | <p>Google infringes claim 43 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein the keep-alive period is administered using a keep-alive timer that is separate from an idle timer that is used to administer the idle time period.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p style="padding-left: 40px;">“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> <p>...</p> <ul style="list-style-type: none"> <li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires</u> (Section 10.2); and</li> <li>• immediately close (Section 10.3) the connection.”</li> </ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“10.2. Idle Timeout</p> |

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|  | <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the max_idle_timeouts (see Section 18.2) and three times the current Probe Timeout (PTO).</p> <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p style="text-align: center;">“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate</p> |
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|  | <p>whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max idle timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| Claim 47 Elements                                                                                                                                   | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| <p>The method of claim 43 wherein the one or more keep-alive packets are conditionally communicated based on at least one keep-alive attribute.</p> | <p>Google infringes claim 43 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein the one or more keep-alive packets are conditionally communicated based on at least one keep-alive attribute.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p>“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |

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|  | <p><b>Note:</b> The following evidence is related to and/or describes the QUIC standard contained herein.</p> <p>“3.3. Session resumption versus Keep-alive</p> <p>Because QUIC is encapsulated in UDP, applications using QUIC must deal with short idle timeouts. Deployed stateful middleboxes will generally establish state for UDP flows on the first packet state, and keep state for much shorter idle periods than for TCP. According to a 2010 study ([Hatonen10]), UDP applications can assume that any NAT binding or other state entry will be expired after just thirty seconds of inactivity.</p> <p>A QUIC application has three strategies to deal with this issue:</p> <ul style="list-style-type: none"><li>• Ignore it, if the application-layer protocol consists only of interactions with no or very short idle periods.</li><li>• Ensure there are no long idle periods.</li><li>• Resume the session after a long idle period, using 0-RTT resumption when appropriate.</li></ul> <p>The first strategy is the easiest, but it only applies to certain applications. Either the server or the client in a QUIC application can send PING frames as keep-alives, to prevent the connection and any on-path state from timing out.</p> <p><u>Recommendations for the use of keep-alives are application specific, mainly depending on the latency requirements and message frequency of the application. In this case, the application mapping must specify whether the client or server is responsible for keeping the application alive.</u> Note that sending PING frames more frequently than every 30 seconds over long idle periods may result in a too much unproductive traffic and power usage for some situations.</p> <p><u>Alternatively, the client (but not the server) can use session resumption instead of sending keepalive traffic.</u> In this case, a client that wants to send data to a server over a connection idle longer than the server's idle timeout (available from the idle_timeout transport parameter) can simply reconnect. When possible, this reconnection can use 0-RTT session resumption, reducing the latency involved with</p> |
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|  | <p>restarting the connection. This of course only applies in cases in which 0-RTT data is safe, when the client is the restarting peer, and when the data to be sent is idempotent.</p> <p>The tradeoffs between resumption and keepalive need to be evaluated on a per-application basis. However, in general applications should use keepalives only in circumstances where continued communication is highly likely; [QUIC-HTTP], for instance, recommends using PING frames for keepalive only when a request is outstanding.”</p> <p><a href="https://www.ietf.org/id/draft-ietf-quic-applicability-07.txt">https://www.ietf.org/id/draft-ietf-quic-applicability-07.txt</a></p> |
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| Claim 48 Elements                                                                                      | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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| <p>The method of claim 47 wherein the keep-alive attribute is separate from the timeout attribute.</p> | <p>Google infringes claim 47 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein the keep-alive attribute is separate from the timeout attribute.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Based upon information and belief, the keep-alive attribute is satisfied by enabling or disabling the sending of one or more PING frames. See, for example, section 19.2 of the QUIC transport draft at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2</a> and section 10.1.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2</a>.</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p style="padding-left: 40px;">“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> <p>...</p> <ul style="list-style-type: none"> <li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires</u> (Section 10.2); and</li> <li>• immediately close (Section 10.3) the connection.”</li> </ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |

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|  | <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the max_idle_timeouts (see Section 18.2) and three times the current Probe Timeout (PTO).</p> <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> |
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|  | <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| Claim 51 Elements                                                                                                                   | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| <p>The method of claim 33 wherein a duration of the idle time period is configured by an application via an analog of a socket.</p> | <p>Google infringes claim 33 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein a duration of the idle time period is configured by an application via an analog of a socket (e.g., a listener socket and/or stream socket, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p>“10.2. Idle Timeout</p> <p><u>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout</u> (see Section 18.1) and three times the current Probe Timeout (PTO).”</p> <p>“The value for an idle timeout can be asymmetric. <u>The value advertised by an endpoint is only used to determine whether the connection is live at that endpoint.</u> An endpoint that sends packets near the end of the idle timeout period of a peer risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could timeout within a Probe Timeout (PTO; see Section 6.3 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> |

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7.4. Transport Parameters

During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.

| Value  | Parameter Name          | Specification |
|--------|-------------------------|---------------|
| 0x0000 | initial_max_stream_data | Section 7.4.1 |
| 0x0001 | initial_max_data        | Section 7.4.1 |
| 0x0002 | initial_max_stream_id   | Section 7.4.1 |
| 0x0003 | idle_timeout            | Section 7.4.1 |
| 0x0004 | omit_connection_id      | Section 7.4.1 |
| 0x0005 | max_packet_size         | Section 7.4.1 |
| 0x0006 | stateless_reset_token   | Section 7.4.1 |

Table 4: Initial QUIC Transport Parameters Entries

QUIC: A UDP-Based Multiplexed and Secure Transport <https://tools.ietf.org/html/draft-ietf-quic-transport-07>

**Note:** The following evidence is related to and/or describes the QUIC standard contained herein.

“Because of the built-in stream multiplexing layer in QUIC, applications need to handle three types of logical objects: listeners, connections, and streams. These objects have different properties from the

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|  | <p>traditional UDP and TCP listeners and connections. As a result, the adaptation to socket semantics was not direct. <u>We used three types of sockets to expose the QUIC API</u>, with the following properties:</p> <ul style="list-style-type: none"><li>• <b><u>Listener sockets</u></b>: like regular TCP/UDP listeners, they bind to a port and are used to accept <u>incoming connections</u>. Listeners can be closed when the application no longer desires to accept new connections.</li><li>• <b><u>Connection sockets</u></b>: these sockets are created by connect or accept calls. Unlike TCP or UDP sockets, however, these sockets cannot be used to send or receive data and are only used to manage the streams belonging to the connection.</li><li>• <b><u>Stream sockets</u></b>: these are the sockets that provide send and receive functions so peers can <u>exchange data</u>. They can be <u>created either by accepting on a connection socket (for streams opened by the peer), or by calling connect on the connection socket to create a new, locally initiated stream</u>. Streams can be closed by either peer at any point during the connection.”</li></ul> <p><a href="https://blogs.cisco.com/cloud/building-fast-quic-sockets-in-vpp">https://blogs.cisco.com/cloud/building-fast-quic-sockets-in-vpp</a> (emphasis added)</p> |
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| Claim 52 Elements                                                                                                                                                                                                                                                                                                        | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| <p>A method comprising: at a node configured to execute a network application such that the network application operates in accordance with a non-transmission control protocol (TCP) protocol that operates above an Internet Protocol (IP) layer and below a hypertext transfer protocol (HTTP) application layer:</p> | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method comprising: at a node configured to execute a network application such that the network application operates in accordance with a non-transmission control protocol (TCP) protocol (e.g., a QUIC protocol, etc.) that operates above an Internet Protocol (IP) layer and below a hypertext transfer protocol (HTTP) application layer.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Google admits that their “Google Cloud Platform” uses QUIC:</p> <p>"Google Cloud Platform Blog...</p> <p>we’re happy to be the first major public cloud to offer QUIC support for our HTTPS load balancers."<br/> <a href="https://cloudplatform.googleblog.com/2018/06/Introducing-QUIC-support-for-HTTPS-load-balancing.html">https://cloudplatform.googleblog.com/2018/06/Introducing-QUIC-support-for-HTTPS-load-balancing.html</a></p> <p><b>Note:</b> The “Google Cloud Platform” that, as established above, uses QUIC, is also used for ALL of Google’s services:</p> <p>“Google Cloud Platform (GCP), offered by Google (company), is a suite of cloud computing services that runs on the same infrastructure that Google uses internally for its end-user products, such as Google Search, Gmail, file storage, and YouTube”<br/> <a href="https://en.wikipedia.org/wiki/Google_Cloud_Platform">https://en.wikipedia.org/wiki/Google_Cloud_Platform</a></p> <p><b>Note:</b> At least a portion of the citations herein are made to the QUIC standard found at:<br/> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a>, and/or <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-27">https://tools.ietf.org/html/draft-ietf-quic-transport-27</a>. Based upon information and belief, the pertinent portions of such version of the QUIC standard may also be found in one or more other versions. For completeness, all of the versions below (and future iterations thereof) are hereby incorporated by reference:</p> <p><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-00">https://tools.ietf.org/html/draft-ietf-quic-transport-00</a></p> |

