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CENTRE FOR ADVANCED INTERNET ARCHITECTURES

Post-game Estimation of Game Client RTT and Hop Count Distributions

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SMART INTERNET TECHNOLOGY CRC

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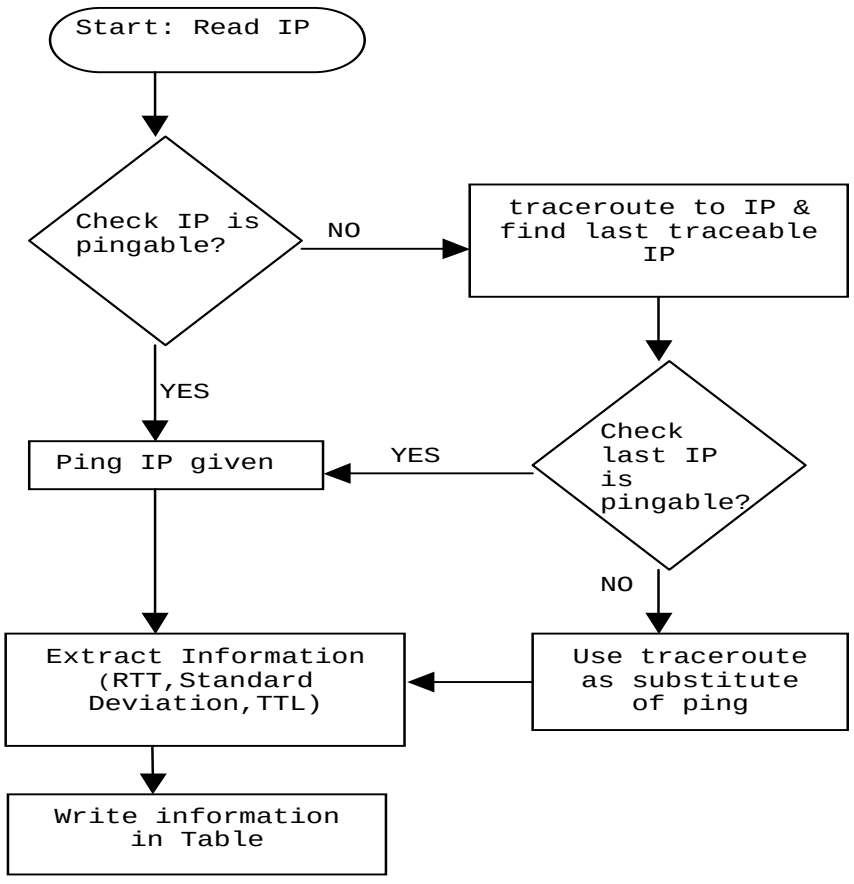
Motivation

- Round Trip Time (RTT) aka 'Lag' strongly influences enjoyment in fast-paced network games
- Useful for server operators and Internet service providers to characterize RTT tolerance of clients who play vs. those who only probe
- Difficult logging RTT of flows in real-time
- ➢ We propose active method of estimating RTT (and hop count) between clients and server days or weeks after clients were playing

Methodology

- Assumptions: known client IP addresses, IP addresses did not move much topologically
- Methodology in a nutshell
  - If IP address does not react to **ping,** use **traceroute** to identify last hop before it
  - Ping/traceroute client or last hop to measure RTT, hop count
  - Sample path multiple times
- Limitations
  - Error in ping RTT estimates (likely to be small)
  - IP address moved great distance (assume this is rare)
  - Varying path conditions (can adjust sampling)

Methodology cont'd



Data Set and Raw Results

- Client IP addresses from real game server
- Reduce data by randomly sampling one IP address from each /24 subnet

	Initial No. Of IP addresses	Reduced No. Of IP addresses
Game Flows	5,469	4,252
Probe Flows	2,397,879	325,707

