

Media Over QUIC  
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A. Bisht  
Cisco Meraki  
T. Evens  
Cisco  
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Geographic Location for Media over QUIC Relays  
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## Abstract

This document defines a mechanism for Media over QUIC (MoQ) relays to advertise their geographic location (geocode) and related path metrics. Some clients require their media data to remain locally or geo-fenced within specific jurisdictions for privacy and security compliance (e.g., GDPR, HIPAA, or sector-specific regulations). This mechanism enables service providers to track the geographic path of media packets through the relay mesh and to enforce geo-fencing policies. It supports Geo-Distributed Orchestration and Routing (GDOR), data residency compliance, latency optimization, and relay selection. The specification includes optional IATA airport codes as human-readable geographic identifiers for major relay locations.

## About This Document

This note is to be removed before publishing as an RFC.

The latest revision of this draft can be found at <https://altanai.github.io/draft-altanai-moq-relay-geocode/draft-altanai-moq-relay-geocode.html>. Status information for this document may be found at <https://datatracker.ietf.org/doc/draft-altanai-moq-relay-geocode/>.

Discussion of this document takes place on the Media Over QUIC Working Group mailing list (<mailto:moq@ietf.org>), which is archived at <https://mailarchive.ietf.org/arch/browse/moq/>. Subscribe at <https://www.ietf.org/mailman/listinfo/moq/>.

Source for this draft and an issue tracker can be found at <https://github.com/altanai/draft-altanai-moq-relay-geocode>.

## Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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## 1. Introduction

Media over QUIC Transport (MOQT) [MoQTransport] uses a relay-based architecture where publishers push media to relays and subscribers pull from relays. Relays can be chained for CDN-like distribution, forming a mesh of interconnected nodes. In such topologies—as illustrated by deployments with multiple relays (e.g., relays A, B, C, D) connecting Home/Enterprise clients to a Service Media backend—the following questions arise:

- \* *Where* is each relay located geographically?
- \* *How close* are relays to each other and to clients?
- \* *Which path* through the relay mesh minimizes latency or satisfies policy?

Today, MoQ provides no standard way for relays to advertise geographic position. Clients and orchestration systems rely on external mechanisms (e.g., IP geolocation, manual configuration) that are often imprecise, inconsistent, or unavailable. This document specifies a lightweight, protocol-aligned mechanism for relays to advertise geocode and related metrics, enabling:

1. *\*Vicinity and path computation\**: Determining physical proximity and logical paths between relays.
2. *\*GDOR (Geo-Distributed Orchestration/Routing)\**: Making routing and placement decisions based on geography (e.g., route through EU relays for GDPR, avoid certain jurisdictions).
3. *\*Latency optimization\**: Selecting relays with lower RTT or propagation time (PT) to the client or to upstream relays.

4. *\*Data residency and compliance\**: Ensuring media flows stay within required geographic boundaries. Clients often require their data to be locally or geo-fenced for privacy and security compliance (e.g., GDPR, HIPAA).
5. *\*Path tracking\**: Enabling service providers to track the geographic path of media packets through the relay mesh for compliance audits and geo-fencing enforcement.

### 1.1. Design Goals

- \* *\*Minimal protocol impact\**: Reuse existing MoQ catalog, metrics, or discovery mechanisms where possible.
- \* *\*Interoperability\**: Use standard geographic representations (WGS84, GeoJSON) and widely recognized identifiers (IATA codes).
- \* *\*Extensibility\**: Allow optional altitude, region codes, and path metrics (RTT, PT) without mandating them.

## 2. Conventions and Definitions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

*\*Geocode\**: A representation of geographic position, typically latitude and longitude (WGS84), optionally with altitude.

*\*Relay Vicinity\**: The geographic proximity of one relay to another or to a client, expressed as distance or as a qualitative relationship (e.g., same region, same metro).

*\*Relay Path\**: A sequence of relays through which media flows from publisher to subscriber, or the logical/geographic route between relays.

*\*GDOR (Geo-Distributed Orchestration/Routing)\**: Routing and orchestration decisions that consider geographic location, including data residency, latency optimization, and jurisdictional compliance.

*\*IATA Code\**: A three-letter code assigned by the International Air Transport Association to identify airports and major metropolitan areas (e.g., JFK, LHR, FRA). Used here as an optional human-readable geographic identifier for relay locations.

### 3. Use Cases

#### 3.1. Relay Selection by Proximity

A subscriber in New York (NY) may have multiple relays available (e.g., A, B, C, D). With geocode and RTT/PT metrics, the client or an orchestration layer can select the relay that minimizes latency or satisfies geographic constraints.

#### 3.2. Geo-Distributed Orchestration (GDOR)

Some clients require their media data to remain locally or geo-fenced within specific jurisdictions for privacy and security compliance (e.g., GDPR, HIPAA, or sector-specific regulations). An operator may require that:

- \* EU subscriber traffic flows only through EU relays.
- \* Media for a given jurisdiction is processed within that jurisdiction.
- \* Path selection avoids certain regions for policy or cost reasons.

