

Round Trip Time and Hop Count Distributions for Clients of an Enemy Territory Server based in Australia

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Outline



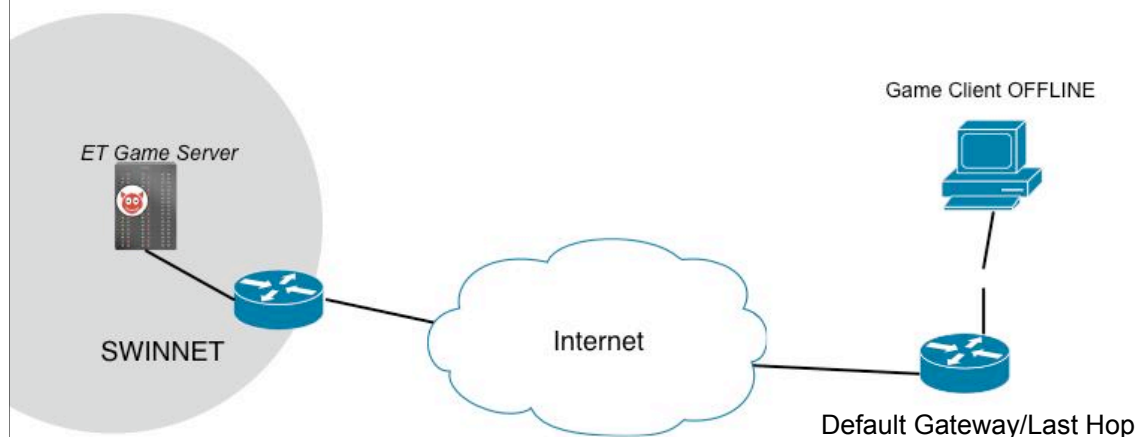
- Motivation
- Design Implementation & Limitations
- Probe Sequence
- Results
- Conclusion & Future Work

Motivation



- Previous game server analysis [1]
- Probe Flow & Game Flow IP addresses logged
- Ping each individual IP address and estimate Round Trip Times to Enemy Territory game clients

Traceroute Assumption



Design Limitations



Limitation	Solution
Game clients no longer existed or were off	Traceroute to IP and ping assumed gateway
Fluctuations in Network Conditions	Send 10 Pings & use Standard Deviation to determine network conditions
Avoid excess traffic on network & Denial of Service Attack	Send pings in 2 second intervals & Traceroutes initial Time To Live set to 4
ICMP packets can be filtered by pathways to game client or on the actual game client	Traceroute method developed. Send UDP packets and retrieve ICMP Time_Exceeded packets to time stamp
Accuracy of Round Trip Time Estimations & parallel probe sequences	Increase FreeBSD kernel frequency to 1000 Hz to give accuracy to +/- 1 ms

Design Limitations (cont) ...



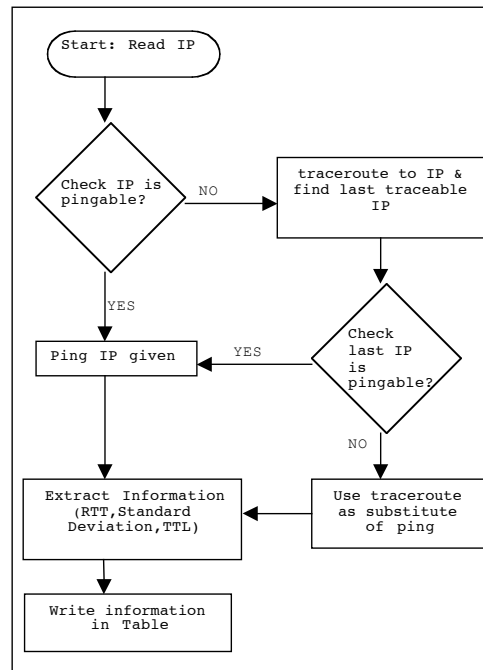
/24 Subnet Reduction of IP Addresses

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

Probe Sequence



- Hop Counts estimated using Time To Live fields of returned ICMP packets
- Geographical Location was estimated of IP addresses
- Ran 50 probe sequences in parallel
- Experiments were ran on popular playing days (Thursday - Sunday)