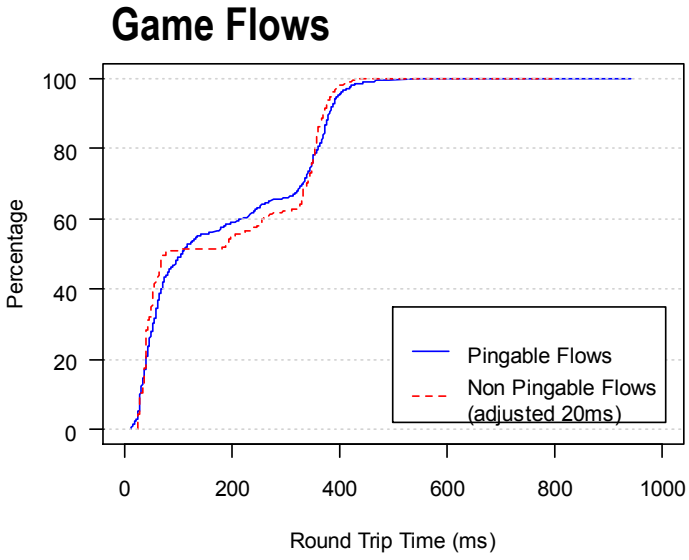
- Raw Results

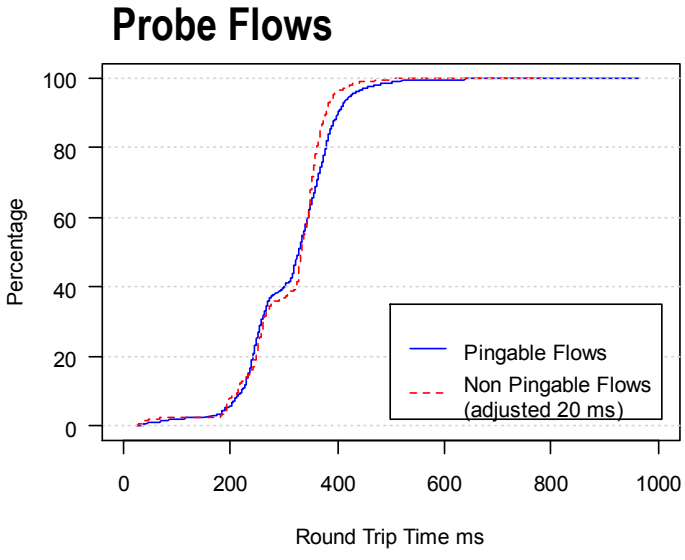
	Game Flows	Probe Flows
Number of IP Addresses	4252	325,707
Ping directly	28%	26%
Ping last hop from traceroute	63%	62%
Used traceroute for RTT computation	9%	12%

- >90% of RTT samples have std. dev. <10ms

Validation of using Last Hop

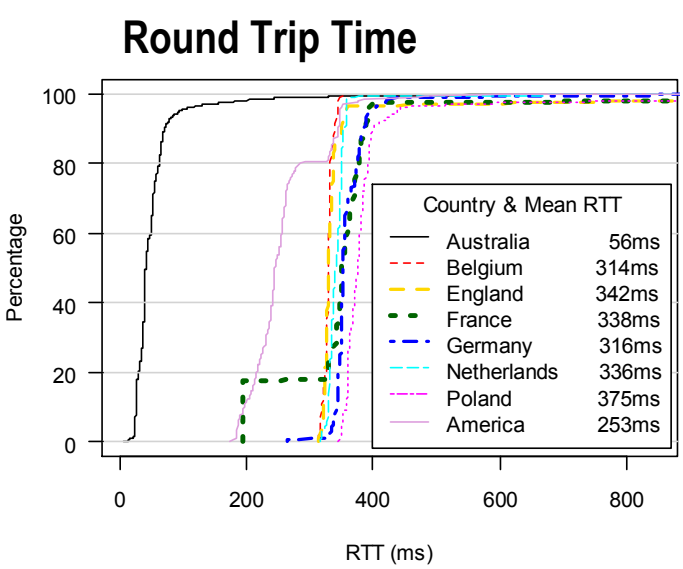
Very similar RTT distributions for pingable and (adjusted) non-pingable game and probe flows (same result for hop count)

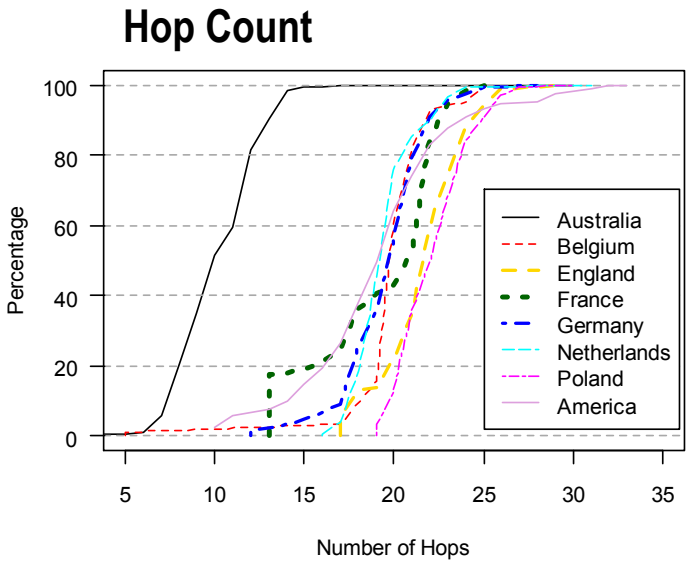




RTT, Hop Count vs. Country

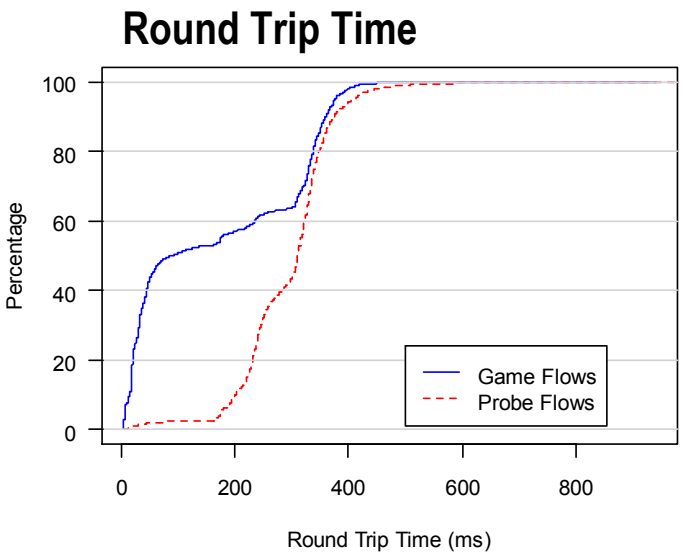
RTT and hop count distributions by country (using GeoIP)