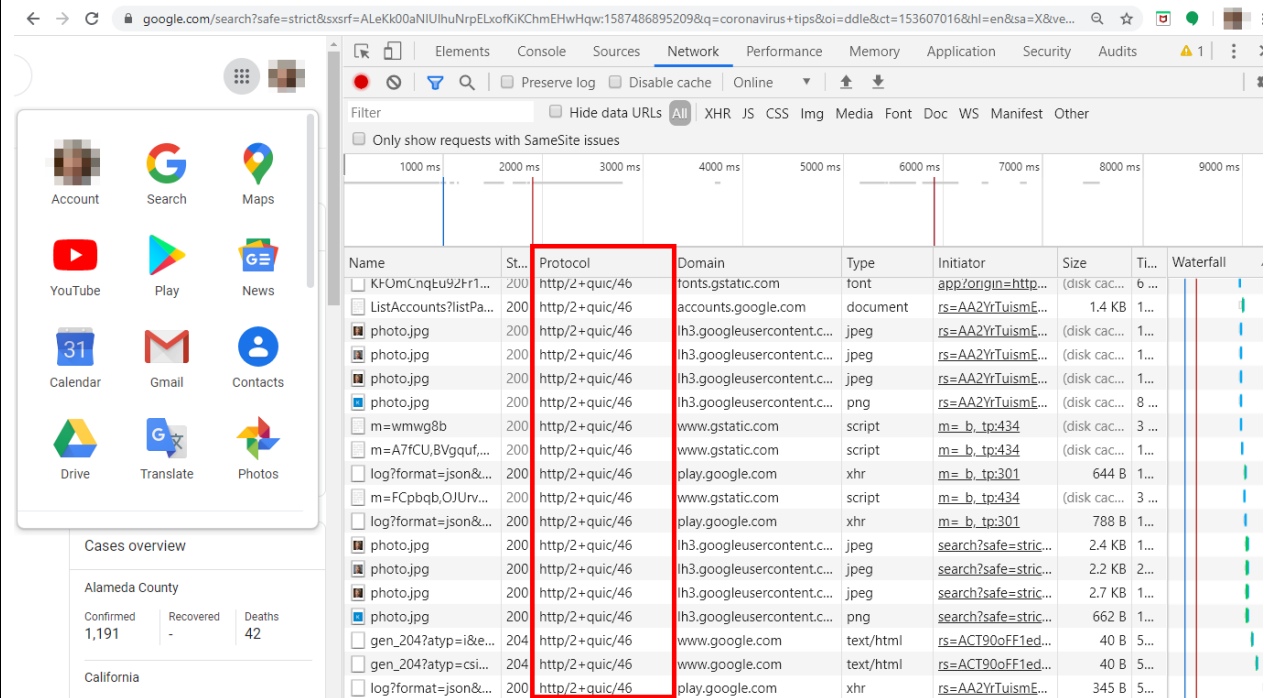
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|  | <p><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-01">https://tools.ietf.org/html/draft-ietf-quic-transport-01</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-02">https://tools.ietf.org/html/draft-ietf-quic-transport-02</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-03">https://tools.ietf.org/html/draft-ietf-quic-transport-03</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-04">https://tools.ietf.org/html/draft-ietf-quic-transport-04</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-05">https://tools.ietf.org/html/draft-ietf-quic-transport-05</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-06">https://tools.ietf.org/html/draft-ietf-quic-transport-06</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-08">https://tools.ietf.org/html/draft-ietf-quic-transport-08</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-09">https://tools.ietf.org/html/draft-ietf-quic-transport-09</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-10">https://tools.ietf.org/html/draft-ietf-quic-transport-10</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-11">https://tools.ietf.org/html/draft-ietf-quic-transport-11</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-12">https://tools.ietf.org/html/draft-ietf-quic-transport-12</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-13">https://tools.ietf.org/html/draft-ietf-quic-transport-13</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-14">https://tools.ietf.org/html/draft-ietf-quic-transport-14</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-15">https://tools.ietf.org/html/draft-ietf-quic-transport-15</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-16">https://tools.ietf.org/html/draft-ietf-quic-transport-16</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-17">https://tools.ietf.org/html/draft-ietf-quic-transport-17</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-18">https://tools.ietf.org/html/draft-ietf-quic-transport-18</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-19">https://tools.ietf.org/html/draft-ietf-quic-transport-19</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-20">https://tools.ietf.org/html/draft-ietf-quic-transport-20</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-21">https://tools.ietf.org/html/draft-ietf-quic-transport-21</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-23">https://tools.ietf.org/html/draft-ietf-quic-transport-23</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-24">https://tools.ietf.org/html/draft-ietf-quic-transport-24</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-25">https://tools.ietf.org/html/draft-ietf-quic-transport-25</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-26">https://tools.ietf.org/html/draft-ietf-quic-transport-26</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-27">https://tools.ietf.org/html/draft-ietf-quic-transport-27</a></p> <p><b>Note:</b> Though these contentions may refer to a specific version of the QUIC standard, the presented evidence is not exclusive to this specific version and is compliant with and/or supported by current versions of the QUIC standard, including QUIC_VERSION_IETF_RFC_V1 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34</a>), QUIC_VERSION_IETF_DRAFT_25 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-25">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-25</a>), QUIC_VERSION_IETF_DRAFT_27</p> |
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(<https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-27>), QUIC\_VERSION\_IETF\_DRAFT\_28 (<https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-28>), QUIC\_VERSION\_IETF\_DRAFT\_29 (<https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-29>), and/or QUIC\_VERSION\_50 which relies in part on IETF\_QUIC\_INVARIANTS\_06 (<https://tools.ietf.org/html/draft-ietf-quic-invariants-06>) and/or IETF\_QUIC\_TRANSPORT\_17 (<https://tools.ietf.org/html/draft-ietf-quic-transport-17>), each of which, upon information and belief, has been utilized by Google LLC through its accused instrumentalities.

**Note:** Below is a web page of Google (<https://www.google.com/>).



The screenshot shows a Google search page with the Network tab open in the developer tools. The 'Protocol' column in the network log is highlighted with a red box, showing 'http/2+quic/46' for multiple requests. The page also shows search results for 'Alameda County' and 'California'.

| Name                   | St... | Protocol       | Domain                     | Type      | Initiator            | Size         | Ti... | Waterfall |
|------------------------|-------|----------------|----------------------------|-----------|----------------------|--------------|-------|-----------|
| KfOmCnqEu92fr1...      | 200   | http/2+quic/46 | tonts.gstatic.com          | tont      | app/origin=http...   | (disk cac... | 6 ... |           |
| ListAccounts?listPa... | 200   | http/2+quic/46 | accounts.google.com        | document  | rs=AA2YrTuismE...    | 1.4 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...    | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...    | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...    | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | png       | rs=AA2YrTuismE...    | (disk cac... | 8 ... |           |
| m=wmwg8b               | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_ tp:434         | (disk cac... | 3 ... |           |
| m=A7fCU,BVgquf,...     | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_ tp:434         | (disk cac... | 1...  |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | m= b_ tp:301         | 644 B        | 1...  |           |
| m=FCpbqb,OJUr...       | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_ tp:434         | (disk cac... | 3 ... |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | m= b_ tp:301         | 788 B        | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=stria... | 2.4 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=stria... | 2.2 KB       | 2...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=stria... | 2.7 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | png       | search?safe=stria... | 662 B        | 1...  |           |
| gen_204?atyp=i&e...    | 204   | http/2+quic/46 | www.google.com             | text/html | rs=ACT90oFF1ed...    | 40 B         | 5...  |           |
| gen_204?atyp=csi...    | 204   | http/2+quic/46 | www.google.com             | text/html | rs=ACT90oFF1ed...    | 40 B         | 5...  |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | rs=AA2YrTuismE...    | 345 B        | 5...  |           |

**Note:** The following evidence is related to and/or describes the QUIC standard contained herein.

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|                                                                                        | <p>“QUIC has been globally deployed at Google on thousands of servers and is used to serve traffic to a range of clients including a widely-used web browser (Chrome) . . .”<br/><a href="https://static.googleusercontent.com/media/research.google.com/en//pubs/archive/46403.pdf">https://static.googleusercontent.com/media/research.google.com/en//pubs/archive/46403.pdf</a> (pg 1)</p> <p><b>Note:</b> As set forth below, a QUIC is a “variant” of TCP.</p> <p><b>Note:</b> The following evidence is related to and/or describes the QUIC standard contained herein.</p> <p>“1. Introduction</p> <p>QUIC is a new multiplexed and secure transport atop UDP. QUIC builds on decades of transport and security experience, and implements mechanisms that make it attractive as a modern general-purpose transport. The QUIC protocol is described in [QUIC-TRANSPORT].</p> <p>QUIC implements the spirit of existing TCP loss recovery mechanisms, described in RFCs, various Internet-drafts, and also those prevalent in the Linux TCP implementation. This document describes QUIC congestion control and loss recovery, and where applicable, attributes the TCP equivalent in RFCs, Internet-drafts, academic papers, and/or TCP implementations.”<br/><i>QUIC Loss Detection and Congestion Control</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-recovery-22">https://tools.ietf.org/html/draft-ietf-quic-recovery-22</a></p> <p>“On the surface, QUIC is very similar to TCP+TLS+HTTP/2 implemented on UDP. ...However, since QUIC is built on top of UDP, it suffers from no such limitations.” <a href="https://medium.com/@nirosh/understanding-quic-wire-protocol-d0ff97644de7">https://medium.com/@nirosh/understanding-quic-wire-protocol-d0ff97644de7</a></p> |
| receiving, from another node, a non-TCP packet during a setup of a non-TCP connection; | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including receiving, from another node (e.g., another one of the QUIC-compliant server or client, etc.), a non-TCP packet during a setup of a non-TCP connection (e.g., QUIC connection, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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|  | <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> <p>“7.3. Transport Parameters</p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |
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| Value  | Parameter Name                      | Specification |
|--------|-------------------------------------|---------------|
| 0x0000 | original_connection_id              | Section 18.1  |
| 0x0001 | idle_timeout                        | Section 18.1  |
| 0x0002 | stateless_reset_token               | Section 18.1  |
| 0x0003 | max_packet_size                     | Section 18.1  |
| 0x0004 | initial_max_data                    | Section 18.1  |
| 0x0005 | initial_max_stream_data_bidi_local  | Section 18.1  |
| 0x0006 | initial_max_stream_data_bidi_remote | Section 18.1  |
| 0x0007 | initial_max_stream_data_uni         | Section 18.1  |
| 0x0008 | initial_max_streams_bidi            | Section 18.1  |
| 0x0009 | initial_max_streams_uni             | Section 18.1  |
| 0x000a | ack_delay_exponent                  | Section 18.1  |
| 0x000b | max_ack_delay                       | Section 18.1  |
| 0x000c | disable_migration                   | Section 18.1  |
| 0x000d | preferred_address                   | Section 18.1  |
| 0x000e | active_connection_id_limit          | Section 18.1  |

Table 6: Initial QUIC Transport Parameters Entries

*QUIC: A UDP-Based Multiplexed and Secure Transport* <https://tools.ietf.org/html/draft-ietf-quic-transport-22>

“18. Transport Parameter Encoding

The format of the transport parameters is the TransportParameters struct from Figure 15. This is described using the presentation language from Section 3 of [TLS13].

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                            | <pre>enum {     original_connection_id(0),     idle_timeout(1),     stateless_reset_token(2),     max_packet_size(3),     initial_max_data(4),     initial_max_stream_data_bidi_local(5),     initial_max_stream_data_bidi_remote(6),     initial_max_stream_data_uni(7),     initial_max_streams_bidi(8),     initial_max_streams_uni(9),     ack_delay_exponent(10),     max_ack_delay(11),     disable_migration(12),     preferred_address(13),     active_connection_id_limit(14),     (65535) } TransportParameterId;</pre> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, the metadata includes a value in seconds that is encoded as an unsigned 16-bit integer.</p> <p>“idle_timeout (0x0001): The idle timeout is a value in milliseconds that is encoded as an integer; see (Section 10.2). If this parameter is absent or zero then the idle timeout is disabled.”<br/> <i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |
| <p>identifying metadata, that specifies at least one of a number of seconds or minutes, in an idle time period parameter field in the non-TCP packet, for an idle time</p> | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including identifying metadata (e.g., a value, etc.), that specifies at least one of a number of seconds or minutes, in an idle time period parameter field (e.g., idle_timeout parameter field, etc.) in the non-TCP packet (e.g., the QUIC negotiation packet, etc.), for an</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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| <p>period, where, as a result of a detection of the idle time period, the non-TCP connection is subject to deactivation; and</p> | <p>idle time period, where, as a result of a detection of the idle time period, the non-TCP connection (e.g., the QUIC connection, etc.) is subject to deactivation (e.g., terminate the connection, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, the metadata includes a value in seconds that is encoded as an unsigned 16-bit integer and, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily detected based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p>“idle_timeout (0x0001): The idle timeout is a value in milliseconds that is encoded as an integer; see (Section 10.2). If this parameter is absent or zero then the idle timeout is disabled.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“10. Connection Termination</p> <p>An established QUIC connection can be terminated in one of three ways:</p> <ul style="list-style-type: none"><li>• idle timeout (Section 10.2)</li><li>• immediate close (Section 10.3)</li><li>• stateless reset (Section 10.4)</li></ul> <p>An endpoint MAY discard connection state if it does not have a validated path on which it can send packets (see Section 8.2).”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout (see Section 18.1) and three times the current Probe Timeout (PTO).”</p> |
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|                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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|                                                                                                 | <p>“The value for an idle timeout can be asymmetric. The value advertised by an endpoint is only used to determine whether the connection is live at that endpoint. An endpoint that sends packets near the end of the idle timeout period of a peer risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could timeout within a Probe Timeout (PTO; see Section 6.3 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p>                                                                                                                                                                                                                                                                                                   |
| determining, based on the metadata, a timeout attribute associated with the non-TCP connection; | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including determining, based on the metadata (e.g., the value, etc.), a timeout attribute associated with the non-TCP connection (e.g., the QUIC connection, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle_timeout parameter that is detected by a recipient of such packet.</p> <p>“7.3. Transport Parameters</p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |

