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Bookmark-driven Query Routing in Peer-to-Peer Web Search

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Overview

- Motivation
- Peer-to-Peer Systems
- Related Work
- Design Fundamentals
- Bookmark-driven Query Routing
- Conclusion/Summary
- Ongoing and Future Work

Motivation

- "Why ask one if you can ask thousands?"
- Break information monopolies.
- Intellectual input from a large number of users.
- Use **bookmarks** to find relevant peers.

→Peer-to-Peer Web Search

P2P Systems

- peer:
  - **“one that is of equal standing with another”**
  - *“one belonging to the same societal group especially based on age, grade, or status ”*

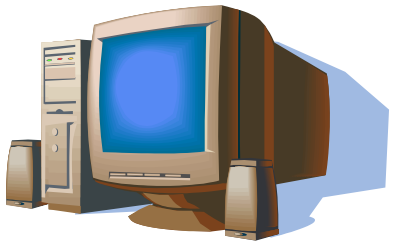
    source: Merriam-Webster Online Dictionary

- Benefits
  - no single point of failure
  - resource/data sharing

- Problems/Challenges:
  - authority/trust/incentives
  - high dynamics
  - …

Structured P2P-Systems

- Distributed Hashtable (DHT)
  Highly efficient support of one “simple” method

lookup(key) → 

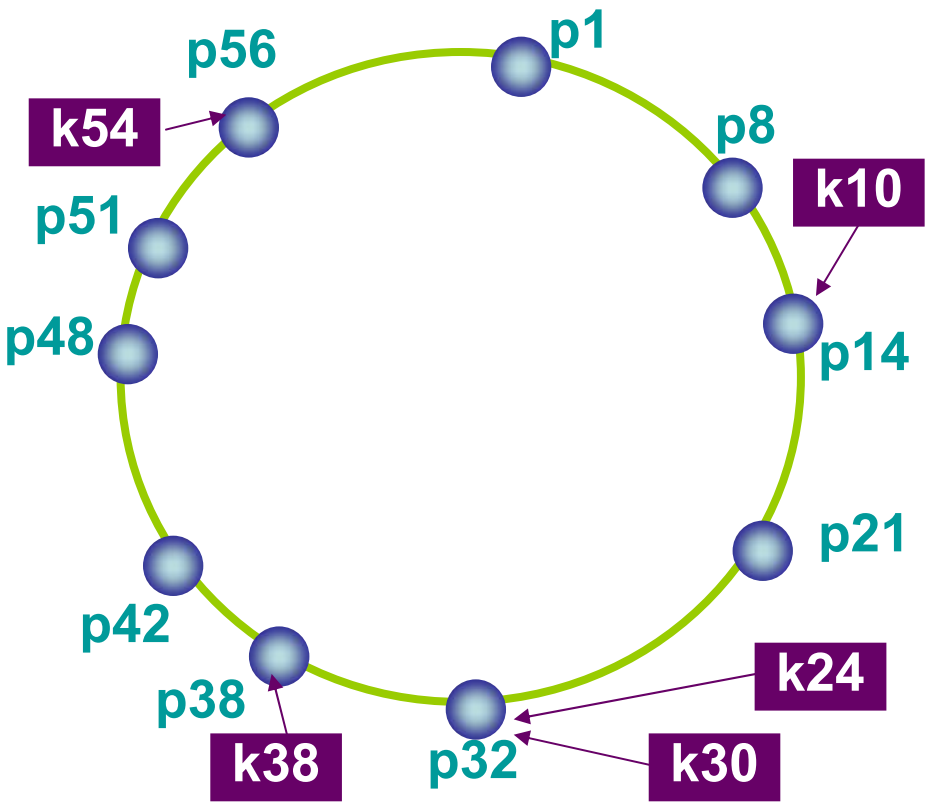
in *O(log n)* routing hops!