Geocode enables GDOR by allowing relays to advertise their jurisdiction (e.g., via country/region codes) and by allowing path computation to respect geographic boundaries. Service providers can use relay geocode and the advertised neighbor topology to \*track the geographic path\* of media packets as they traverse the MoQ relay mesh, supporting compliance audits and geo-fencing enforcement.

#### 3.3. Path and Vicinity Awareness

In a relay mesh (e.g., ABCD), knowing the geocode of each relay allows:

- \* **\*Vicinity\***: Computing great-circle distance or approximate propagation delay between relays.
- \* **\*Path\***: Understanding the geographic route (e.g., NY → Relay D → Relay A → SVC) and optimizing it.

#### 3.4. Metrics Integration

Deployments commonly measure **\*RTT to Relay\*** and **\*PT (Propagation Time) to Relay\*** as key metrics. Geocode complements these by providing a stable, policy-relevant attribute (location) that does not change with network conditions, while RTT/PT provide dynamic performance signals.

## 4. Geocode Representation

### 4.1. Primary Format: WGS84 Coordinates

Relay geocode MUST be representable as WGS84 coordinates (as used in GeoJSON [RFC7946]):

- \* `*latitude*`: Decimal degrees, -90 to 90.
- \* `*longitude*`: Decimal degrees, -180 to 180.
- \* `*altitude*` (optional): Meters above WGS84 ellipsoid.

Example (JSON):

```
json { "latitude": 40.6413, "longitude": -73.7781, "altitude": 4 }
```

### 4.2. Optional: IATA Code

An IATA airport code MAY be included as a human-readable geographic identifier. IATA codes are widely used for airports and major metro areas and provide a compact, recognizable reference (e.g., JFK for New York, LHR for London).

`*Suggested IATA codes for common relay regions*` (informative):

Region / Metro	Suggested IATA	Notes
New York (NYC metro)	JFK, LGA, EWR	Primary: JFK for NYC area
Virginia (DC metro)	IAD, DCA	IAD for Ashburn/DC area
London	LHR, LGW	LHR for London
Frankfurt	FRA	Major EU hub
Paris	CDG	Major EU hub
Amsterdam	AMS	Major EU hub
Tokyo	NRT, HND	NRT for Tokyo area
Singapore	SIN	Asia-Pacific
Sydney	SYD	Australia
So Paulo	GRU	South America

Table 1

The IATA code SHOULD correspond to the nearest major airport or metro area where the relay is located. It is advisory only; precise routing MUST use latitude/longitude when geographic accuracy is required.

#### 4.3. Optional: Region and Jurisdiction

For GDOR and compliance, relays MAY advertise:

- \* `*country*`: ISO 3166-1 alpha-2 (e.g., "US", "DE").
- \* `*subdivision*`: ISO 3166-2 (e.g., "US-NY", "DE-BY") as in [RFC9388].

#### 5. Relay Advertisement Format

### 5.1. JSON Schema

The following JSON structure defines the relay geocode advertisement. It MAY be carried in MoQ catalog extensions, metrics ([MoQMetrics]), or a dedicated discovery resource (e.g., well-known URI).

```
json { "$schema": "http://json-schema.org/draft-07/schema#", "title":
"MoQ Relay Geocode", "type": "object", "required": ["relay_id",
"latitude", "longitude"], "properties": { "relay_id": { "type":
"string", "description": "Unique relay identifier" }, "latitude": {
"type": "number", "minimum": -90, "maximum": 90 }, "longitude": {
"type": "number", "minimum": -180, "maximum": 180 }, "altitude": {
"type": "number", "description": "Meters above WGS84 ellipsoid" },
"iata_code": { "type": "string", "pattern": "^[A-Z]{3}$",
"description": "IATA airport/metro code" }, "country": { "type":
"string", "pattern": "^[A-Z]{2}$", "description": "ISO 3166-1 alpha-
2" }, "subdivision": { "type": "string", "description": "ISO 3166-2
subdivision" }, "rtt_ms": { "type": "number", "description": "RTT to
this relay (ms), if advertised" }, "pt_ms": { "type": "number",
"description": "Propagation time to relay (ms), if advertised" },
"neighbors": { "type": "array", "items": { "type": "object",
"properties": { "relay_id": { "type": "string" }, "rtt_ms": { "type":
"number" }, "pt_ms": { "type": "number" } } }, "description":
"Adjacent relays and inter-relay metrics" } } }
```

### 5.2. Example Advertisement

Relay D in New York area, with path metrics:

```
json { "relay_id": "relay-D", "latitude": 40.6413, "longitude":
-73.7781, "altitude": 4, "iata_code": "JFK", "country": "US",
"subdivision": "US-NY", "rtt_ms": 16, "pt_ms": 12, "neighbors": [ {
"relay_id": "relay-A", "rtt_ms": 7, "pt_ms": 3 }, { "relay_id":
"relay-C", "rtt_ms": 12, "pt_ms": 5 } ] }
```

### 5.3. Integration with MoQ

- \* **\*Catalog\***: A relay MAY include geocode in catalog metadata for namespaces or tracks it serves.
- \* **\*Metrics\***: Geocode MAY be part of metrics exposed per [MoQMetrics] for relay selection and monitoring.
- \* **\*Discovery\***: A relay MAY serve geocode at a well-known path (e.g., /.well-known/moq-relay-geocode) or via a Setup Option in SETUP.