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| Value  | Parameter Name                      | Specification |
|--------|-------------------------------------|---------------|
| 0x0000 | original_connection_id              | Section 18.1  |
| 0x0001 | idle_timeout                        | Section 18.1  |
| 0x0002 | stateless_reset_token               | Section 18.1  |
| 0x0003 | max_packet_size                     | Section 18.1  |
| 0x0004 | initial_max_data                    | Section 18.1  |
| 0x0005 | initial_max_stream_data_bidi_local  | Section 18.1  |
| 0x0006 | initial_max_stream_data_bidi_remote | Section 18.1  |
| 0x0007 | initial_max_stream_data_uni         | Section 18.1  |
| 0x0008 | initial_max_streams_bidi            | Section 18.1  |
| 0x0009 | initial_max_streams_uni             | Section 18.1  |
| 0x000a | ack_delay_exponent                  | Section 18.1  |
| 0x000b | max_ack_delay                       | Section 18.1  |
| 0x000c | disable_migration                   | Section 18.1  |
| 0x000d | preferred_address                   | Section 18.1  |
| 0x000e | active_connection_id_limit          | Section 18.1  |

Table 6: Initial QUIC Transport Parameters Entries

*QUIC: A UDP-Based Multiplexed and Secure Transport* <https://tools.ietf.org/html/draft-ietf-quic-transport-22>

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|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>“18. Transport Parameter Encoding</b></p> <p>The format of the transport parameters is the TransportParameters struct from Figure 15. This is described using the presentation language from Section 3 of [TLS13].</p> <pre>enum {<br/>    original_connection_id(0),<br/>    idle_timeout(1),<br/>    stateless_reset_token(2),<br/>    max_packet_size(3),<br/>    initial_max_data(4),<br/>    initial_max_stream_data_bidi_local(5),<br/>    initial_max_stream_data_bidi_remote(6),<br/>    initial_max_stream_data_uni(7),<br/>    initial_max_streams_bidi(8),<br/>    initial_max_streams_uni(9),<br/>    ack_delay_exponent(10),<br/>    max_ack_delay(11),<br/>    disable_migration(12),<br/>    preferred_address(13),<br/>    active_connection_id_limit(14),<br/>    (65535)<br/>} TransportParameterId;</pre> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>“19.2. PING Frame</b></p> <p>Endpoints can use PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> |
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|                                                                                                                                                                                          | <p>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out. An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><b>A connection will time out if no packets are sent or received for a period longer than the time specified in the <code>idle_timeout</code> transport parameter (see Section 10).</b> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p>                                                                                               |
| wherein, based on operating in accordance with the TCP protocol, a three-way TCP handshake is performed for establishing a TCP connection that is different than the non-TCP connection. | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein, based on operating in accordance with the TCP protocol, a three-way TCP handshake is performed for establishing a TCP connection that is different than the non-TCP connection (e.g., the QUIC connection, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b><u>Note:</u></b> The following evidence is related to and/or describes the QUIC standard contained herein.</p> <p><u>“To start a TCP connection 3 way handshake is performed.</u> This adds a significant delay when creating a new connection. We need to negotiate TLS, to create a secure, encrypted, https connection, even more network packets have to be sent back and forth.</p> <p>On the other hand UDP is connectionless. That means <u>UDP doesn’t establish connections as TCP does, so UDP does not perform this 3-way handshake</u> and for this reason, it is referred to as an unreliable protocol. That doesn’t mean UDP can’t transfer data, it just doesn’t negotiate how the connection will work, UDP just transmits and hopes for the best. The benefit is less time spent on the network to validate</p> |

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|  | packets, the downside is that in order to be reliable, something has to be built on top of UDP to confirm packet delivery.”<br><a href="https://medium.com/@nirosh/understanding-quic-wire-protocol-d0ff97644de7">https://medium.com/@nirosh/understanding-quic-wire-protocol-d0ff97644de7</a> |
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| Claim 55 Elements                                                                                                                                                    | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| <p>The method of claim 52 wherein one or more keep-alive packets are communicated, based on a keep-alive period that is, in turn, based on the idle time period.</p> | <p>Google infringes claim 52 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein one or more keep-alive packets are communicated, based on a keep-alive period that is, in turn, based on the idle time period.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Based upon information and belief, infringement occurs, for example, at least during a packet communication scenario when a keep-alive packet starts a detected idle time period and no other keep-alives are communicated during the idle period.</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p style="padding-left: 40px;">“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> <p>...</p> <ul style="list-style-type: none"> <li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires (Section 10.2); and</u></li> <li>• immediately close (Section 10.3) the connection.”</li> </ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“10.2. Idle Timeout</p> |

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|  | <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the max_idle_timeouts (see Section 18.2) and three times the current Probe Timeout (PTO).</p> <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p style="text-align: center;">“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance</p> |
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|  | <p>about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| Claim 56 Elements                                                                                                            | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| <p>The method of claim 55 wherein the keep-alive period is not configurable, while the idle time period is configurable.</p> | <p>Google infringes claim 55 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein the keep-alive period is not configurable, while the idle time period is configurable.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Based on the list of negotiable parameters (see Section 18.2), the keep-alive period is not configurable during connection setup. Based upon information and belief, the keep-alive period is constrained by the idle time period, which is negotiated at connection setup.</p> <p>The duration for an idle time period includes negotiation/configuration via a max_idle_timeout transport parameter. See, for example, section 10.1.2 of the QUIC transport draft at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2spec">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2spec</a> and section 18.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-18.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-18.2</a>). It is also clear from the list of negotiable parameters in section 18.2 that the keep-alive period is not negotiable/configurable during connection setup. Further, the keep-alive period is constrained by the idle time period as described in section 19.2 and 10.1.2. See section 10.1.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1</a> and section 19.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2</a>.</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p style="padding-left: 40px;">“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> |

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|  | <p>...</p> <ul style="list-style-type: none"><li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires (Section 10.2); and</u></li><li>• immediately close (Section 10.3) the connection.”</li></ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the max_idle_timeouts (see Section 18.2) and three times the current Probe Timeout (PTO).</p> <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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|  | <p style="text-align: center;">“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| Claim 57 Elements                                                                                                                                   | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| <p>The method of claim 55 wherein the one or more keep-alive packets are conditionally communicated based on at least one keep-alive attribute.</p> | <p>Google infringes claim 55 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein the one or more keep-alive packets are conditionally communicated based on at least one keep-alive attribute.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Based upon information and belief, the keep-alive attribute is satisfied by enabling or disabling the sending of one or more PING frames. See, for example, section 19.2 of the QUIC transport draft at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2</a> and section 10.1.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2</a>.</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p style="padding-left: 40px;">“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval,</p> |

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|  | <p>experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.<br/><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p><b>Note:</b> The following evidence is related to and/or describes the QUIC standard contained herein.</p> <p>“3.3. Session resumption versus Keep-alive</p> <p>Because QUIC is encapsulated in UDP, applications using QUIC must deal with short idle timeouts. Deployed stateful middleboxes will generally establish state for UDP flows on the first packet state, and keep state for much shorter idle periods than for TCP. According to a 2010 study ([Hatonen10]), UDP applications can assume that any NAT binding or other state entry will be expired after just thirty seconds of inactivity.</p> <p>A QUIC application has three strategies to deal with this issue:</p> <ul style="list-style-type: none"><li>• Ignore it, if the application-layer protocol consists only of interactions with no or very short idle periods.</li><li>• Ensure there are no long idle periods.</li><li>• Resume the session after a long idle period, using 0-RTT resumption when appropriate.</li></ul> <p>The first strategy is the easiest, but it only applies to certain applications. Either the server or the client in a QUIC application can send PING frames as keep-alives, to prevent the connection and any on-path state from timing out.</p> <p><u>Recommendations for the use of keep-alives are application specific</u>, mainly depending on the latency requirements and message frequency of the application. <u>In this case, the application mapping must specify whether the client or server is responsible for keeping the application alive</u>. Note that sending PING frames more frequently than every 30 seconds over long idle periods may result in a too much unproductive traffic and power usage for some situations.</p> |
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|  | <p><u>Alternatively, the client (but not the server) can use session resumption instead of sending keepalive traffic.</u> In this case, a client that wants to send data to a server over a connection idle longer than the server's idle timeout (available from the idle_timeout transport parameter) can simply reconnect. When possible, this reconnection can use 0-RTT session resumption, reducing the latency involved with restarting the connection. This of course only applies in cases in which 0-RTT data is safe, when the client is the restarting peer, and when the data to be sent is idempotent.</p> <p>The tradeoffs between resumption and keepalive need to be evaluated on a per-application basis. However, in general applications should use keepalives only in circumstances where continued communication is highly likely; [QUIC-HTTP], for instance, recommends using PING frames for keepalive only when a request is outstanding.”</p> <p><a href="https://www.ietf.org/id/draft-ietf-quic-applicability-07.txt">https://www.ietf.org/id/draft-ietf-quic-applicability-07.txt</a></p> |
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| Claim 59 Elements                                                                                                                                                                                                                          | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <p>The method of claim 55 wherein the node determines, based on the metadata, the timeout attribute associated with the non-TCP connection, in connection with negotiating, with the another node, a duration of the idle time period.</p> | <p>Google infringes claim 55 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein the node determines, based on the metadata (e.g., the value, etc.), the timeout attribute associated with the non-TCP connection (e.g., the QUIC connection, etc.), in connection with negotiating, with the another node, a duration of the idle time period.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet is received by one of the nodes.</p> <p><b>7.4. Transport Parameters</b></p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.</p> <p>QUIC packet: A well-formed UDP payload that can be parsed by a QUIC receiver. QUIC packet size in this document refers to the UDP</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a></p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p>“idle_timeout (0x0001): The idle timeout is a value in milliseconds that is encoded as an integer; see (Section 10.2). <u>If this parameter is absent or zero then the idle timeout is disabled.</u>”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |

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|  | <p>“10.2. Idle Timeout</p> <p>...</p> <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| Claim 60 Elements                                                                                                                   | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| <p>The method of claim 55 wherein a duration of the idle time period is configured by an application via an analog of a socket.</p> | <p>Google infringes claim 55 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein a duration of the idle time period is configured by an application via an analog of a socket (e.g., a listener socket and/or stream socket, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p>“10.2. Idle Timeout</p> <p><u>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout</u> (see Section 18.1) and three times the current Probe Timeout (PTO).”</p> <p>“The value for an idle timeout can be asymmetric. <u>The value advertised by an endpoint is only used to determine whether the connection is live at that endpoint.</u> An endpoint that sends packets near the end of the idle timeout period of a peer risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could timeout within a Probe Timeout (PTO; see Section 6.3 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> |

