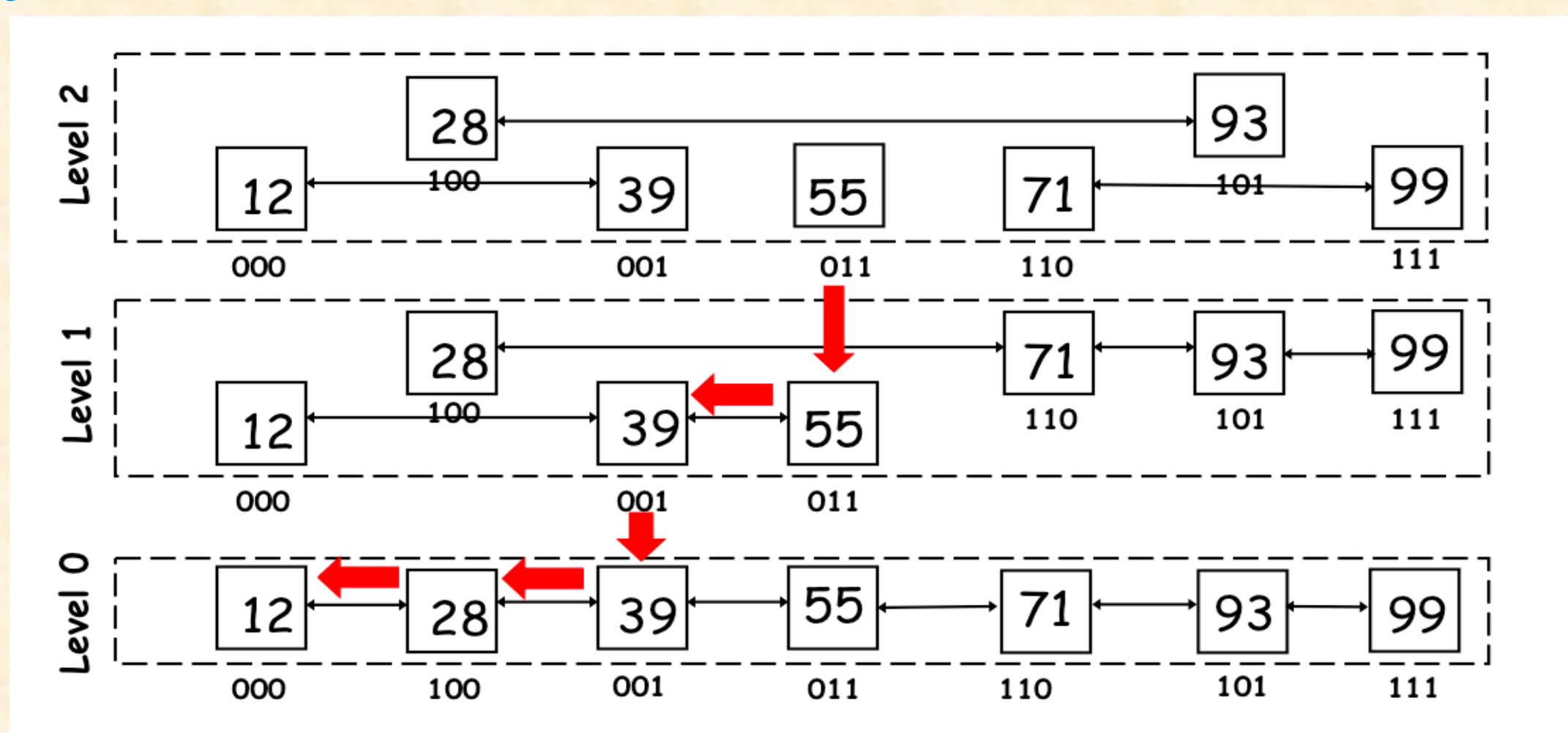


## Problem

Skip Graph, as a distributed hash table (DHT) based data structure, plays a key role in peer-to-peer (P2P) storage systems, distributed online social networks, search engines, and several DHT-based applications. In the Skip Graph structure, node identifiers define the connectivity. However, traditional identifier assignment algorithms do not consider the Skip Graph nodes' locations. Neglecting the nodes' localities in the identifier assignments results in high end-to-end latency in the overlay network which negatively affects the overall system performance.

