

Position Paper: Starlink

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Introduction

Navigating challenges in IP Geolocation (GeoIP) is critical in operating Starlink, a global internet service provider that leverages a constellation of over 8,500 satellites in low earth orbit (LEO). Starlink provides service to millions of users across 150+ countries and territories, with the capability to support users in every remote region in the world, including aviation and maritime use cases. This position paper discusses the use of and problems with GeoIP, along with recommendations for improvements, drawing from the Starlink network experience over the past 5 years.

We want to ensure users are routed to the lowest-latency endpoint with region-appropriate content (e.g., streaming catalogs). Users expect consistent experiences, e.g. maintaining home-country media while in international waters or mid-flight. No standards yet exist for "international waters" or polar regions, leading to less-than-ideal user experience or mismatched user expectations (e.g., should a U.S.-flagged vessel get a U.S. IP?).

Traditional GeoIP approaches assume fixed locations, but Starlink supports "anycast users", for example, an aircraft shifting PoPs from Qatar to New York mid-flight while retaining the same IP. Today, this can result in less-than-optimal content steering and poor user experience, as GeoIP does not reflect real-time ingress/egress location. Communicating PoP geography would also aid in the case where users in one state (e.g., Montana) are today geolocated to another (e.g., Seattle) to improve content steering. Recent U.S. state laws on internet restrictions necessitate finer-grained (state-level) mappings – today this may result in non-optimal content steering.

Steering and content delivery could be improved by conveying PoP locations, last-mile type (e.g., satellite, terrestrial, cellular, etc), and dynamic attributes (e.g., "international waters" flags) alongside of geography. We want to optimize traffic based on network topology (and low latency) rather than physical geography. This could use extensions to existing protocols like EDNS / ECS for more real-time hints.

We have also experienced challenges slow update cadences of GeoIP services. To mitigate this, Starlink "reserves" unused IPs for up to a month, wasting address space and delaying network

changes. Faster, event-driven publishing (e.g., via APIs) to reduce update delays. We would suggest an SLA or RFC-recommended update cadence of 24 hours.

Starlink publishes GeoIP data at <https://geoip.starlinkisp.net/> and PoP mappings at <https://geoip.starlinkisp.net/pops.csv>, which are regularly validated against public sources to ensure successful ingestion.