Distributed Hash Tables

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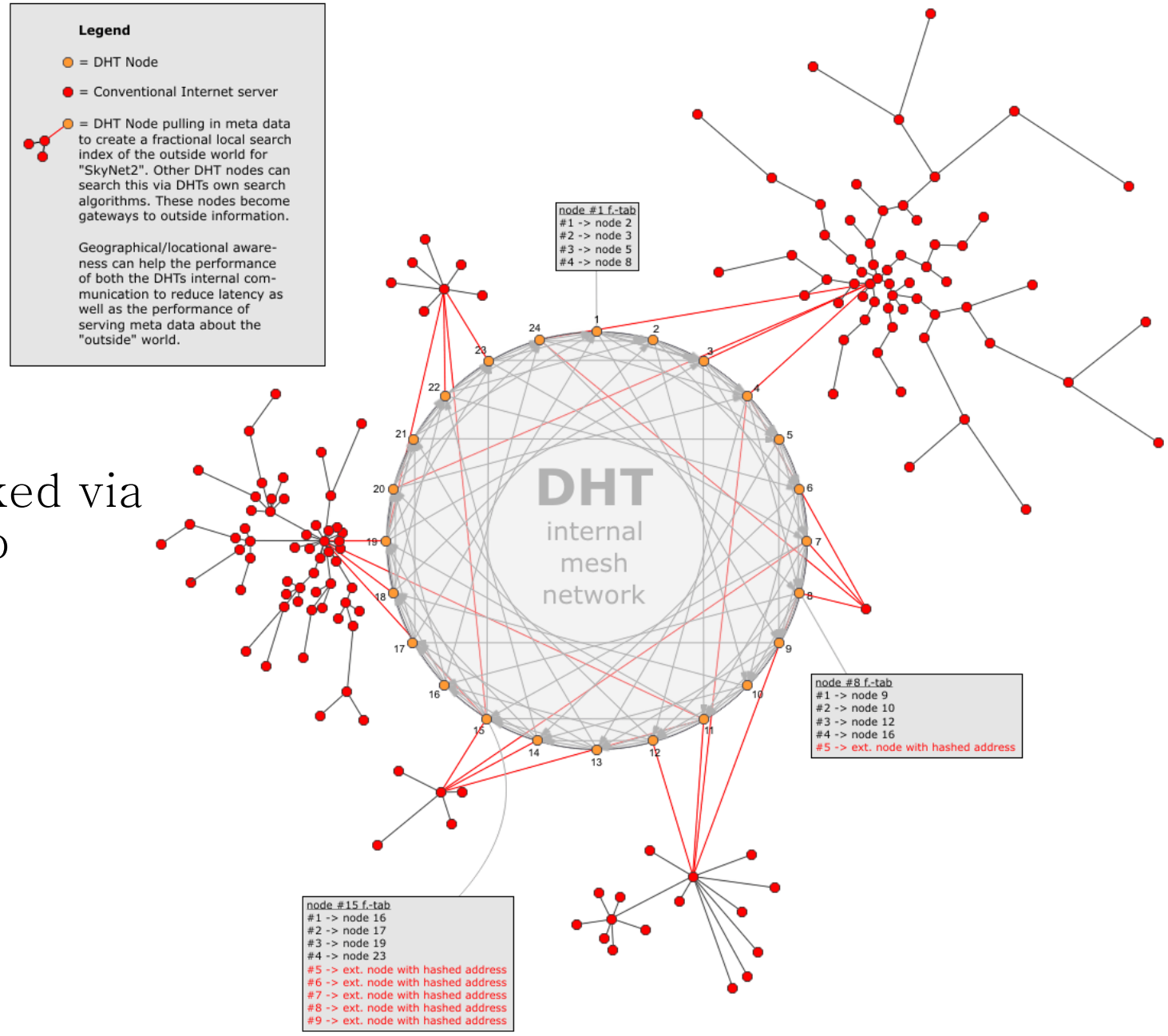
Introduction to DHT

Definition

Similar to hash tables but for a distributed system (computers linked via network). Stores IP addressed into nodes(hosts).