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7.4. Transport Parameters

During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.

| Value  | Parameter Name          | Specification |
|--------|-------------------------|---------------|
| 0x0000 | initial_max_stream_data | Section 7.4.1 |
| 0x0001 | initial_max_data        | Section 7.4.1 |
| 0x0002 | initial_max_stream_id   | Section 7.4.1 |
| 0x0003 | idle_timeout            | Section 7.4.1 |
| 0x0004 | omit_connection_id      | Section 7.4.1 |
| 0x0005 | max_packet_size         | Section 7.4.1 |
| 0x0006 | stateless_reset_token   | Section 7.4.1 |

Table 4: Initial QUIC Transport Parameters Entries

QUIC: A UDP-Based Multiplexed and Secure Transport <https://tools.ietf.org/html/draft-ietf-quic-transport-07>

**Note:** The following evidence is related to and/or describes the QUIC standard contained herein.

“Because of the built-in stream multiplexing layer in QUIC, applications need to handle three types of logical objects: listeners, connections, and streams. These objects have different properties from the

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|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>traditional UDP and TCP listeners and connections. As a result, the adaptation to socket semantics was not direct. <u>We used three types of sockets to expose the QUIC API</u>, with the following properties:</p> <ul style="list-style-type: none"><li>• <b><u>Listener sockets</u></b>: like regular TCP/UDP listeners, they bind to a port and are used to accept <u>incoming connections</u>. Listeners can be closed when the application no longer desires to accept new connections.</li><li>• <b><u>Connection sockets</u></b>: these sockets are created by connect or accept calls. Unlike TCP or UDP sockets, however, these sockets cannot be used to send or receive data and are only used to manage the streams belonging to the connection.</li><li>• <b><u>Stream sockets</u></b>: these are the sockets that provide send and receive functions so peers can <u>exchange data</u>. They can be <u>created either by accepting on a connection socket (for streams opened by the peer)</u>, or by calling connect on the connection socket to create a new, locally <u>initiated stream</u>. Streams can be closed by either peer at any point during the connection.”</li></ul> <p><a href="https://blogs.cisco.com/cloud/building-fast-quic-sockets-in-vpp">https://blogs.cisco.com/cloud/building-fast-quic-sockets-in-vpp</a> (emphasis added)</p> |
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| Claim 61 Elements                                                                                                                                                                                                                                                                                                    | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A method comprising: at a node configured to execute a network application such that the network application is operates in accordance with a non-transmission control protocol (TCP) protocol that operates above an Internet Protocol (IP) layer and below a hypertext transfer protocol (HTTP) application layer: | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method comprising: at a node (e.g., one of a QUIC-compliant server or client, etc.) configured to execute a network application such that the network application is operates in accordance with a non-transmission control protocol (TCP) protocol (e.g., a QUIC protocol, etc.) that operates above an Internet Protocol (IP) layer and below a hypertext transfer protocol (HTTP) application layer.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Google admits that their “Google Cloud Platform” uses QUIC:</p> <p>"Google Cloud Platform Blog...</p> <p>we’re happy to be the first major public cloud to offer QUIC support for our HTTPS load balancers."<br/> <a href="https://cloudplatform.googleblog.com/2018/06/Introducing-QUIC-support-for-HTTPS-load-balancing.html">https://cloudplatform.googleblog.com/2018/06/Introducing-QUIC-support-for-HTTPS-load-balancing.html</a></p> <p><b>Note:</b> The “Google Cloud Platform” that, as established above, uses QUIC, is also used for ALL of Google’s services:</p> <p>“Google Cloud Platform (GCP), offered by Google (company), is a suite of cloud computing services that runs on the same infrastructure that Google uses internally for its end-user products, such as Google Search, Gmail, file storage, and YouTube”<br/> <a href="https://en.wikipedia.org/wiki/Google_Cloud_Platform">https://en.wikipedia.org/wiki/Google_Cloud_Platform</a></p> <p><b>Note:</b> At least a portion of the citations herein are made to the QUIC standard found at:<br/> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a>, and/or <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-27">https://tools.ietf.org/html/draft-ietf-quic-transport-27</a>. Based upon information and belief, the pertinent portions of such version of the QUIC standard may also be found in one or more other versions. For completeness, all of the versions below (and future iterations thereof) are hereby incorporated by reference:</p> <p><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-00">https://tools.ietf.org/html/draft-ietf-quic-transport-00</a></p> |

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|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-01">https://tools.ietf.org/html/draft-ietf-quic-transport-01</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-02">https://tools.ietf.org/html/draft-ietf-quic-transport-02</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-03">https://tools.ietf.org/html/draft-ietf-quic-transport-03</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-04">https://tools.ietf.org/html/draft-ietf-quic-transport-04</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-05">https://tools.ietf.org/html/draft-ietf-quic-transport-05</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-06">https://tools.ietf.org/html/draft-ietf-quic-transport-06</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-08">https://tools.ietf.org/html/draft-ietf-quic-transport-08</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-09">https://tools.ietf.org/html/draft-ietf-quic-transport-09</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-10">https://tools.ietf.org/html/draft-ietf-quic-transport-10</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-11">https://tools.ietf.org/html/draft-ietf-quic-transport-11</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-12">https://tools.ietf.org/html/draft-ietf-quic-transport-12</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-13">https://tools.ietf.org/html/draft-ietf-quic-transport-13</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-14">https://tools.ietf.org/html/draft-ietf-quic-transport-14</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-15">https://tools.ietf.org/html/draft-ietf-quic-transport-15</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-16">https://tools.ietf.org/html/draft-ietf-quic-transport-16</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-17">https://tools.ietf.org/html/draft-ietf-quic-transport-17</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-18">https://tools.ietf.org/html/draft-ietf-quic-transport-18</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-19">https://tools.ietf.org/html/draft-ietf-quic-transport-19</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-20">https://tools.ietf.org/html/draft-ietf-quic-transport-20</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-21">https://tools.ietf.org/html/draft-ietf-quic-transport-21</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-23">https://tools.ietf.org/html/draft-ietf-quic-transport-23</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-24">https://tools.ietf.org/html/draft-ietf-quic-transport-24</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-25">https://tools.ietf.org/html/draft-ietf-quic-transport-25</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-26">https://tools.ietf.org/html/draft-ietf-quic-transport-26</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-27">https://tools.ietf.org/html/draft-ietf-quic-transport-27</a></p> <p><b>Note:</b> Though these contentions may refer to a specific version of the QUIC standard, the presented evidence is not exclusive to this specific version and is compliant with and/or supported by current versions of the QUIC standard, including QUIC_VERSION_IETF_RFC_V1 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34</a>), QUIC_VERSION_IETF_DRAFT_25 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-25">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-25</a>), QUIC_VERSION_IETF_DRAFT_27</p> |
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(<https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-27>), QUIC\_VERSION\_IETF\_DRAFT\_28 (<https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-28>), QUIC\_VERSION\_IETF\_DRAFT\_29 (<https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-29>), and/or QUIC\_VERSION\_50 which relies in part on IETF\_QUIC\_INVARIANTS\_06 (<https://tools.ietf.org/html/draft-ietf-quic-invariants-06>) and/or IETF\_QUIC\_TRANSPORT\_17 (<https://tools.ietf.org/html/draft-ietf-quic-transport-17>), each of which, upon information and belief, has been utilized by Google LLC through its accused instrumentalities.

**Note:** Below is a web page of Google (<https://www.google.com/>).

The screenshot shows a Google search page with the Network tab open in the developer tools. The Network tab displays a list of requests, with the 'Protocol' column highlighted in red. The highlighted protocols are 'http/2+quic/46'. The page also shows a sidebar with Google services and a 'Cases overview' section for Alameda County.

| Name                   | St... | Protocol       | Domain                     | Type      | Initiator            | Size         | Ti... | Waterfall |
|------------------------|-------|----------------|----------------------------|-----------|----------------------|--------------|-------|-----------|
| KfOmCnqEu92fr1...      | 200   | http/2+quic/46 | tonts.gstatic.com          | tont      | app/origin=http...   | (disk cac... | 6 ... |           |
| ListAccounts?listPa... | 200   | http/2+quic/46 | accounts.google.com        | document  | rs=AA2YrTuismE...    | 1.4 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...    | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...    | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...    | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | png       | rs=AA2YrTuismE...    | (disk cac... | 8 ... |           |
| m=wmwg8b               | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_ tp:434         | (disk cac... | 3 ... |           |
| m=A7fCU,BVgquf,...     | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_ tp:434         | (disk cac... | 1...  |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | m= b_ tp:301         | 644 B        | 1...  |           |
| m=FCpbqb,OJUr...       | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_ tp:434         | (disk cac... | 3 ... |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | m= b_ tp:301         | 788 B        | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=stria... | 2.4 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=stria... | 2.2 KB       | 2...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=stria... | 2.7 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | png       | search?safe=stria... | 662 B        | 1...  |           |
| gen_204?atyp=i&e...    | 204   | http/2+quic/46 | www.google.com             | text/html | rs=ACT90oFF1ed...    | 40 B         | 5...  |           |
| gen_204?atyp=csi...    | 204   | http/2+quic/46 | www.google.com             | text/html | rs=ACT90oFF1ed...    | 40 B         | 5...  |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | rs=AA2YrTuismE...    | 345 B        | 5...  |           |

**Note:** As set forth below, a QUIC is a “variant” of TCP.

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|                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                         | <p>“1. Introduction</p> <p>QUIC is a new multiplexed and secure transport atop UDP. QUIC builds on decades of transport and security experience, and implements mechanisms that make it attractive as a modern general-purpose transport. The QUIC protocol is described in [QUIC-TRANSPORT].</p> <p>QUIC implements the spirit of existing TCP loss recovery mechanisms, described in RFCs, various Internet-drafts, and also those prevalent in the Linux TCP implementation. This document describes QUIC congestion control and loss recovery, and where applicable, attributes the TCP equivalent in RFCs, Internet-drafts, academic papers, and/or TCP implementations.”<br/> <i>QUIC Loss Detection and Congestion Control</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-recovery-22">https://tools.ietf.org/html/draft-ietf-quic-recovery-22</a></p> <p>“On the surface, QUIC is very similar to TCP+TLS+HTTP/2 implemented on UDP. ...However, since QUIC is built on top of UDP, it suffers from no such limitations.” <a href="https://medium.com/@nirosh/understanding-quic-wire-protocol-d0ff97644de7">https://medium.com/@nirosh/understanding-quic-wire-protocol-d0ff97644de7</a></p> |
| receiving idle information for use in detecting an idle time period that results in a non-TCP connection being subject to deactivation; | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including receiving idle information for use in detecting an idle time period that results in a non-TCP connection (e.g., QUIC connection, etc.) being subject to deactivation.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, the metadata includes a value in seconds that is encoded as an unsigned 16-bit integer.</p> <p>“idle_timeout (0x0001): The idle timeout is a value in milliseconds that is encoded as an integer; see (Section 10.2). If this parameter is absent or zero then the idle timeout is disabled.”<br/> <i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“10.2. Idle Timeout</p>                                                                                                                                                                                                                             |