The exact wire format and negotiation are left to a companion specification or a future revision of the MoQ transport or metrics documents.

## 6. Vicinity and Path Computation

### 6.1. Great-Circle Distance

Given two relays with geocode (lat1, lon1) and (lat2, lon2), the approximate great-circle distance in kilometers can be computed using the Haversine formula or an equivalent. This provides a stable measure of physical proximity independent of network topology.

### 6.2. Path Metrics

When relays advertise neighbors with rtt\_ms and pt\_ms, a client or orchestration system can:

1. *\*Build a relay graph\**: Nodes = relays, edges = neighbor relationships with RTT/PT.
2. *\*Compute paths\**: Shortest path by RTT, by PT, or by geographic distance.
3. *\*Apply GDOR constraints\**: Filter paths to those that stay within required jurisdictions (using country, subdivision).

### 6.3. Vicinity Semantics

- \* *\*Same metro\**: Relays with the same iata\_code or within ~50 km.
- \* *\*Same region\**: Relays with the same subdivision or country.
- \* *\*Cross-border\**: Path crosses country boundaries; may trigger compliance checks.

## 7. Security Considerations

### 7.1. Privacy

- \* Geocode reveals relay location. Operators who wish to hide exact location MAY advertise only country and subdivision, or a coarse-grained geocode (e.g., rounded to 0.1°).
- \* IATA codes are less precise than coordinates and may be preferred when exact location must not be disclosed.

## 7.2. Integrity

- \* Geocode advertisements SHOULD be integrity-protected (e.g., over TLS as with MoQ) and, when used for compliance, SHOULD be verifiable (e.g., signed by a trusted authority).

## 7.3. Misuse

- \* Adversaries could advertise false geocode to attract traffic or evade geographic restrictions. Relays SHOULD be authenticated; geocode from untrusted sources SHOULD be validated or ignored.

## 8. IANA Considerations

This document does not require IANA actions. If a well-known URI or a MoQ parameter type is registered in the future, the appropriate IANA registry would be updated.

## 9. References

### 9.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/rfc/rfc2119>>.
- [RFC7946] Butler, H., Daly, M., Doyle, A., Gillies, S., Hagen, S., and T. Schaub, "The GeoJSON Format", August 2016.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/rfc/rfc8174>>.

### 9.2. Informative References

- [MoQMetrics] Jennings, C., "Metrics over MOQT", Work in Progress, Internet-Draft, draft-jennings-moq-metrics-02, 2025, <<https://datatracker.ietf.org/doc/draft-jennings-moq-metrics/>>.
- [MoQTransport] IETF MOQ WG, "Media over QUIC Transport", Work in Progress, Internet-Draft, draft-ietf-moq-transport-17, 2026, <<https://datatracker.ietf.org/doc/draft-ietf-moq-transport/>>.

- [RFC8801] "Discovering Provisioning Domain Names and Data", July 2020.
- [RFC8805] "A Format for Self-Published IP Geolocation Feeds", August 2020.
- [RFC9388] "Content Delivery Network Interconnection (CDNI) Footprint Types: Country Subdivision Code and Footprint Union", June 2023.

#### Appendix A. Appendix A. Example Topology (Informative)

The following example illustrates a typical relay mesh topology:

Home/Ent (NY) Relay Mesh SVC Media MS | A --- B | \ / +-----(16ms  
RTT)-----> D | / \ | C --- (to SVC)

- \* \*Relay D\*: JFK (NY), serves Home/Ent with 16ms RTT.
- \* \*Relay A, B, C\*: Interconnected; A connects to SVC.
- \* Geocode for each enables path selection (e.g., NY client → D → A → SVC) and GDOR (e.g., ensure D and A are in permitted jurisdictions).

#### Appendix B. Appendix B. IATA Code Reference (Informative)

IATA codes are maintained by the International Air Transport Association. A subset useful for MoQ relay identification:

Code	City/Region
JFK	New York (John F. Kennedy)
LGA	New York (LaGuardia)
EWK	Newark (NYC metro)
IAD	Washington Dulles (Virginia)
DCA	Washington Reagan
LHR	London Heathrow
FRA	Frankfurt
CDG	Paris Charles de Gaulle
AMS	Amsterdam
NRT	Tokyo Narita
SIN	Singapore
SYD	Sydney
GRU	So Paulo

Table 2

Operators SHOULD use the official IATA code list for authoritative mappings.

#### Acknowledgments

TODO acknowledge.

#### Authors' Addresses

Altanai Bisht  
Cisco Meraki  
Email: [albisht@cisco.com](mailto:albisht@cisco.com)

Tim Evens  
Cisco

Email: [tievens@cisco.com](mailto:tievens@cisco.com)