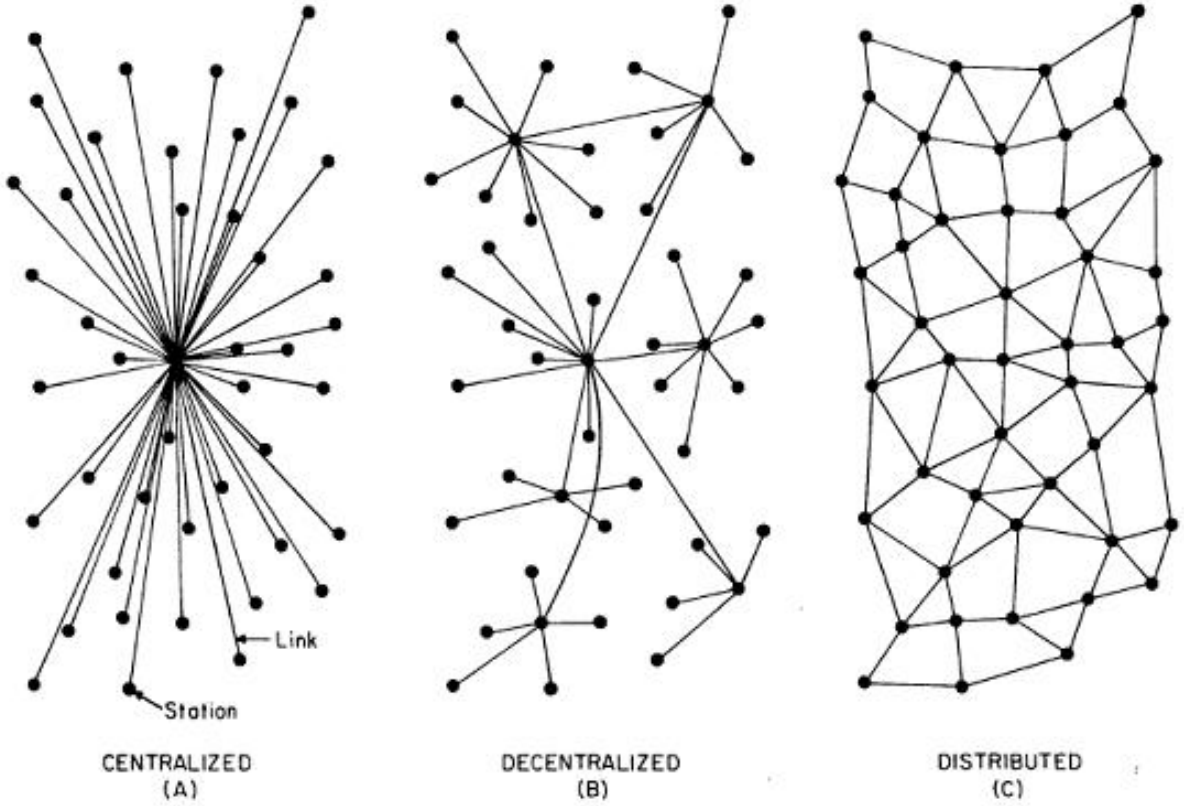


Problem:

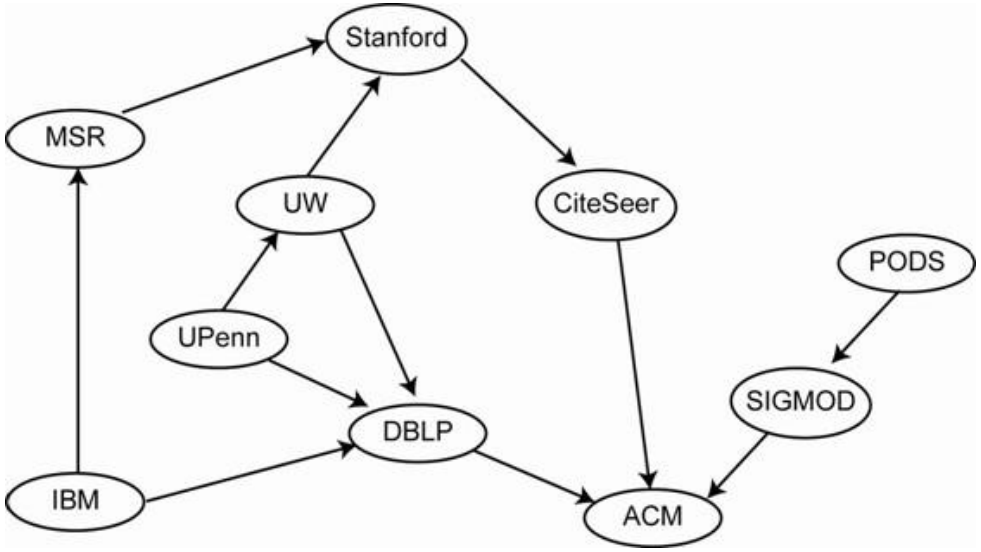
- Need for a decentralized and more secure peer to peer content distribution system

Solution:

- DHT nodes interact with only few other nodes in the network
- Nodes can join, update network and leave quick
- More secure for protecting the network from a malware source