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|                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                         | <p>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout (see Section 18.1) and three times the current Probe Timeout (PTO)."</p> <p>"The value for an idle timeout can be asymmetric. The value advertised by an endpoint is only used to determine whether the connection is live at that endpoint. An endpoint that sends packets near the end of the idle timeout period of a peer risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could timeout within a Probe Timeout (PTO; see Section 6.3 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried."</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p>                                                                                                                                                                                                       |
| generating, based on the idle information, a non-TCP packet including an idle time period parameter field identifying metadata that is specified in at least one of a number of seconds or minutes; and | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including generating, based on the idle information, a non-TCP packet (e.g., QUIC negotiation packet, etc.) including an idle time period parameter field (e.g., idle_timeout parameter field, etc.) identifying metadata (e.g., a value, etc.) that is specified in at least one of a number of seconds or minutes.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> <p>"7.3. Transport Parameters</p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling."</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |

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| Value  | Parameter Name                      | Specification |
|--------|-------------------------------------|---------------|
| 0x0000 | original_connection_id              | Section 18.1  |
| 0x0001 | idle_timeout                        | Section 18.1  |
| 0x0002 | stateless_reset_token               | Section 18.1  |
| 0x0003 | max_packet_size                     | Section 18.1  |
| 0x0004 | initial_max_data                    | Section 18.1  |
| 0x0005 | initial_max_stream_data_bidi_local  | Section 18.1  |
| 0x0006 | initial_max_stream_data_bidi_remote | Section 18.1  |
| 0x0007 | initial_max_stream_data_uni         | Section 18.1  |
| 0x0008 | initial_max_streams_bidi            | Section 18.1  |
| 0x0009 | initial_max_streams_uni             | Section 18.1  |
| 0x000a | ack_delay_exponent                  | Section 18.1  |
| 0x000b | max_ack_delay                       | Section 18.1  |
| 0x000c | disable_migration                   | Section 18.1  |
| 0x000d | preferred_address                   | Section 18.1  |
| 0x000e | active_connection_id_limit          | Section 18.1  |

Table 6: Initial QUIC Transport Parameters Entries

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|  | <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“18. Transport Parameter Encoding</p> <p>The format of the transport parameters is the TransportParameters struct from Figure 15. This is described using the presentation language from Section 3 of [TLS13].</p> <pre>enum {<br/>    original_connection_id(0),<br/>    idle_timeout(1),<br/>    stateless_reset_token(2),<br/>    max_packet_size(3),<br/>    initial_max_data(4),<br/>    initial_max_stream_data_bidi_local(5),<br/>    initial_max_stream_data_bidi_remote(6),<br/>    initial_max_stream_data_uni(7),<br/>    initial_max_streams_bidi(8),<br/>    initial_max_streams_uni(9),<br/>    ack_delay_exponent(10),<br/>    max_ack_delay(11),<br/>    disable_migration(12),<br/>    preferred_address(13),<br/>    active_connection_id_limit(14),<br/>    (65535)<br/>} TransportParameterId;”</pre> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, the metadata includes a value in seconds that is encoded as an unsigned 16-bit integer.</p> <p>“idle_timeout (0x0001): The idle timeout is a value in milliseconds that is encoded as an integer; see (Section 10.2). If this parameter is absent or zero then the idle timeout is disabled.”</p> |
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|                                                                                                                                                                                                                                                                   | <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p>sending, from the node to another node and for establishing the non-TCP connection, the non-TCP packet to provide the metadata to the another node, for use by the another node in determining a timeout attribute associated with the non-TCP connection;</p> | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including sending, from the node (e.g., one of a QUIC-compliant server or client, etc.) to another node (e.g., the other one of the QUIC-compliant server or client, etc.) and for establishing the non-TCP connection (e.g., the QUIC connection, etc.), the non-TCP packet (e.g., the QUIC negotiation packet, etc.) to provide the metadata (e.g., the value, etc.) to the another node, for use by the another node in determining a timeout attribute associated with the non-TCP connection.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p>“The initial handshake packet from the client needs to fit in a single packet (#338)”<br/> <i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“QUIC packet: A complete processable unit of QUIC that can be encapsulated in a UDP datagram. Multiple QUIC packets can be encapsulated in a single UDP datagram.”<br/> <i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, prior to a QUIC connection being established, the QUIC connection is “set up” using the aforementioned handshake.</p> <p>“5.2.2. Server Packet Handling<br/>         ...<br/>         If the packet is an Initial packet fully conforming with the specification, the server proceeds with the handshake (Section 7). This commits the server to the version that the client selected.<br/>         ...<br/>         If the packet is a 0-RTT packet, the server MAY buffer a limited number of these packets in anticipation of a late-arriving Initial packet. Clients are not able to send Handshake packets prior to receiving a server response, so servers SHOULD ignore any such packets.</p> |

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|  | <p>...</p> <p>7. Cryptographic and Transport Handshake</p> <p>QUIC relies on a combined cryptographic and transport handshake to minimize connection establishment latency. QUIC uses the CRYPTO frame Section 19.6 to transmit the cryptographic handshake. Version 0x00000001 of QUIC uses TLS as described in [QUIC-TLS]; a different QUIC version number could indicate that a different cryptographic handshake protocol is in use.</p> <p>QUIC provides reliable, ordered delivery of the cryptographic handshake data. QUIC packet protection is used to encrypt as much of the handshake protocol as possible.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> <p>“7.3. Transport Parameters</p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |
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| Value  | Parameter Name                      | Specification |
|--------|-------------------------------------|---------------|
| 0x0000 | original_connection_id              | Section 18.1  |
| 0x0001 | idle_timeout                        | Section 18.1  |
| 0x0002 | stateless_reset_token               | Section 18.1  |
| 0x0003 | max_packet_size                     | Section 18.1  |
| 0x0004 | initial_max_data                    | Section 18.1  |
| 0x0005 | initial_max_stream_data_bidi_local  | Section 18.1  |
| 0x0006 | initial_max_stream_data_bidi_remote | Section 18.1  |
| 0x0007 | initial_max_stream_data_uni         | Section 18.1  |
| 0x0008 | initial_max_streams_bidi            | Section 18.1  |
| 0x0009 | initial_max_streams_uni             | Section 18.1  |
| 0x000a | ack_delay_exponent                  | Section 18.1  |
| 0x000b | max_ack_delay                       | Section 18.1  |
| 0x000c | disable_migration                   | Section 18.1  |
| 0x000d | preferred_address                   | Section 18.1  |
| 0x000e | active_connection_id_limit          | Section 18.1  |

Table 6: Initial QUIC Transport Parameters Entries

QUIC: A UDP-Based Multiplexed and Secure Transport <https://tools.ietf.org/html/draft-ietf-quic-transport-22>

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|  | <p><b>“18. Transport Parameter Encoding</b></p> <p>The format of the transport parameters is the TransportParameters struct from Figure 15. This is described using the presentation language from Section 3 of [TLS13].</p> <pre>enum {<br/>    original_connection_id(0),<br/>    idle_timeout(1),<br/>    stateless_reset_token(2),<br/>    max_packet_size(3),<br/>    initial_max_data(4),<br/>    initial_max_stream_data_bidi_local(5),<br/>    initial_max_stream_data_bidi_remote(6),<br/>    initial_max_stream_data_uni(7),<br/>    initial_max_streams_bidi(8),<br/>    initial_max_streams_uni(9),<br/>    ack_delay_exponent(10),<br/>    max_ack_delay(11),<br/>    disable_migration(12),<br/>    preferred_address(13),<br/>    active_connection_id_limit(14),<br/>    (65535)<br/>} TransportParameterId;”</pre> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily determined based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p>“idle_timeout (0x0001): The idle timeout is a value in milliseconds that is encoded as an integer; see (Section 10.2). If this parameter is absent or zero then the idle timeout is disabled.”</p> |
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|  | <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“10. Connection Termination</p> <p>An established QUIC connection can be terminated in one of three ways:</p> <ul style="list-style-type: none"><li>• idle timeout (Section 10.2)</li><li>• immediate close (Section 10.3)</li><li>• stateless reset (Section 10.4)</li></ul> <p>An endpoint MAY discard connection state if it does not have a validated path on which it can send packets (see Section 8.2).”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout (see Section 18.1) and three times the current Probe Timeout (PTO).”</p> <p>“The value for an idle timeout can be asymmetric. The value advertised by an endpoint is only used to determine whether the connection is live at that endpoint. An endpoint that sends packets near the end of the idle timeout period of a peer risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could timeout within a Probe Timeout (PTO; see Section 6.3 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“19.2. PING Frame</p> <p>Endpoints can use PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> |
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|                                                                                                                                | <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out. An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><b>A connection will time out if no packets are sent or received for a period longer than the time specified in the <code>idle_timeout</code> transport parameter (see Section 10).</b> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> |
| wherein a three-way TCP handshake is performed for establishing a TCP connection that is separate from the non-TCP connection. | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein a three-way TCP handshake is performed for establishing a TCP connection that is separate from the non-TCP connection (e.g., the QUIC connection, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, the method (and webserver designed to operate therewith) supports both TCP (which is the current standard) and QUIC.</p> <p><b>Note:</b> The following evidence is related to and/or describes the QUIC standard contained herein.</p> <p>"The standard way to do secure web browsing involves communicating over TCP + TLS, which requires 2 to 3 round trips with a server to establish a secure connection before the browser can request the actual web page ... Google has added QUIC support to recent builds of Chrome and enabled it for some of its online services, making it possible to test the protocol's real-world performance at scale."</p>                                                                                                                                                                                                    |

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|  | <p><a href="https://www.theregister.co.uk/2015/04/17/google_quic_test_results/">https://www.theregister.co.uk/2015/04/17/google_quic_test_results/</a></p> <p><b>Note:</b> The following evidence is related to and/or describes the QUIC standard contained herein.</p> <p>“The synchronization requires each side to send its own initial sequence number and to receive a confirmation of it in acknowledgment from the other side. Each side must also receive the other side's initial sequence number and send a confirming acknowledgment.</p> <p>1) A --&gt; B SYN my sequence number is X<br/>2) A &lt;-- B ACK your sequence number is X<br/>3) A &lt;-- B SYN my sequence number is Y<br/>4) A --&gt; B ACK your sequence number is Y</p> <p>Because steps 2 and 3 can be combined in a single message this is called the three way (or three message) handshake.</p> <p>A three way handshake is necessary because sequence numbers are not tied to a global clock in the network, and TCPs may have different mechanisms for picking the ISN's. The receiver of the first SYN has no way of knowing whether the segment was an old delayed one or not, unless it remembers the last sequence number used on the connection (which is not always possible), and so it must ask the sender to verify this SYN. The three way handshake and the advantages of a clock-driven scheme are discussed in [3].”</p> <p>“Request for Comments” (RFC) document RFC 793 (September 1981) <a href="https://tools.ietf.org/html/rfc793">https://tools.ietf.org/html/rfc793</a></p> |
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| Claim 64 Elements                                                                                                                                              | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| The method of claim 61 wherein: one or more keep-alive packets are communicated, based on a keep-alive period that is, in turn, based on the idle time period; | <p>Google infringes claim 61 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein: one or more keep-alive packets are communicated, based on a keep-alive period that is, in turn, based on the idle time period.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Based upon information and belief, infringement occurs, for example, at least during a packet communication scenario when a keep-alive packet starts a detected idle time period and no other keep-alives are communicated during the idle period.</p> <p><b>Note:</b> Based on the list of negotiable parameters (see Section 18.2), the keep-alive period is not configurable during connection setup. Based upon information and belief, the keep-alive period is constrained by the idle time period, which is negotiated at connection setup.</p> <p>The duration for an idle time period includes negotiation/configuration via a max_idle_timeout transport parameter. See, for example, section 10.1.2 of the QUIC transport draft at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2spec">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2spec</a> and section 18.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-18.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-18.2</a>). It is also clear from the list of negotiable parameters in section 18.2 that the keep-alive period is not negotiable/configurable during connection setup. Further, the keep-alive period is constrained by the idle time period as described in section 19.2 and 10.1.2. See section 10.1.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1</a> and section 19.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2</a>.</p> <p><b>Note:</b> Based upon information and belief, the keep-alive attribute is satisfied by enabling or disabling the sending of one or more PING frames. See, for example, section 19.2 of the QUIC transport draft at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2</a> and section 10.1.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2</a>.</p> |