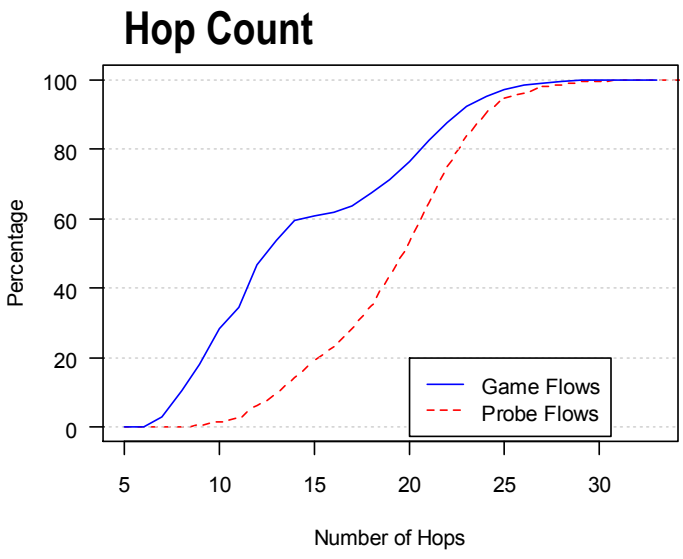




Game Flows vs. Probe Flows

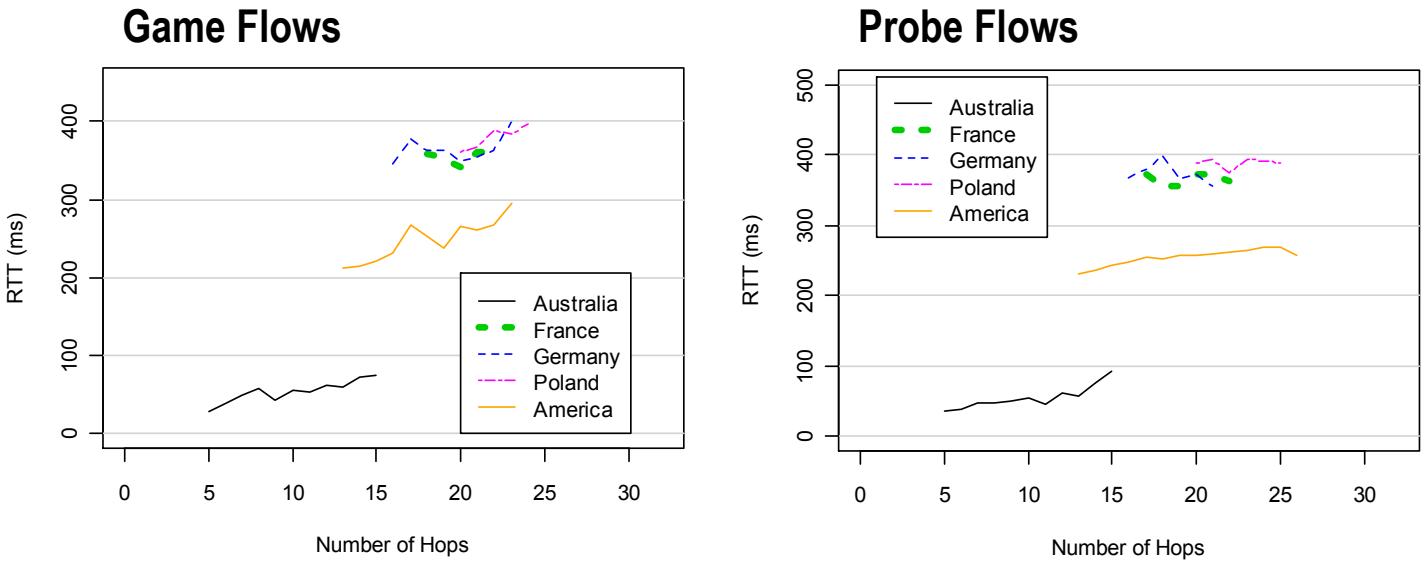
RTT and hop count of game flows and probe flows





RTT vs. Hop Count

Relationship between RTT, hop count and geographical origin



Conclusions

- Difficult to log RTT and hop count of game and probe flows in real-time
- Proposed method measures RTT and hop count between game server and client **after the fact**
- Demonstrated effectiveness using client IP data from real game server
- Obtained RTT and hop-count distributions illustrate topological and geographical characteristics of clients that played vs. those who only probed the server

Poster Arrangement (A0)