Mapping

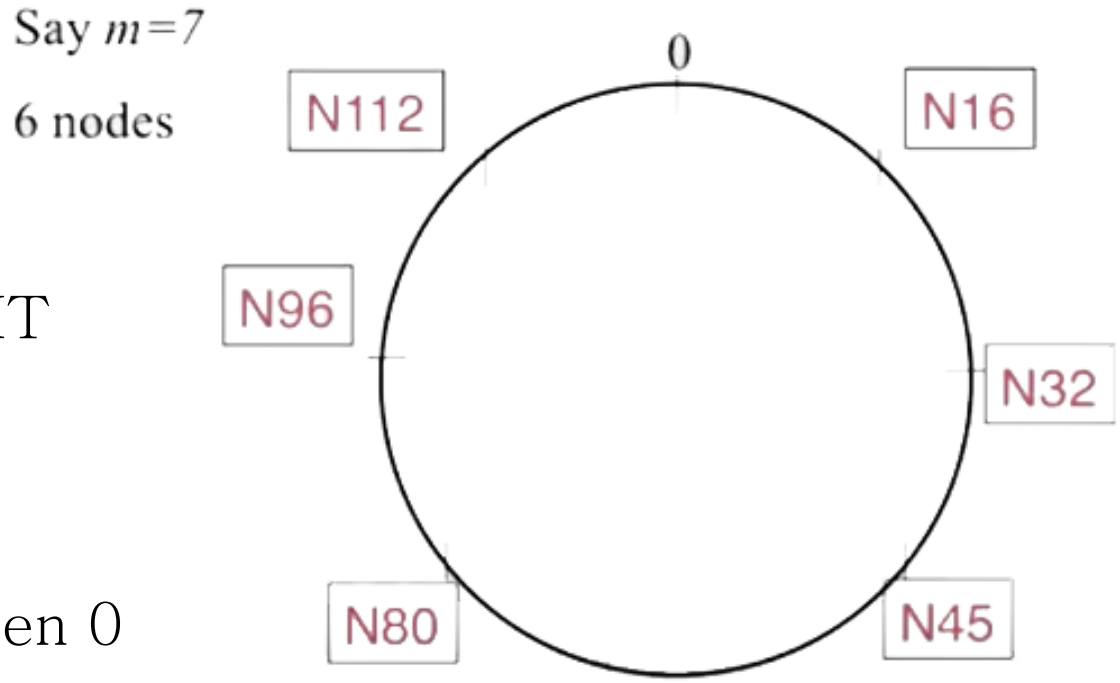


- Idea of DHT is to distribute the content or location of the content on all nodes
- Direct – node will have actual value stored. Cannot store big amount of data
- Indirect – node will store a key and value
- Ideal mapping = keys mapped evenly to all nodes, a node can reference a few other nodes, key is simple to find and node can come in and leave quickly