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|  | <p><b>Note:</b> As set forth below, since the <code>idle_timeout</code> value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the <code>idle_timeout</code> field of the connection negotiation packet.</p> <p>“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> <p>...</p> <ul style="list-style-type: none"><li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires (Section 10.2); and</u></li><li>• immediately close (Section 10.3) the connection.”</li></ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the <code>max_idle_timeouts</code> (see Section 18.2) and three times the current Probe Timeout (PTO).</p> <p><u>Each endpoint advertises a <code>max_idle_timeout</code>, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a <code>max_idle_timeout</code>, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending</p> |
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|  | <p>packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> |
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| <p>the keep-alive period is not configurable, while the idle time period is configurable; and</p> | <p>Google infringes claim 61 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein the keep-alive period is not configurable, while the idle time period is configurable.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p style="padding-left: 40px;">“5.4. Required Operations on Connections</p> <p>There are certain operations which an application MUST be able to perform when interacting with the QUIC transport. This document does not specify an API, but any implementation of this version of QUIC MUST expose the ability to perform the operations described in this section on a QUIC connection.</p> <p>...</p> <p>In either role, applications need to be able to:</p> <p>...</p> <ul style="list-style-type: none"><li>• <u>keep a connection from silently closing, either by generating PING frames (Section 19.2) or by requesting that the transport send additional frames before the idle timeout expires</u> (Section 10.2); and</li><li>• immediately close (Section 10.3) the connection.”</li></ul> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“10.2. Idle Timeout</p> <p>If the idle timeout is enabled by either peer, a connection is silently closed and its state is discarded when it remains idle for longer than the minimum of the max_idle_timeouts (see Section 18.2) and three times the current Probe Timeout (PTO).</p> |
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|  | <p><u>Each endpoint advertises a max_idle_timeout, but the effective value at an endpoint is computed as the minimum of the two advertised values.</u> By announcing a max_idle_timeout, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.</p> <p>An endpoint restarts its idle timer when a packet from its peer is received and processed successfully. The idle timer is also restarted when sending an ack-eliciting packet (see [QUIC-RECOVERY]), but only if no other ack-eliciting packets have been sent since last receiving a packet. Restarting when sending packets ensures that connections do not prematurely time out when initiating new activity. An endpoint might need to send packets to avoid an idle timeout if it is unable to send application data due to being blocked on flow control limits; see Section 4.</p> <p>An endpoint that sends packets near the end of the idle timeout period risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could time out within a Probe Timeout (PTO; see Section 6.6 of [QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p>“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> |
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|                                                                                                               | <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| the one or more keep-alive packets are conditionally communicated based on at least one keep-alive attribute. | <p>Google infringes claim 61 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein the one or more keep-alive packets are conditionally communicated based on at least one keep-alive attribute.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p style="padding-left: 40px;">“19.2. PING Frame</p> <p>Endpoints <u>can use</u> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer. The PING frame contains no additional fields.</p> <p>The receiver of a PING frame simply needs to acknowledge the packet containing this frame.</p> <p><u>The PING frame can be used to keep a connection alive when an application or application protocol wishes to prevent the connection from timing out.</u> An application protocol SHOULD provide guidance about the conditions under which generating a PING is recommended. This guidance SHOULD indicate whether it is the client or the server that is expected to send the PING. Having both endpoints send PING frames without coordination can produce an excessive number of packets and poor performance.</p> <p><u>A connection will time out if no packets are sent or received for a period longer than the time negotiated using the max_idle_timeout transport parameter (see Section 10).</u> However, state in middleboxes might</p> |

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|  | <p>time out earlier than that. Though REQ-5 in [RFC4787] recommends a 2 minute timeout interval, experience shows that sending packets every 15 to 30 seconds is necessary to prevent the majority of middleboxes from losing state for UDP flows.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt">https://tools.ietf.org/id/draft-ietf-quic-transport-27.txt</a></p> <p><b>Note:</b> The following evidence is related to and/or describes the QUIC standard contained herein.</p> <p>“3.3. Session resumption versus Keep-alive</p> <p>Because QUIC is encapsulated in UDP, applications using QUIC must deal with short idle timeouts. Deployed stateful middleboxes will generally establish state for UDP flows on the first packet state, and keep state for much shorter idle periods than for TCP. According to a 2010 study ([Hatonen10]), UDP applications can assume that any NAT binding or other state entry will be expired after just thirty seconds of inactivity.</p> <p>A QUIC application has three strategies to deal with this issue:</p> <ul style="list-style-type: none"><li>• Ignore it, if the application-layer protocol consists only of interactions with no or very short idle periods.</li><li>• Ensure there are no long idle periods.</li><li>• Resume the session after a long idle period, using 0-RTT resumption when appropriate.</li></ul> <p>The first strategy is the easiest, but it only applies to certain applications. Either the server or the client in a QUIC application can send PING frames as keep-alives, to prevent the connection and any on-path state from timing out.</p> <p><u>Recommendations for the use of keep-alives are application specific</u>, mainly depending on the latency requirements and message frequency of the application. <u>In this case, the application mapping must specify whether the client or server is responsible for keeping the application alive.</u> Note that sending PING frames more frequently than every 30 seconds over long idle periods may result in a too much unproductive traffic and power usage for some situations.</p> |
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|  | <p><u>Alternatively, the client (but not the server) can use session resumption instead of sending keepalive traffic.</u> In this case, a client that wants to send data to a server over a connection idle longer than the server's idle timeout (available from the idle_timeout transport parameter) can simply reconnect. When possible, this reconnection can use 0-RTT session resumption, reducing the latency involved with restarting the connection. This of course only applies in cases in which 0-RTT data is safe, when the client is the restarting peer, and when the data to be sent is idempotent.</p> <p>The tradeoffs between resumption and keepalive need to be evaluated on a per-application basis. However, in general applications should use keepalives only in circumstances where continued communication is highly likely; [QUIC-HTTP], for instance, recommends using PING frames for keepalive only when a request is outstanding.”</p> <p><a href="https://www.ietf.org/id/draft-ietf-quic-applicability-07.txt">https://www.ietf.org/id/draft-ietf-quic-applicability-07.txt</a></p> |
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| Claim 66 Elements                                                                                                                                                                                                                                                                   | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| The method of claim 64 and further comprising: configuring the node to cause the another node to determine, based on the metadata, the timeout attribute associated with the non-TCP connection, in connection with negotiating, with the node, a duration of the idle time period. | <p>Google infringes claim 64 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method further comprising: configuring the node to cause the another node to determine, based on the metadata (e.g., the value, etc.), the timeout attribute associated with the non-TCP connection (e.g., the QUIC connection, etc.), in connection with negotiating, with the node, a duration of the idle time period.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Based on the list of negotiable parameters (see Section 18.2), the keep-alive period is not configurable during connection setup. Based upon information and belief, the keep-alive period is constrained by the idle time period, which is negotiated at connection setup.</p> <p>The duration for an idle time period includes negotiation/configuration via a max_idle_timeout transport parameter. See, for example, section 10.1.2 of the QUIC transport draft at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2spec">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2spec</a> and section 18.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-18.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-18.2</a>). It is also clear from the list of negotiable parameters in section 18.2 that the keep-alive period is not negotiable/configurable during connection setup. Further, the keep-alive period is constrained by the idle time period as described in section 19.2 and 10.1.2. See section 10.1.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1</a> and section 19.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2</a>.</p> <p><b>Note:</b> Based upon information and belief, the keep-alive attribute is satisfied by enabling or disabling the sending of one or more PING frames. See, for example, section 19.2 of the QUIC transport draft at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2</a> and section 10.1.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2</a>.</p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet is received by one of the nodes.</p> |

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7.4. Transport Parameters

During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.

QUIC packet: A well-formed UDP payload that can be parsed by a QUIC receiver. QUIC packet size in this document refers to the UDP

*QUIC: A UDP-Based Multiplexed and Secure Transport* <https://tools.ietf.org/html/draft-ietf-quic-transport-07>

**Note:** As set forth below, since the `idle_timeout` value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the `idle_timeout` field of the connection negotiation packet.

`idle_timeout (0x0001)`: The idle timeout is a value in milliseconds that is encoded as an integer; see (Section 10.2). If this parameter is absent or zero then the idle timeout is disabled.

*QUIC: A UDP-Based Multiplexed and Secure Transport* <https://tools.ietf.org/html/draft-ietf-quic-transport-22>

“10.2. Idle Timeout

...

Each endpoint advertises a `max_idle_timeout`, but the effective value at an endpoint is computed as the minimum of the two advertised values. By announcing a `max_idle_timeout`, an endpoint commits to initiating an immediate close (Section 10.3) if it abandons the connection prior to the effective value.”

*QUIC: A UDP-Based Multiplexed and Secure Transport* <https://tools.ietf.org/html/draft-ietf-quic-transport-27.txt>

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| Claim 67 Elements                                                                                                                   | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| <p>The method of claim 64 wherein a duration of the idle time period is configured by an application via an analog of a socket.</p> | <p>Google infringes claim 64 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein a duration of the idle time period is configured by an application via an analog of a socket (e.g., a listener socket and/or stream socket, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Based on the list of negotiable parameters (see Section 18.2), the keep-alive period is not configurable during connection setup. Based upon information and belief, the keep-alive period is constrained by the idle time period, which is negotiated at connection setup.</p> <p>The duration for an idle time period includes negotiation/configuration via a max_idle_timeout transport parameter. See, for example, section 10.1.2 of the QUIC transport draft at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2spec">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1.2spec</a> and section 18.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-18.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-18.2</a>). It is also clear from the list of negotiable parameters in section 18.2 that the keep-alive period is not negotiable/configurable during connection setup. Further, the keep-alive period is constrained by the idle time period as described in section 19.2 and 10.1.2. See section 10.1.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-10.1</a> and section 19.2 at <a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34#section-19.2</a>.</p> <p>“10.2. Idle Timeout</p> <p><u>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout (see Section 18.1) and three times the current Probe Timeout (PTO).”</u></p> <p>“The value for an idle timeout can be asymmetric. The value advertised by an endpoint is only used to determine whether the connection is live at that endpoint. An endpoint that sends packets near the end of the idle timeout period of a peer risks having those packets discarded if its peer enters the draining state before the packets arrive. If a peer could timeout within a Probe Timeout (PTO; see Section 6.3 of</p> |

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|  | <p>[QUIC-RECOVERY]), it is advisable to test for liveness before sending any data that cannot be retried safely. Note that it is likely that only applications or application protocols will know what information can be retried.”</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> <p><b>7.4. Transport Parameters</b></p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.</p> |
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| Value  | Parameter Name          | Specification |
|--------|-------------------------|---------------|
| 0x0000 | initial_max_stream_data | Section 7.4.1 |
| 0x0001 | initial_max_data        | Section 7.4.1 |
| 0x0002 | initial_max_stream_id   | Section 7.4.1 |
| 0x0003 | idle_timeout            | Section 7.4.1 |
| 0x0004 | omit_connection_id      | Section 7.4.1 |
| 0x0005 | max_packet_size         | Section 7.4.1 |
| 0x0006 | stateless_reset_token   | Section 7.4.1 |

Table 4: Initial QUIC Transport Parameters Entries

**Note:** The following evidence is related to and/or describes the QUIC standard contained herein.

“Because of the built-in stream multiplexing layer in QUIC, applications need to handle three types of logical objects: listeners, connections, and streams. These objects have different properties from the traditional UDP and TCP listeners and connections. As a result, the adaptation to socket semantics was not direct. We used three types of sockets to expose the QUIC API, with the following properties:

- **Listener sockets:** like regular TCP/UDP listeners, they bind to a port and are used to accept incoming connections. Listeners can be closed when the application no longer desires to accept new connections.

