

Verifying Geographic Location Presence of Internet Clients

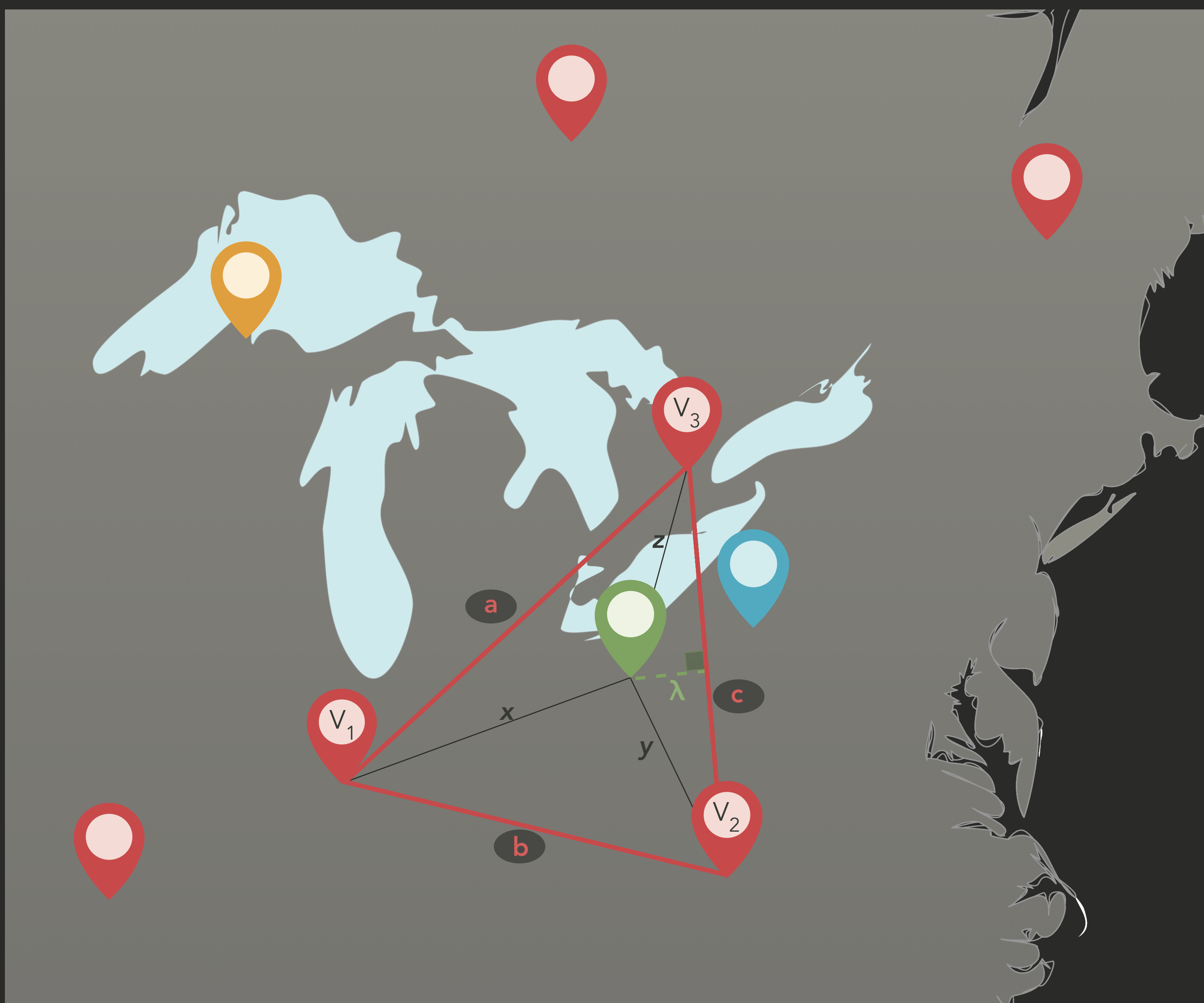
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Applications

- Location-oriented streaming²
- Location-restricted operations (online voting/gambling)
- Fraud prevention
- Location-based (second-factor) authentication
- Privacy laws vary by jurisdiction, allowing content only in some regions³