Results

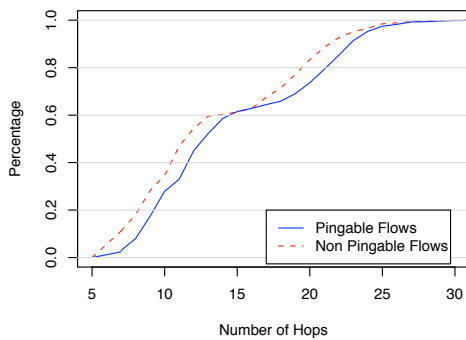


	Game Flows	Probe Flows
Number of IP Addresses	4,252	325,707
Ping directly	28%	26%
Ping last hop from traceroute	63%	62%
Used traceroute for RTT computation	9%	12%

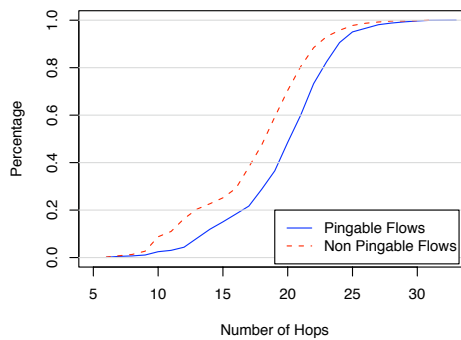
Validity of Results



- 90% of RTT estimations had a standard deviation of under 10ms
- Split Results into Pingable and Non Pingable Addresses



Game Flows



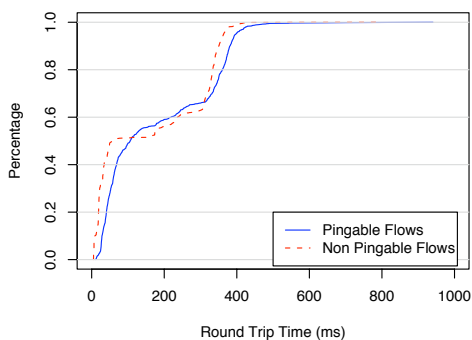
Probe Flows



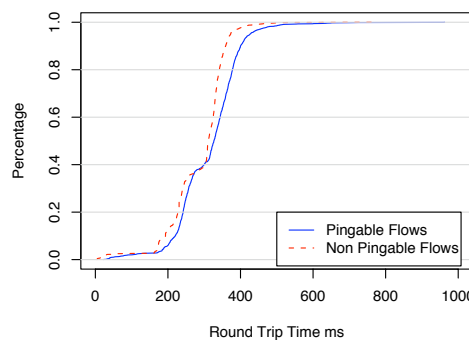
Validity of Results (cont) ...



- Non Pingable RTTs 10 - 30 ms left of Pingables



Game Flows



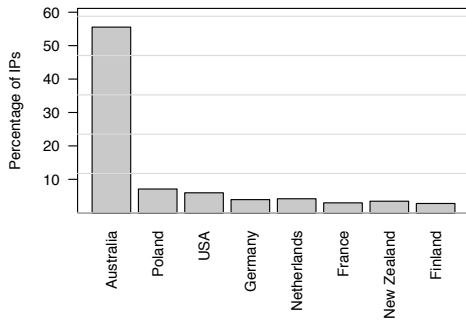
Probe Flows



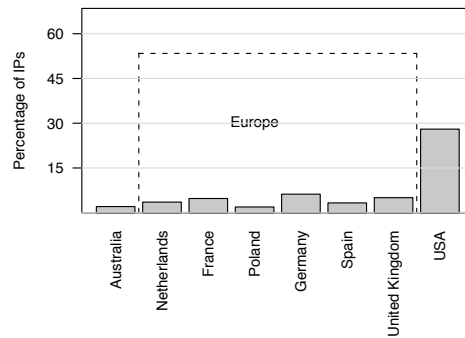
Country Distributions of IP Addresses



- 54 countries amongst game flows and 138 countries amongst probe flows identified



