# Overlay Routing using Coordinate Systems

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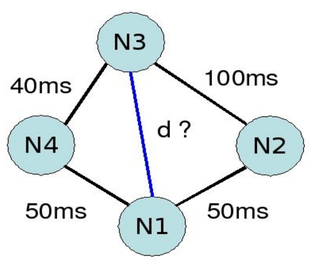
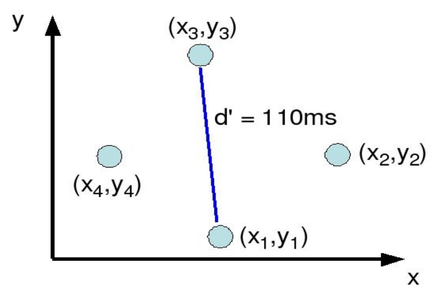
## Objectives

- Finding indirect overlay paths that reduce the latency between pairs of nodes.
- Obtaining results without too much measurement overhead.

## Internet coordinate systems (ICS) and Vivaldi

- An ICS associates a coordinate in a metric space with each node of a network, such that the distance between the coordinates of two nodes gives an estimation of the RTT between these nodes.

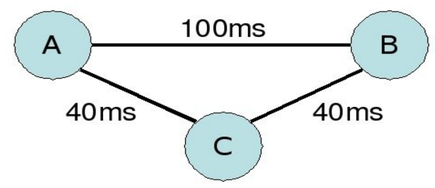



- Vivaldi is an ICS in which each node computes its own coordinate by doing measurements with only a few other nodes (generally 32 or 64) chosen in the network (its neighbors).

## Using estimated RTTs

- We intend to use an internet coordinate system (namely Vivaldi) to estimate RTTs instead of measuring them.
- Using only estimated RTTs is impossible: according to the estimated RTTs, the shortest path between two nodes will always be the direct path because shortcuts cannot be represented in the metric space.
- We combine estimated and measured RTTs:
  a) If we look for existing shortcuts for a link AB, we assume that the RTT between A and B can be measured.
  b) We can use Vivaldi's measurement results between nodes and their neighbors.
- We focus on using only one intermediate node as shortcut.

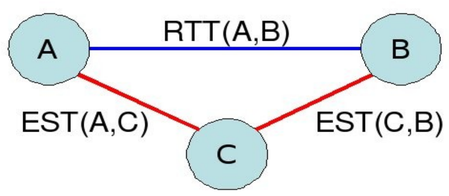



- It is possible to obtain a better latency gain by using more than one intermediate node as alternative path (future work).

## Two simple detection criteria

### Estimation detection criterion

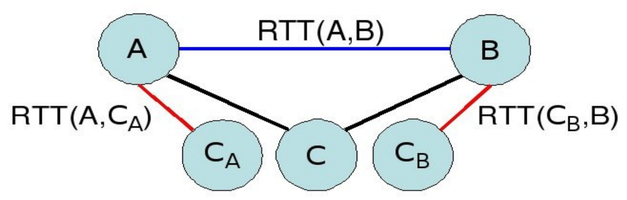
- Compare the RTT of the link AB to the estimated RTT of the path ACB.




- If EST(A,C) + EST(C,B) < RTT(A,B) then C is considered as a shortcut for the link AB.

### Approximation detection criterion

- Let $C_A$ (resp. $C_B$) be A's (resp B's) Vivaldi neighbor that is the nearest to C (according to the estimated RTTs).




- If $RTT(A,C_A) + RTT(C_B,B) < RTT(A,B)$ then C is considered as a shortcut for the link AB.

## Detection results

- A node C is an *interesting shortcut* if it provides at least an absolute latency gain of 10ms and a relative latency gain of 10% compared to RTT(A,B).
- We tested our detection techniques on three real datasets: the P2PSim dataset (1700 nodes), the Meridian dataset (2500 nodes) and the Planetlab dataset (180 nodes). In these datasets, there exists an interesting shortcut for respectively 42%, 83% and 16% of the node pairs.

| | Estimation criterion | | | Approximation criterion | | |
|---|---|---|---|---|---|---|
| | P2PSim | Meridian | Planetlab | P2PSim | Meridian | Planetlab |
| Percentage of shortcuts detected as shortcuts | 54.6% | 56.9% | 37.3% | 59.4% | 63.6% | 40.2% |
| Percentage of interesting shortcuts detected as shortcuts | 85.0% | 65.6% | 75.0% | 86.5% | 70.8% | 73.5% |
| Percentage of non shortcuts detected as shortcuts | 2.4% | 10.4% | 2.8% | 6.3% | 17.1% | 4.8% |

## Conclusion

- First results are encouraging and we will try and get better detection results by using more sophisticated techniques.
- Collecting the coordinates of all network's nodes and computing all the estimated delays could be quite costly. To avoid unnecessary work, we are currently working on a criterion to suspect the existence of a shortcut for a node pair by observing the behaviour of the ICS.