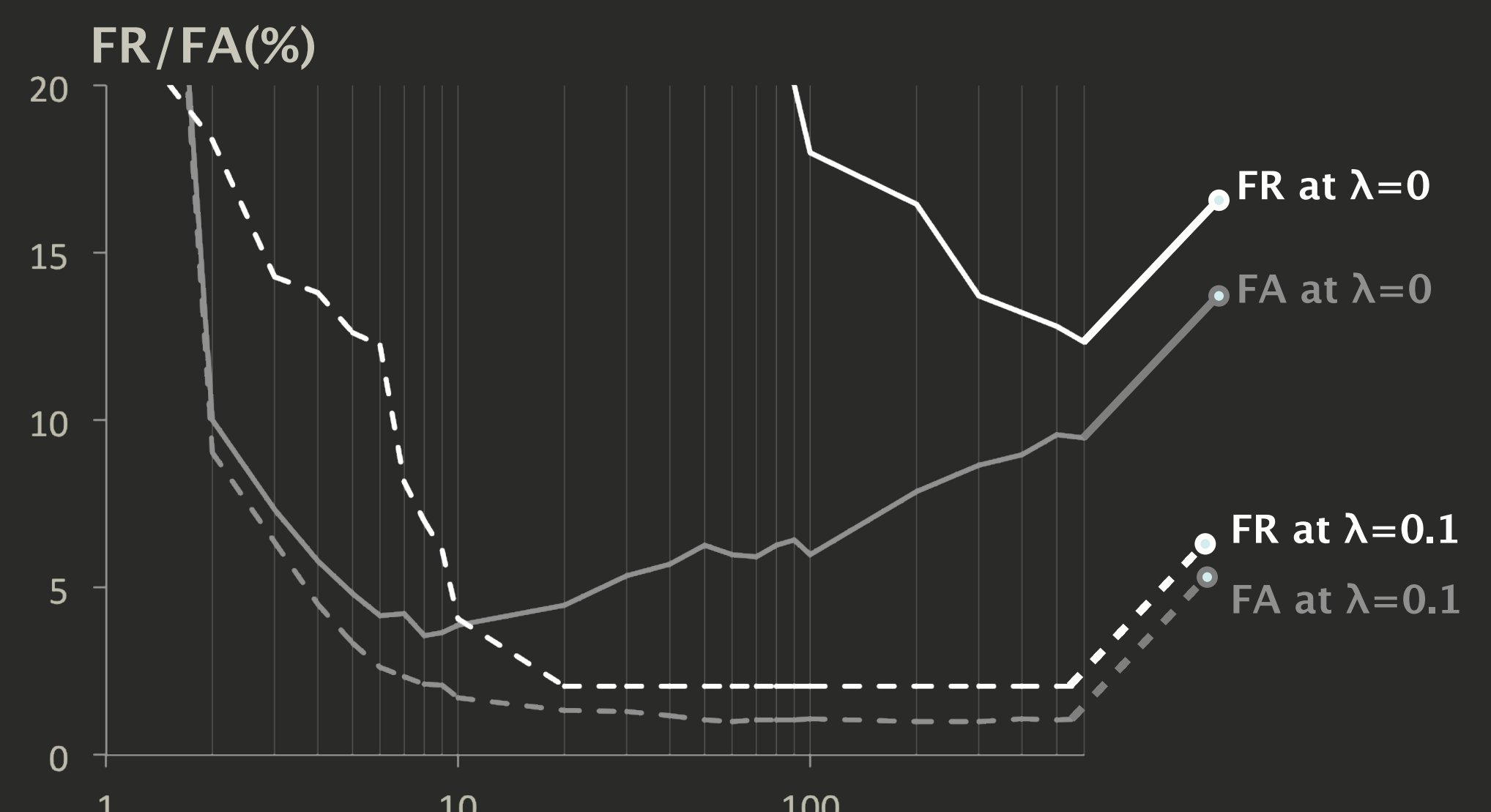
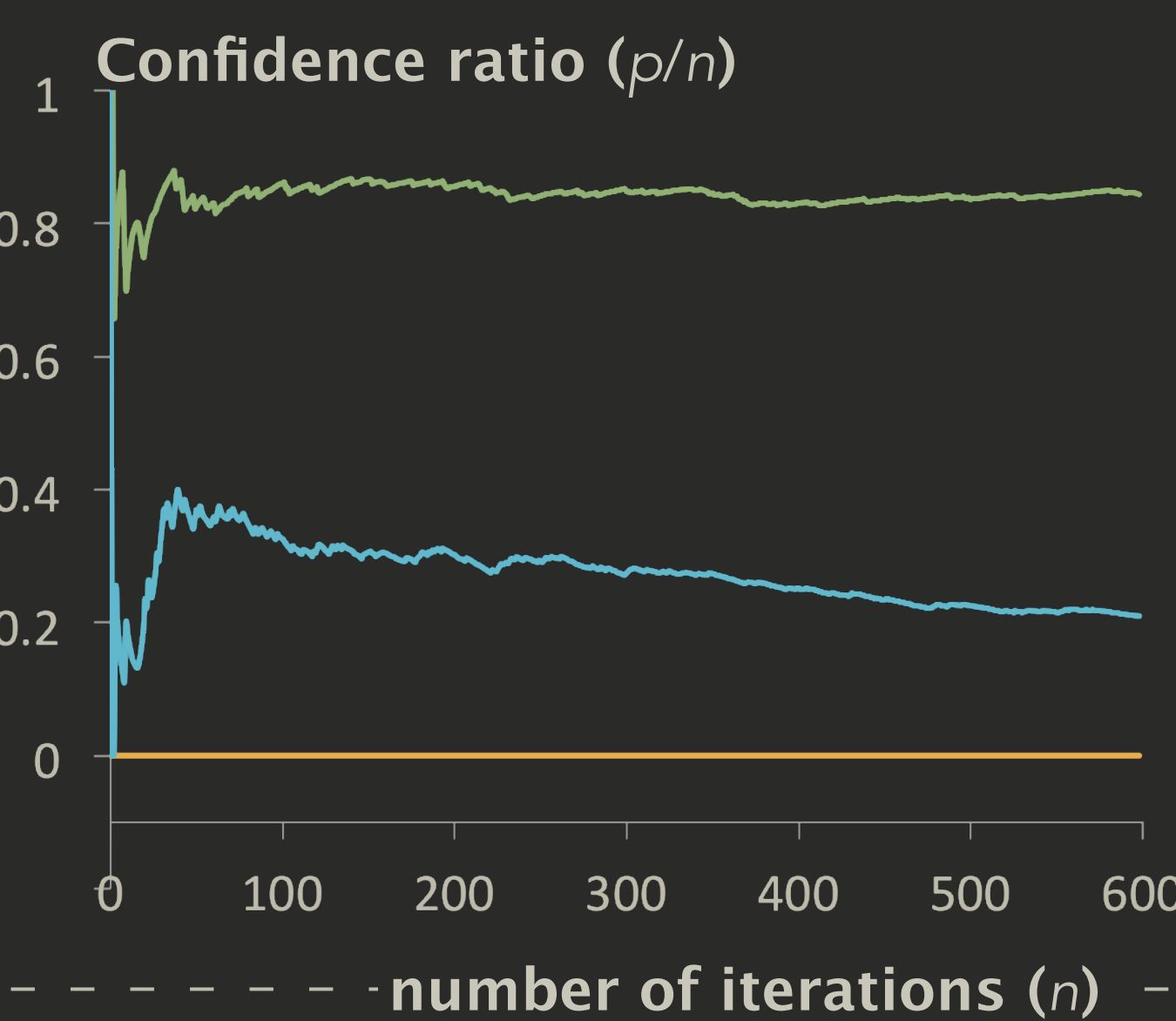