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|  | <ul style="list-style-type: none"><li>• <b>Connection sockets:</b> these sockets are created by connect or accept calls. Unlike TCP or UDP sockets, however, these sockets cannot be used to send or receive data and are only used to manage the streams belonging to the connection.</li><li>• <b>Stream sockets:</b> these are the sockets that provide send and receive functions so peers can <u>exchange data</u>. They can be <u>created either by accepting on a connection socket (for streams opened by the peer), or by calling connect on the connection socket to create a new, locally initiated stream</u>. Streams can be closed by either peer at any point during the connection.”<br/><a href="https://blogs.cisco.com/cloud/building-fast-quic-sockets-in-vpp">https://blogs.cisco.com/cloud/building-fast-quic-sockets-in-vpp</a> (emphasis added)</li></ul> |
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| Claim 68 Elements                                                                                                                                                                                                                                                                                                                                                                                              | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>A method comprising: at a node configured with a network application that is configured to operate in accordance with a first protocol including a transmission control protocol (TCP) to establish a TCP connection: based on operating in accordance with a second protocol, that is separate from the TCP, to establish a second protocol connection:</p> <p>receiving, from another node, a packet;</p> | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method comprising: at a node (e.g., one of a QUIC-compliant server or client, etc.) configured with a network application that is configured to operate in accordance with a first protocol including a transmission control protocol (TCP) to establish a TCP connection: based on operating in accordance with a second protocol (e.g., QUIC, etc.), that is separate from the TCP, to establish a second protocol connection (e.g., QUIC connection, etc.): receiving, from another node (e.g., the other one of the QUIC-compliant server or client, etc.), a packet (e.g., QUIC negotiation packet, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> Google admits that their “Google Cloud Platform” uses QUIC:</p> <p>"Google Cloud Platform Blog...</p> <p>we’re happy to be the first major public cloud to offer QUIC support for our HTTPS load balancers."<br/> <a href="https://cloudplatform.googleblog.com/2018/06/Introducing-QUIC-support-for-HTTPS-load-balancing.html">https://cloudplatform.googleblog.com/2018/06/Introducing-QUIC-support-for-HTTPS-load-balancing.html</a></p> <p><b>Note:</b> The “Google Cloud Platform” that, as established above, uses QUIC, is also used for ALL of Google’s services:</p> <p>“Google Cloud Platform (GCP), offered by Google (company), is a suite of cloud computing services that runs on the same infrastructure that Google uses internally for its end-user products, such as Google Search, Gmail, file storage, and YouTube”<br/> <a href="https://en.wikipedia.org/wiki/Google_Cloud_Platform">https://en.wikipedia.org/wiki/Google_Cloud_Platform</a></p> <p><b>Note:</b> At least a portion of the citations herein are made to the QUIC standard found at: <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a>, and/or <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-27">https://tools.ietf.org/html/draft-ietf-quic-transport-27</a>. Based upon information and belief, the pertinent portions of such version of the QUIC</p> |

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|  | <p>standard may also be found in one or more other versions. For completeness, all of the versions below (and future iterations thereof) are hereby incorporated by reference:</p> <p><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-00">https://tools.ietf.org/html/draft-ietf-quic-transport-00</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-01">https://tools.ietf.org/html/draft-ietf-quic-transport-01</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-02">https://tools.ietf.org/html/draft-ietf-quic-transport-02</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-03">https://tools.ietf.org/html/draft-ietf-quic-transport-03</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-04">https://tools.ietf.org/html/draft-ietf-quic-transport-04</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-05">https://tools.ietf.org/html/draft-ietf-quic-transport-05</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-06">https://tools.ietf.org/html/draft-ietf-quic-transport-06</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-08">https://tools.ietf.org/html/draft-ietf-quic-transport-08</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-09">https://tools.ietf.org/html/draft-ietf-quic-transport-09</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-10">https://tools.ietf.org/html/draft-ietf-quic-transport-10</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-11">https://tools.ietf.org/html/draft-ietf-quic-transport-11</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-12">https://tools.ietf.org/html/draft-ietf-quic-transport-12</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-13">https://tools.ietf.org/html/draft-ietf-quic-transport-13</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-14">https://tools.ietf.org/html/draft-ietf-quic-transport-14</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-15">https://tools.ietf.org/html/draft-ietf-quic-transport-15</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-16">https://tools.ietf.org/html/draft-ietf-quic-transport-16</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-17">https://tools.ietf.org/html/draft-ietf-quic-transport-17</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-18">https://tools.ietf.org/html/draft-ietf-quic-transport-18</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-19">https://tools.ietf.org/html/draft-ietf-quic-transport-19</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-20">https://tools.ietf.org/html/draft-ietf-quic-transport-20</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-21">https://tools.ietf.org/html/draft-ietf-quic-transport-21</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-23">https://tools.ietf.org/html/draft-ietf-quic-transport-23</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-24">https://tools.ietf.org/html/draft-ietf-quic-transport-24</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-25">https://tools.ietf.org/html/draft-ietf-quic-transport-25</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-26">https://tools.ietf.org/html/draft-ietf-quic-transport-26</a><br/><a href="https://tools.ietf.org/html/draft-ietf-quic-transport-27">https://tools.ietf.org/html/draft-ietf-quic-transport-27</a></p> |
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CLAIM CHARTS  
BASED ON INFRINGEMENT ANALYSIS OF GOOGLE  
U.S. Patent No. 10,306,026

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>Note:</b> Though these contentions may refer to a specific version of the QUIC standard, the presented evidence is not exclusive to this specific version and is compliant with and/or supported by current versions of the QUIC standard, including QUIC_VERSION_IETF_RFC_V1 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-34</a>), QUIC_VERSION_IETF_DRAFT_25 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-25">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-25</a>), QUIC_VERSION_IETF_DRAFT_27 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-27">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-27</a>), QUIC_VERSION_IETF_DRAFT_28 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-28">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-28</a>), QUIC_VERSION_IETF_DRAFT_29 (<a href="https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-29">https://datatracker.ietf.org/doc/html/draft-ietf-quic-transport-29</a>), and/or QUIC_VERSION_50 which relies in part on IETF_QUIC_INVARIANTS_06 (<a href="https://tools.ietf.org/html/draft-ietf-quic-invariants-06">https://tools.ietf.org/html/draft-ietf-quic-invariants-06</a>) and/or IETF_QUIC_TRANSPORT_17 (<a href="https://tools.ietf.org/html/draft-ietf-quic-transport-17">https://tools.ietf.org/html/draft-ietf-quic-transport-17</a>), each of which, upon information and belief, has been utilized by Google LLC through its accused instrumentalities.</p> <p><b>Note:</b> Below is a web page of Google (<a href="https://www.google.com/">https://www.google.com/</a>).</p> |
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Account

Search

Maps

YouTube

Play

News

Calendar

Gmail

Contacts

Drive

Translate

Photos

Cases overview

Alameda County

Confirmed  
1,191

Recovered  
-

Deaths  
42

California

google.com/search?safe=strict&ssrf=AleKk0aNIUIhuNrpELxofGKChmEHwHqwr1587486895209&q=coronavirus+tips&oi=ddle&ct=153607016&hl=en&sa=X&ve...

Elements Console Sources Network Performance Memory Application Security Audits

Filter Hide data URLs XHR JS CSS Img Media Font Doc WS Manifest Other

Only show requests with SameSite issues

1000 ms 2000 ms 3000 ms 4000 ms 5000 ms 6000 ms 7000 ms 8000 ms 9000 ms

| Name                   | St... | Protocol       | Domain                     | Type      | Initiator            | Size         | TI... | Waterfall |
|------------------------|-------|----------------|----------------------------|-----------|----------------------|--------------|-------|-----------|
| KfOmCnqtu92f1...       | 200   | http/2+quic/46 | fonts.gstatic.com          | font      | app/origin=http...   | (disk cac... | 6 ... |           |
| ListAccounts?listPa... | 200   | http/2+quic/46 | accounts.google.com        | document  | rs=AA2YrTuismE...    | 1.4 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...    | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...    | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | rs=AA2YrTuismE...    | (disk cac... | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | png       | rs=AA2YrTuismE...    | (disk cac... | 8 ... |           |
| m=wmwg8b               | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_tp:434          | (disk cac... | 3 ... |           |
| m=A7fCU,8Vgquf,...     | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_tp:434          | (disk cac... | 1...  |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | m= b_tp:301          | 644 B        | 1...  |           |
| m=FCpbqb,OJUr...       | 200   | http/2+quic/46 | www.gstatic.com            | script    | m= b_tp:434          | (disk cac... | 3 ... |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | m= b_tp:301          | 788 B        | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=strie... | 2.4 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=strie... | 2.2 KB       | 2...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | jpeg      | search?safe=strie... | 2.7 KB       | 1...  |           |
| photo.jpg              | 200   | http/2+quic/46 | lh3.googleusercontent.c... | png       | search?safe=strie... | 662 B        | 1...  |           |
| gen_204?atyp=i&e...    | 204   | http/2+quic/46 | www.google.com             | text/html | rs=ACT90oFF1ed...    | 40 B         | 5...  |           |
| gen_204?atyp=csi...    | 204   | http/2+quic/46 | www.google.com             | text/html | rs=ACT90oFF1ed...    | 40 B         | 5...  |           |
| log?format=json&...    | 200   | http/2+quic/46 | play.google.com            | xhr       | rs=AA2YrTuismE...    | 345 B        | 5...  |           |

**Note:** As set forth below, QUIC is separate from TCP.

1. Introduction

QUIC is a multiplexed and secure transport protocol that runs on top of UDP. QUIC aims to provide a flexible set of features that allow it to be a general-purpose transport for multiple applications.