Game Flows



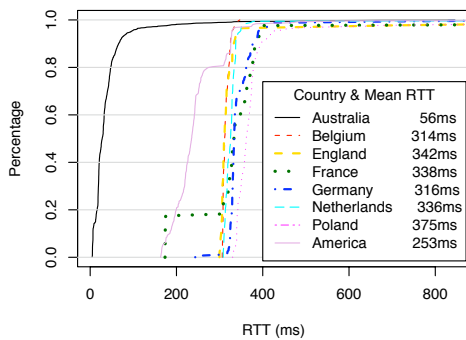
Probe Flows



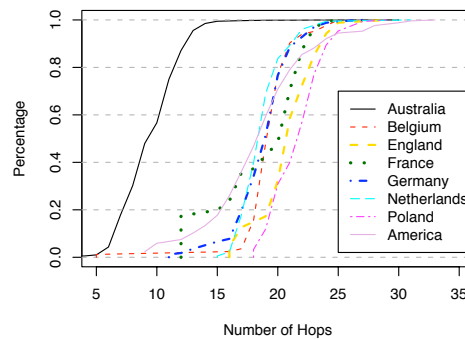
Country Round Trip Times & Hops



Round Trip Time



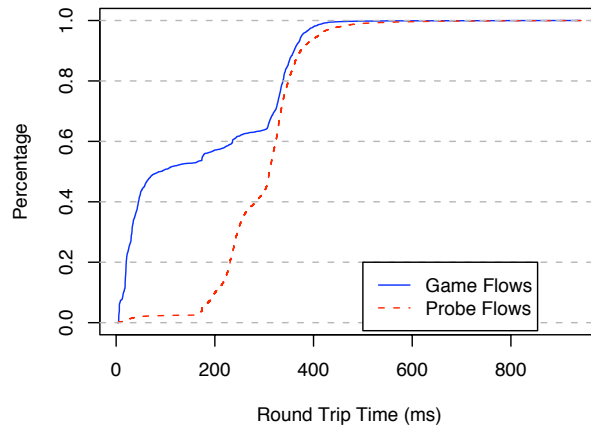
Hops



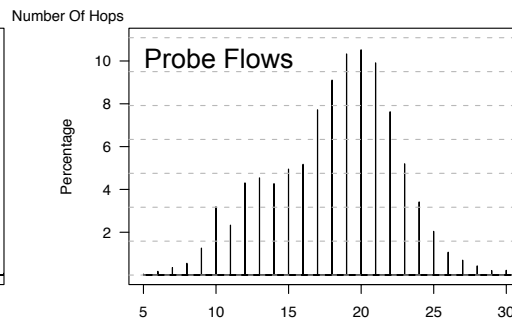
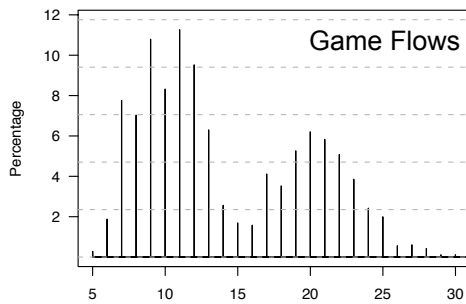
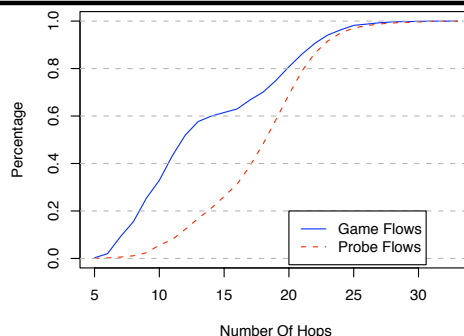
Round Trip Time Analysis



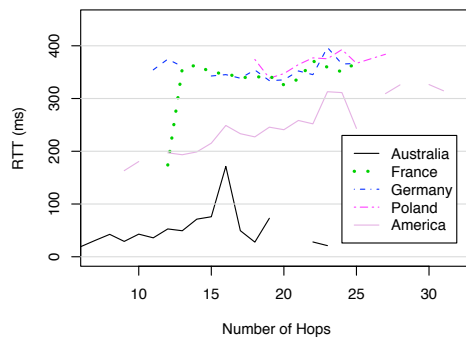
- Geographical Origins of flows affect CDF



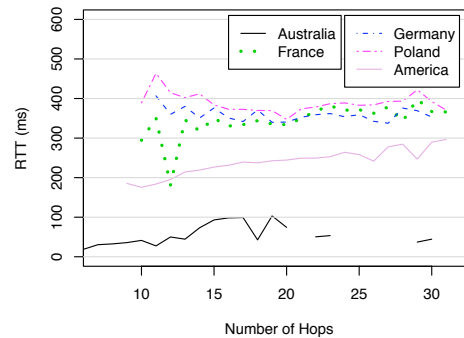
Hop Analysis



Round Trip Time vs Hops



Game Flows



Probe Flows

Conclusion



- Estimated Round Trip Times to game clients that played or probe CAIA ET server
- 57 % of Game Flow IP addresses were from Australia
- Countries such as Germany & Poland played with RTTs of 300 - 350 ms
- Australian clients were 5 - 15 hops from ET server which had significantly lower RTTs no matter how many hops away
- Europe & USA were over 10 hops and RTTs greater than 200 ms

Future Work



- Investigate the process of how game clients discover game servers over the internet.
- Play more Enemy Territory for research purposes.

Thank you



- Any Questions?