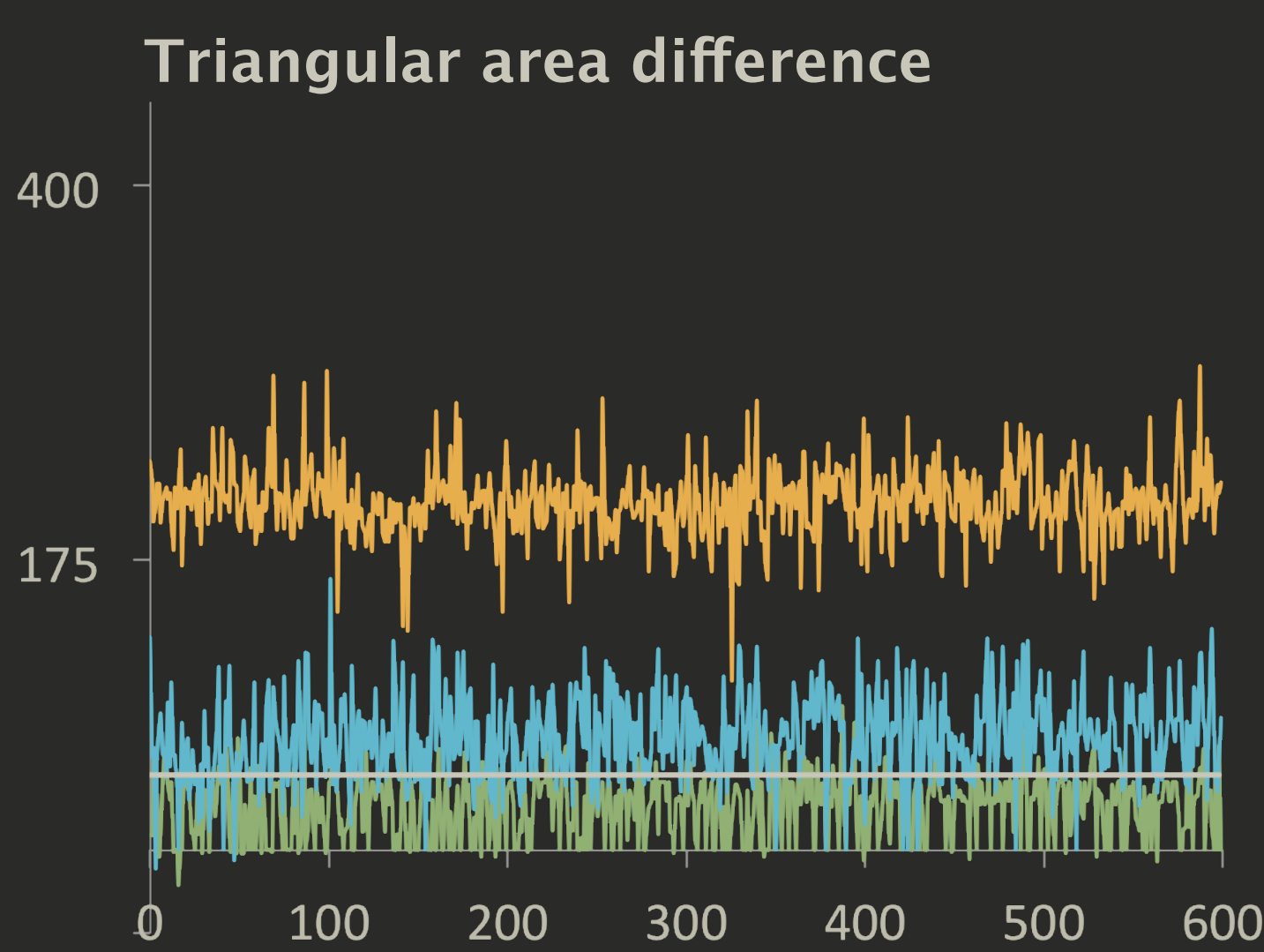
Algorithm