QUIC implements techniques learned from experience with TCP, SCTP and

QUIC: A UDP-Based Multiplexed and Secure Transport <https://tools.ietf.org/html/draft-ietf-quic-transport-07>

**Note:** The following evidence is related to and/or describes the QUIC standard contained herein.

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U.S. Patent No. 10,306,026

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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|  | <p>“On the surface, QUIC is very similar to TCP+TLS+HTTP/2 implemented on UDP. ...However, since QUIC is built on top of UDP, it suffers from no such limitations.” <a href="https://www.chromium.org/quic">https://www.chromium.org/quic</a></p> <p><b>Note:</b> As set forth below, a QUIC connection establishment begins by sending a handshake packet.</p> <p>7.2. Version Negotiation</p> <p>QUIC’s connection establishment begins with version negotiation, since all communication between the endpoints, including packet and frame formats, relies on the two endpoints agreeing on a version.</p> <p>A QUIC connection begins with a client sending a Client Initial packet (Section 5.4.1). The details of the handshake mechanisms are described in Section 7.3, but all of the initial packets sent from the client to the server MUST use the long header format - which includes the version of the protocol being used - and they MUST be padded to at least 1200 octets.</p> <p>The design of version negotiation permits a server to avoid maintaining state for packets that it rejects in this fashion. However, when the server generates a Version Negotiation packet, it cannot randomly generate a reserved version number. This is because the server is required to include the same value in its transport parameters (see Section 7.4.4). To avoid the selected version number</p> <ul style="list-style-type: none"><li>o The initial handshake packet from the client needs to fit in a single packet (#338)</li></ul> <p>QUIC packet: A well-formed UDP payload that can be parsed by a QUIC receiver. QUIC packet size in this document refers to the UDP</p> <p>QUIC: A UDP-Based Multiplexed and Secure Transport <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a></p> |
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 U.S. Patent No. 10,306,026

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|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                              | <p><b>Note:</b> As set forth below, prior to a QUIC connection being established, the QUIC connection is “set up” using the aforementioned handshake.</p> <p>3.1. Low-Latency Connection Establishment</p> <p>QUIC relies on a combined cryptographic and transport handshake for setting up a secure transport connection. QUIC connections are expected to commonly use 0-RTT handshakes, meaning that for most QUIC connections, data can be sent immediately following the client handshake packet, without waiting for a reply from the server. QUIC provides a dedicated stream (Stream ID 0) to be used for performing the cryptographic handshake and QUIC options negotiation. The format of the QUIC options and parameters used during negotiation are described in this document, but the handshake protocol that runs on Stream ID 0 is described in the accompanying cryptographic handshake draft [QUIC-TLS].</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a></p> |
| detecting an idle time period parameter field in the packet; | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including detecting an idle time period parameter field (e.g., idle timeout parameter field, etc.) in the packet (e.g., QUIC negotiation packet, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, a QUIC negotiation packet includes transport parameters that include an idle timeout parameter that is detected by a recipient of such packet.</p> <p>7.4. Transport Parameters</p> <p>During connection establishment, both endpoints make authenticated declarations of their transport parameters. These declarations are made unilaterally by each endpoint. Endpoints are required to comply with the restrictions implied by these parameters; the description of each parameter includes rules for its handling.</p>                                                                                                                                                                       |

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| Value  | Parameter Name          | Specification |
|--------|-------------------------|---------------|
| 0x0000 | initial_max_stream_data | Section 7.4.1 |
| 0x0001 | initial_max_data        | Section 7.4.1 |
| 0x0002 | initial_max_stream_id   | Section 7.4.1 |
| 0x0003 | idle_timeout            | Section 7.4.1 |
| 0x0004 | omit_connection_id      | Section 7.4.1 |
| 0x0005 | max_packet_size         | Section 7.4.1 |
| 0x0006 | stateless_reset_token   | Section 7.4.1 |

Table 4: Initial QUIC Transport Parameters Entries

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|                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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|                                                                                                                                                                                                                | <p>The format of the transport parameters is the TransportParameters struct from Figure 6. This is described using the presentation language from Section 3 of [I-D.ietf-tls-tls13].</p> <pre> uint32 QuicVersion;  enum {     initial_max_stream_data(0),     initial_max_data(1),     initial_max_stream_id(2),     idle_timeout(3),     omit_connection_id(4),     max_packet_size(5),     stateless_reset_token(6),     (65535) } TransportParameterId;                     </pre> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a></p>                                                                                                                                                                                               |
| <p>identifying metadata in the idle time period parameter field for an idle time period, where, in response to the idle time period being detected, the second protocol connection is deemed inactive; and</p> | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including identifying metadata (e.g., a value, etc.) in the idle time period parameter field (e.g., idle timeout parameter field, etc.) for an idle time period, where, in response to the idle time period being detected, the second protocol connection (e.g., QUIC connection, etc.) is deemed inactive.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, the metadata includes a value in seconds that is encoded as an unsigned 16-bit integer.</p> <pre> idle_timeout (0x0003): The idle timeout is a value in seconds that     is encoded as an unsigned 16-bit integer. The maximum value is     600 seconds (10 minutes).                     </pre> |

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|                                                                                                                   | <p><b>7.8.2. Idle Timeout</b></p> <p>A connection that remains idle for longer than the idle timeout (see <a href="#">Section 7.4.1</a>) becomes closed. Either peer removes connection state if they have neither sent nor received a packet for this time.</p> <p>The time at which an idle timeout takes effect won't be perfectly synchronized on peers. A connection enters the draining period when the idle timeout expires. During this time, an endpoint that receives new packets MAY choose to restore the connection. Alternatively, an endpoint that receives packets MAY signal the timeout using an immediate close.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a></p>                                                                                              |
| creating or modifying, based on the metadata, a timeout attribute associated with the second protocol connection. | <p>Google, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method including creating or modifying, based on the metadata (e.g., the value, etc.), a timeout attribute associated with the second protocol connection (e.g., QUIC connection, etc.).</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, since the <code>idle_timeout</code> value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily modified based on the value received in the <code>idle_timeout</code> field of the connection negotiation packet.</p> <p><code>idle_timeout (0x0003):</code> The idle timeout is a value in seconds that is encoded as an unsigned 16-bit integer. The maximum value is 600 seconds (10 minutes).</p> |

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|  | <p>7.8. Connection Termination</p> <p>Connections should remain open until they become idle for a pre-negotiated period of time. A QUIC connection, once established, can be terminated in one of three ways:</p> <p>7.8.2. Idle Timeout</p> <p>A connection that remains idle for longer than the idle timeout (see <a href="#">Section 7.4.1</a>) becomes closed. Either peer removes connection state if they have neither sent nor received a packet for this time.</p> <p>The time at which an idle timeout takes effect won't be perfectly synchronized on peers. A connection enters the draining period when the idle timeout expires. During this time, an endpoint that receives new packets MAY choose to restore the connection. Alternatively, an endpoint that receives packets MAY signal the timeout using an immediate close.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-07">https://tools.ietf.org/html/draft-ietf-quic-transport-07</a></p> |
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| Claim 69 Elements                                                                                                                                                       | Applicability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <p>The method of claim 68 wherein creating or modifying the timeout attribute renders one or more keep-alive packets in the second protocol connection unnecessary.</p> | <p>Google infringes claim 68 and, through its products/services owns, controls, and/or uses at least one server computer and/or the Google Cloud Platform to that performs a method wherein creating or modifying the timeout attribute renders one or more keep-alive packets in the second protocol connection (e.g., QUIC connection, etc.) unnecessary.</p> <p>See excerpt(s) below, for example (emphasis added, if any):</p> <p><b>Note:</b> As set forth below, since the idle_timeout value sets the duration of idleness, after which the connection is shutdown, a timeout attribute of the connection is necessarily created or modified based on the value received in the idle_timeout field of the connection negotiation packet.</p> <p>“idle_timeout (0x0001): The idle timeout is a value in milliseconds that is encoded as an integer; see (Section 10.2). If this parameter is absent or zero then the idle timeout is disabled.”<br/> <i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“10. Connection Termination</p> <p>An established QUIC connection can be terminated in one of three ways:</p> <ul style="list-style-type: none"> <li>• idle timeout (Section 10.2)</li> <li>• immediate close (Section 10.3)</li> <li>• stateless reset (Section 10.4)</li> </ul> <p>An endpoint MAY discard connection state if it does not have a validated path on which it can send packets (see Section 8.2).”<br/> <i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>“10.2. Idle Timeout</p> |

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|  | <p>If the idle timeout is enabled, a connection is silently closed and the state is discarded when it remains idle for longer than both the advertised idle timeout (see Section 18.1) and three times the current Probe Timeout (PTO)."</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p>"<b>19.2. PING Frame</b><br/><u>Endpoints <b>can use</b> PING frames (type=0x01) to verify that their peers are still alive or to check reachability to the peer.</u> The PING frame contains no additional fields.</p> <p><i>QUIC: A UDP-Based Multiplexed and Secure Transport</i> <a href="https://tools.ietf.org/html/draft-ietf-quic-transport-22">https://tools.ietf.org/html/draft-ietf-quic-transport-22</a></p> <p><b>Note:</b> The following evidence is related to and/or describes the QUIC standard contained herein.</p> <p>"3.3. Session resumption versus Keep-alive</p> <p>Because QUIC is encapsulated in UDP, applications using QUIC must deal with short idle timeouts. Deployed stateful middleboxes will generally establish state for UDP flows on the first packet state, and keep state for much shorter idle periods than for TCP. According to a 2010 study ([Hatonen10]), UDP applications can assume that any NAT binding or other state entry will be expired after just thirty seconds of inactivity.</p> <p>A QUIC application has three strategies to deal with this issue:</p> <ul style="list-style-type: none"><li>• Ignore it, if the application-layer protocol consists only of interactions with no or very short idle periods.</li><li>• Ensure there are no long idle periods.</li><li>• Resume the session after a long idle period, using 0-RTT resumption when appropriate.</li></ul> |
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CLAIM CHARTS  
BASED ON INFRINGEMENT ANALYSIS OF GOOGLE  
U.S. Patent No. 10,306,026

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|  | <p>The first strategy is the easiest, but it only applies to certain applications. Either the server or the client in a QUIC application can send PING frames as keep-alives, to prevent the connection and any on-path state from timing out.</p> <p><u>Recommendations for the use of keep-alives are application specific</u>, mainly depending on the latency requirements and message frequency of the application. <u>In this case, the application mapping must specify whether the client or server is responsible for keeping the application alive</u>. Note that sending PING frames more frequently than every 30 seconds over long idle periods may result in a too much unproductive traffic and power usage for some situations.</p> <p><u>Alternatively, the client (but not the server) can use session resumption instead of sending keepalive traffic</u>. In this case, a client that wants to send data to a server over a connection idle longer than the server's idle timeout (available from the idle_timeout transport parameter) can simply reconnect. When possible, this reconnection can use 0-RTT session resumption, reducing the latency involved with restarting the connection. This of course only applies in cases in which 0-RTT data is safe, when the client is the restarting peer, and when the data to be sent is idempotent.</p> <p>The tradeoffs between resumption and keepalive need to be evaluated on a per-application basis. However, in general applications should use keepalives only in circumstances where continued communication is highly likely; [QUIC-HTTP], for instance, recommends using PING frames for keepalive only when a request is outstanding.”<br/><a href="https://www.ietf.org/id/draft-ietf-quic-applicability-07.txt">https://www.ietf.org/id/draft-ietf-quic-applicability-07.txt</a></p> |
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