Implementation

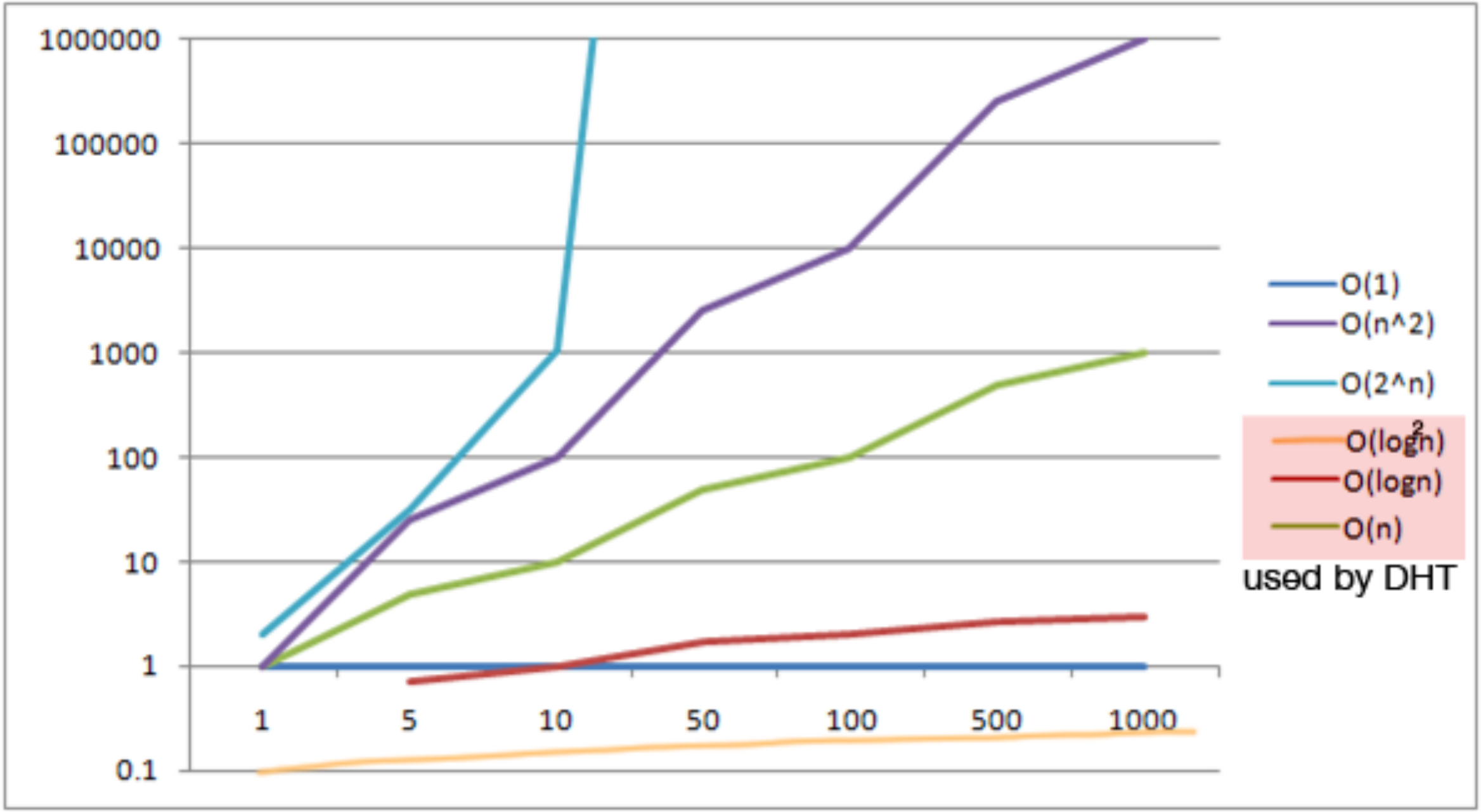
Chord

- One Developed by UC Berkeley and MIT
- Uses consistent hashing (SHA-1) and returns a 160-bit string
- Truncates the string to m bits (system parameter) and return a peer id (between 0 to $2^m + 1$)
- Each node knows the address to its successor and predecessor

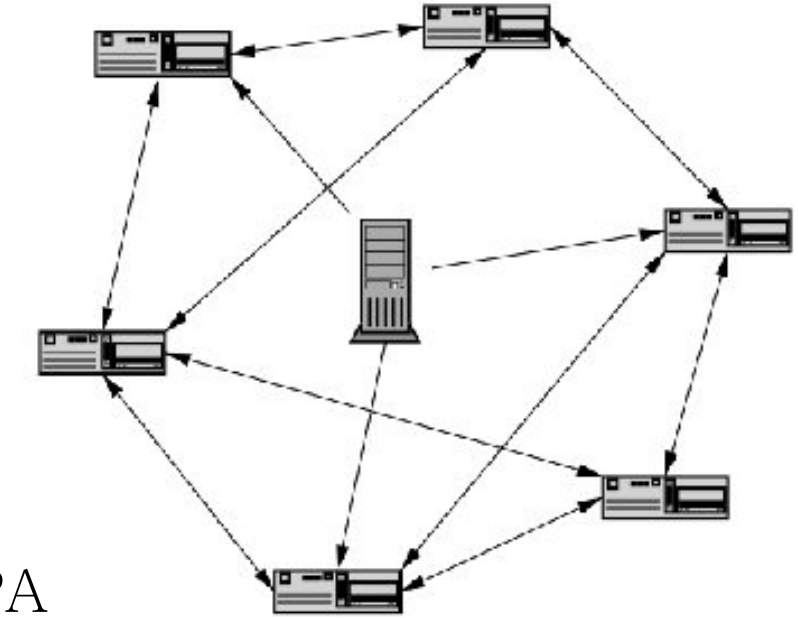


Operations & Growth Functions

Operation		Growth Function
Finger[k]		O(log N)
Find_successor		O(log N)
Closest_predecessor		O(log N)
LookUp	Basic LookUp	O(N)
	Efficient LookUp	O(log N)
Join		$O(\log^2 N)$
Leave		$O(\log^2 N)$


1000000
100000
10000
1000
100
10
1
0.1
1
5
10
50
100
500
1000
O(1)
O(n^2)
O(2^n)
O(log^2n)
O(logn)
O(n)
used by DHT

Application



Distributed Storage (Bit-Torrent)

- Peer IPA stored using infohash as the key
- “Get” operation looks up a key and returns the IPA
- “Put” operation stores an IPA into a key
- Peers randomly assigned to store values belonging to little parts of the key

BitTorrent™

Resources

1. CENL, “Distributed Hash Tables - DHT” pp. 2-77, January 2006¬
2. V.Richard, “Lecture on Distributed Hash Tables” pp. 10- 13, December 2015
3. M.Leiva-Gomez, “MTE Explains: How BitTorrent DHT Peer Discovery Works” January 2013
4. Ion Stoica, Roberr Morris, David Kargar, M. Frans Kaashoek, and Hari Balakrishnan. Chord: A scalable peerto-peer lookup service for internet applications. In Proceedings of the ACM SIGCOMM ’01 Conference, California, August 2001.