The proposed Client Presence Verification (CPV)¹ algorithm works as follows (see map):

[inputs: ϵ , n , and τ]

1. Initialize integer $p = 0$
2. Estimate one-way delays (OWDs) for edges x , y , and z as follows:
 - i. V_1 sends a timestamp to Client
 - ii. Client sends the timestamp to V_2 and V_3
 - iii. Repeat (i) and (ii) twice, for V_2 and V_3
 - iv. Omit the larger of forward/reverse delays
 - v. Solve simultaneously for x , y and z
3. Estimate OWDs³ for edges a , b , and c
4. If OWDs violate triangular inequality, use round-trip time (RTT) estimates
5. Compare triangular areas based on delays
6. If area difference is $< \epsilon$, increment p
7. Repeat steps 2 to 6 for n times
8. Accept asserted location if $p/n < \tau$

Evaluation Results



Legend

- Legitimate client
- Close-by adversary
- Far away adversary
- Verifier

References

- [1] A. Abdou, A. Matrawy, and P.C. van Oorschot. "CPV: Delay-based Location Verification for the Internet" IEEE TDSC. (in print).
- [2] J. Burnett. "Geographically Restricted Streaming Content and Evasion of Geolocation: the Applicability of the Copyright Anticircumvention Rules." Mich. Telecomm. & Tech. L. Rev. 19 (2012): 461.
- [3] S. Shalunov, B. Teitelbaum, A. Karp, J. Boote, and M. Zekauskas, "A One-way Active Measurement Protocol (OWAMP)" RFC 4656 (Proposed Standard), Sep. 2006.