## Objective



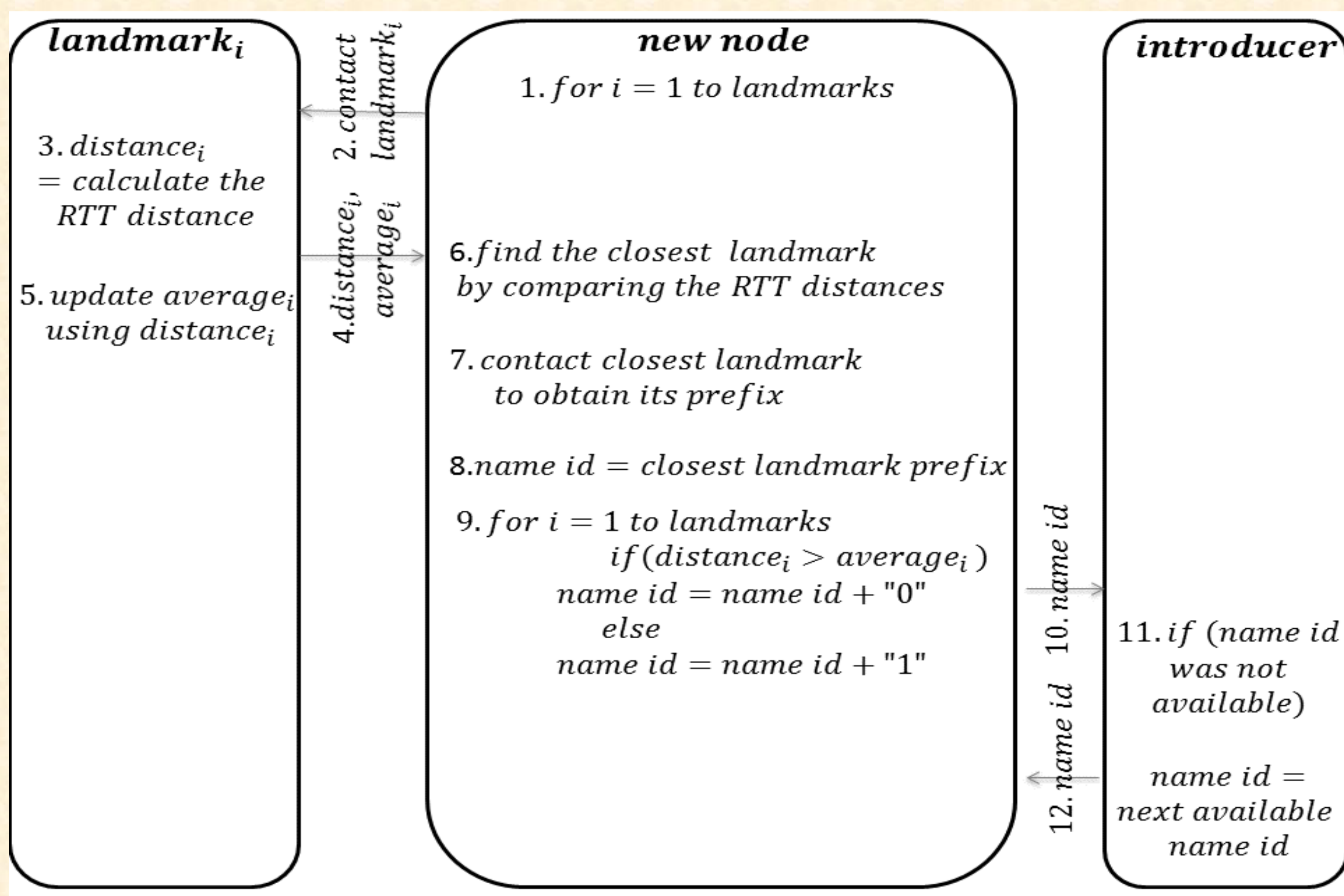
Improving the end-to-end latency in the Skip Graph's search query by making it locality aware

