Verifying Geographic Location Presence of Internet Clients
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Applications
- Location-oriented streaming
- Location-restricted operations (online voting/gambling)
- Fraud prevention
- Location-based (second-factor) authentication
- Privacy laws vary by jurisdiction, allowing content only in some regions

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

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 OWDs 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 $< \varepsilon$, 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