Skip Graph has the potential to be used instead of **DHT** in various DHT-based applications. Therefore, by making the Skip Graph locality aware and optimizing end-to-end latency in its search queries, would also help optimizing query processing and response time in such applications. Using a locality aware Skip Graph instead of a DHT will also enable DHT-based storage systems to perform **data replications** based on the location of the peers

## DPAD: Dynamic Prefix

## Average Distance algorithm

We propose the **first dynamic fully decentralized** algorithm, DPAD to assign locality aware name ids to the nodes of a Skip Graph.



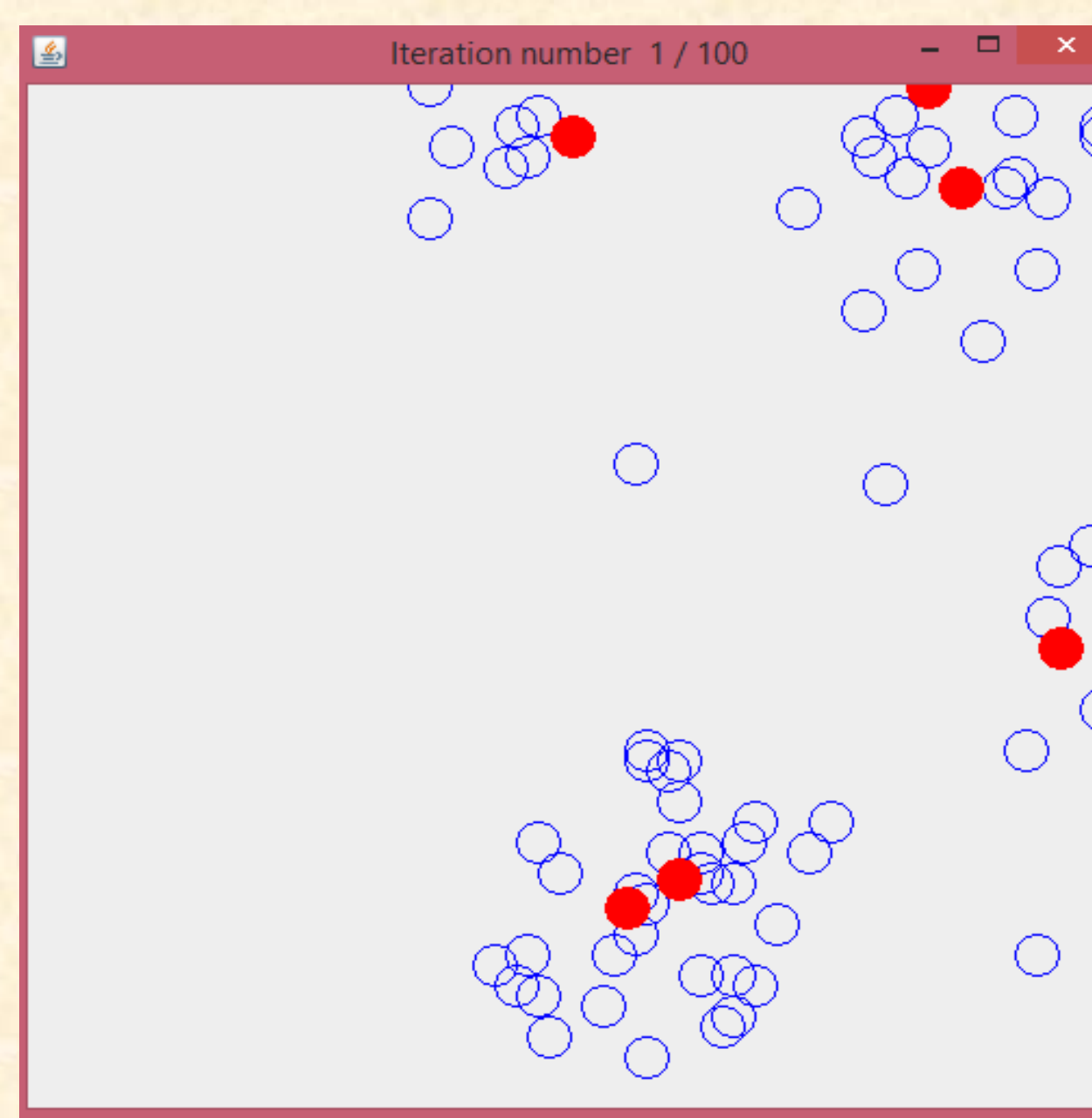
The interactions between a new node, its introducer and landmarks during the execution of DPAD algorithm

Method	Behavior	Decentralized	Locality Awareness
LAND	Dynamic	Full	No
LDHT	Dynamic	Hybrid	Hybrid
Hierarchical Assignment	Dynamic	Hybrid	Hybrid
LMDS	Static	Hybrid	Full
<b>DPAD</b>	<b>Dynamic</b>	<b>Full</b>	<b>Full</b>

Comparison between various methods of identifier assignment

## Simulation: SkipSim

We developed a simulation environment **SkipSim** for simulating the name id assignment algorithms, look up operations, and fault tolerance on the Skip Graph in both centralized and decentralized manner.

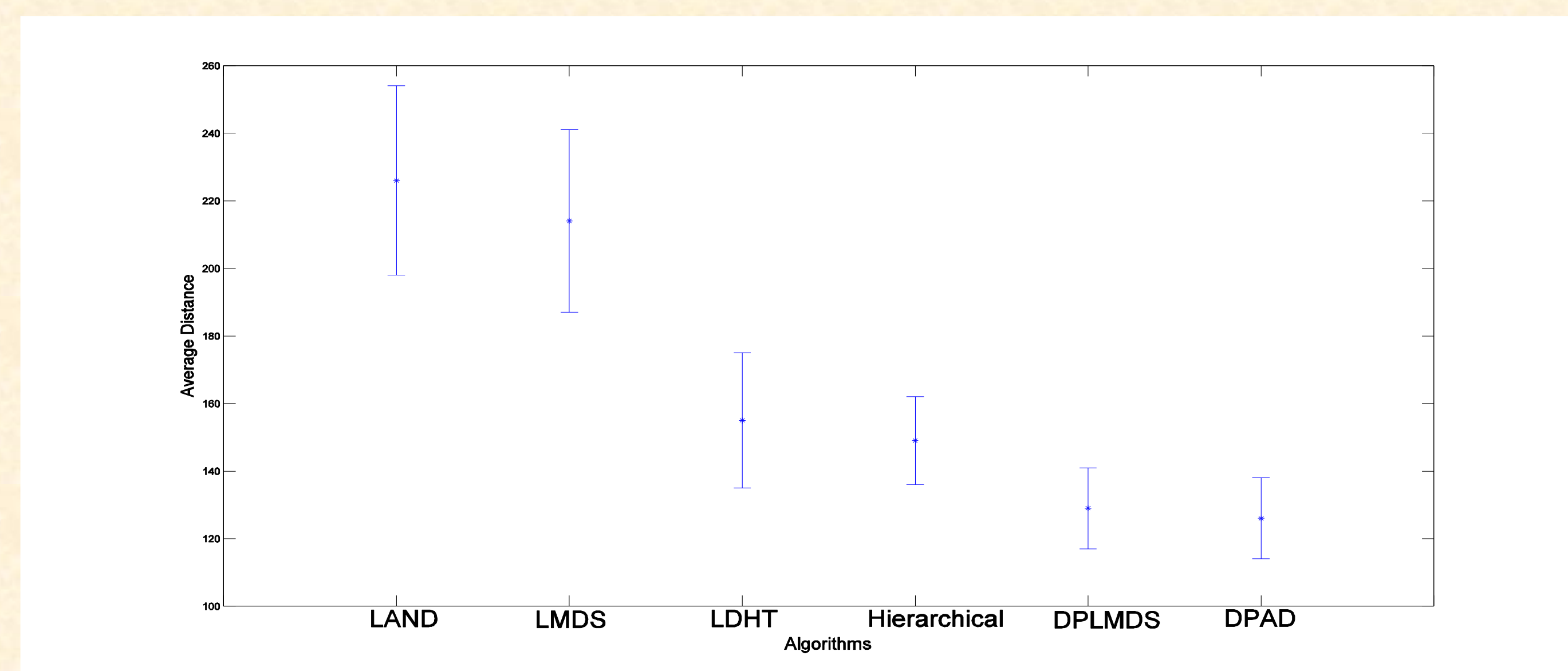


SkipSim topology interface

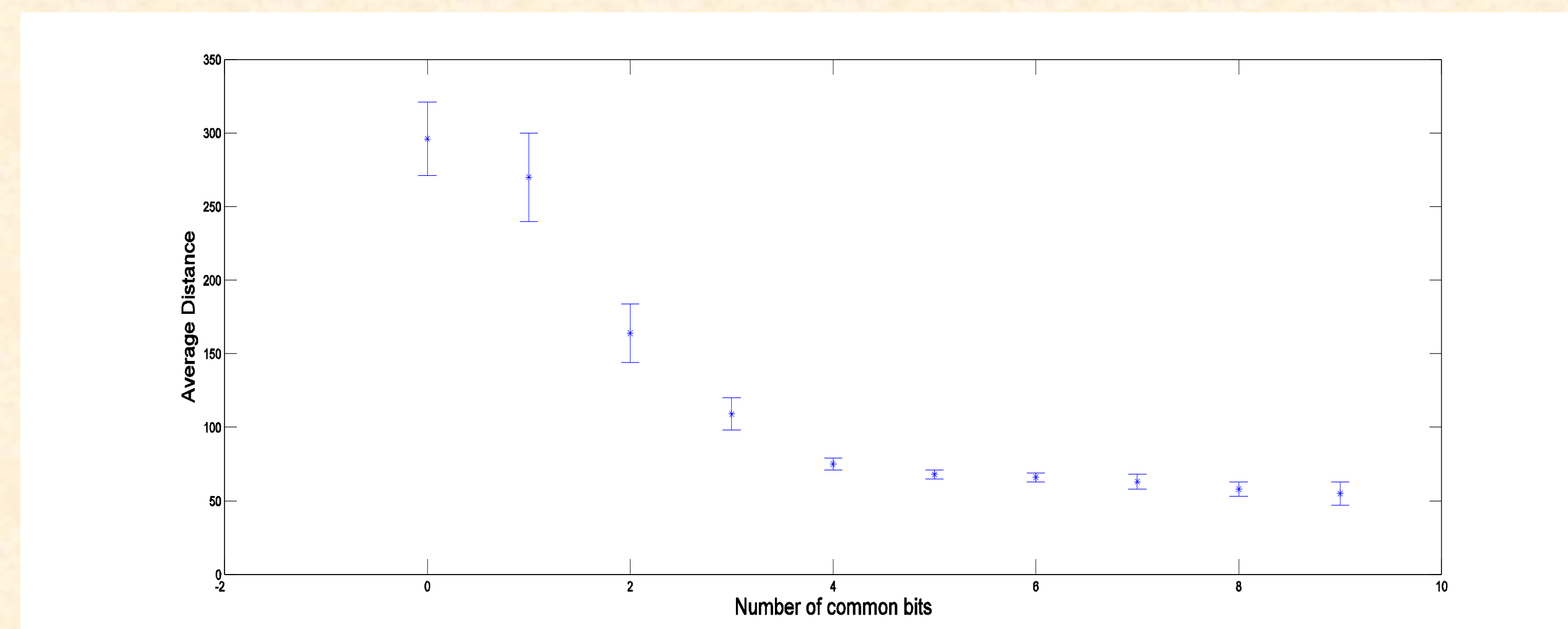
○ Peer  
● Landmark

100 Random Topologies  
1000 Random Transactions per topology  
100,000 Total Random Transactions

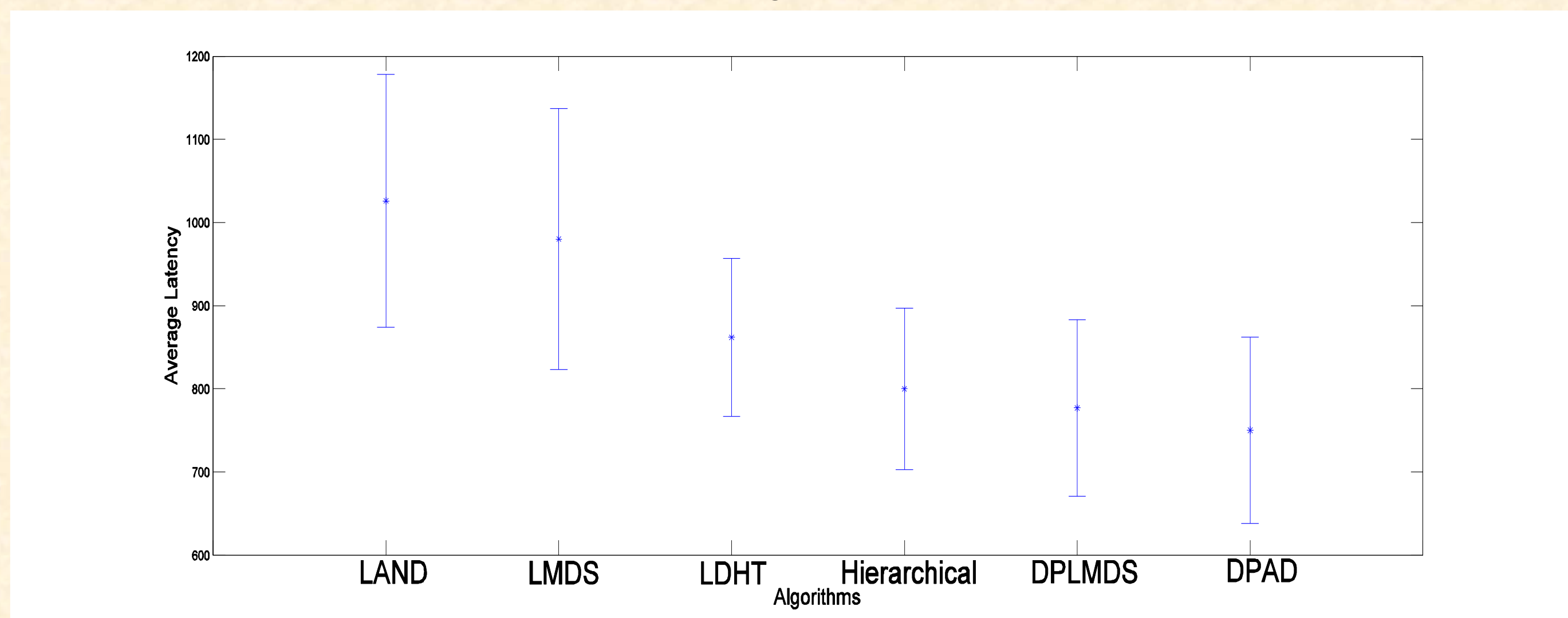
## Results:



Average distance of the nodes to their look-up table's neighbors in the name id assignment algorithms



Average distance between the nodes with different common prefix in the DPAD algorithm



Effect of name id assignment algorithms on the end-to-end latency of the search by numerical id

Our DPAD algorithm **40%** improves the end-to-end latency of the search queries and performs about **82%** better in preserving the locality awareness of the Skip Graph nodes than the previous best known dynamic, fully decentralized counterparts.

## Reference

Hassanzadeh-Nazarabadi, Y., Küpçü, A., & Özkasap, Ö. Locality Aware Skip Graph. Submitted to ESP-DGC 2015.



Action IC0804