+ robustness to load skew, failures, dynamics

- Chord: I. Stoica et al.
- CAN: S. Ratnasamy et al.
- P-Grid: K. Aberer

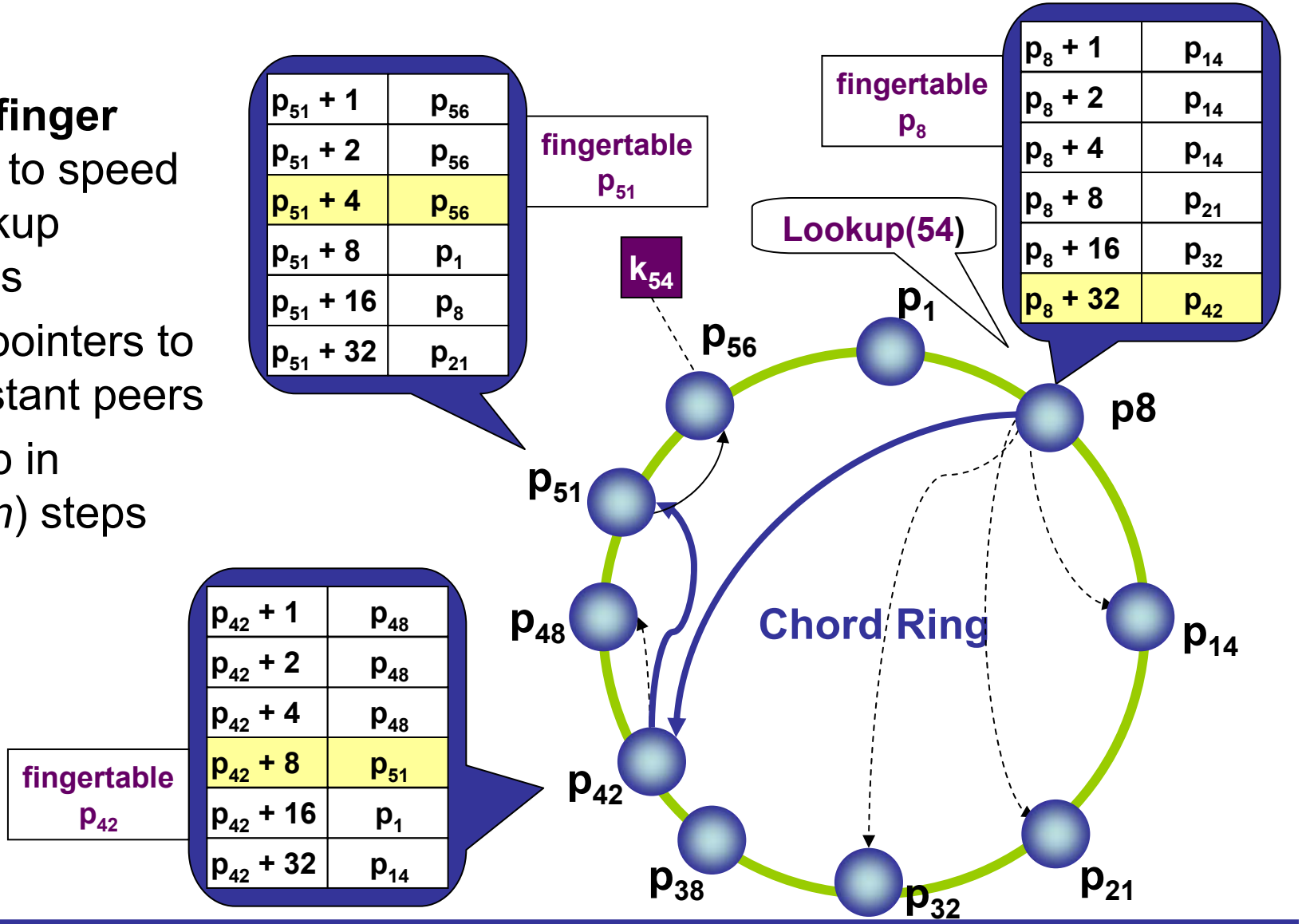
Chord

- Peers and keys are mapped to the same cyclic ID space using a hash function
- Key *k* (e.g., *hash*(file name)) is assigned to the node with key *p* (e.g., *hash*(IP address)) such that $k \leq p$ and there is no node *p'* with $k \leq p'$ and $p' < p$



Chord

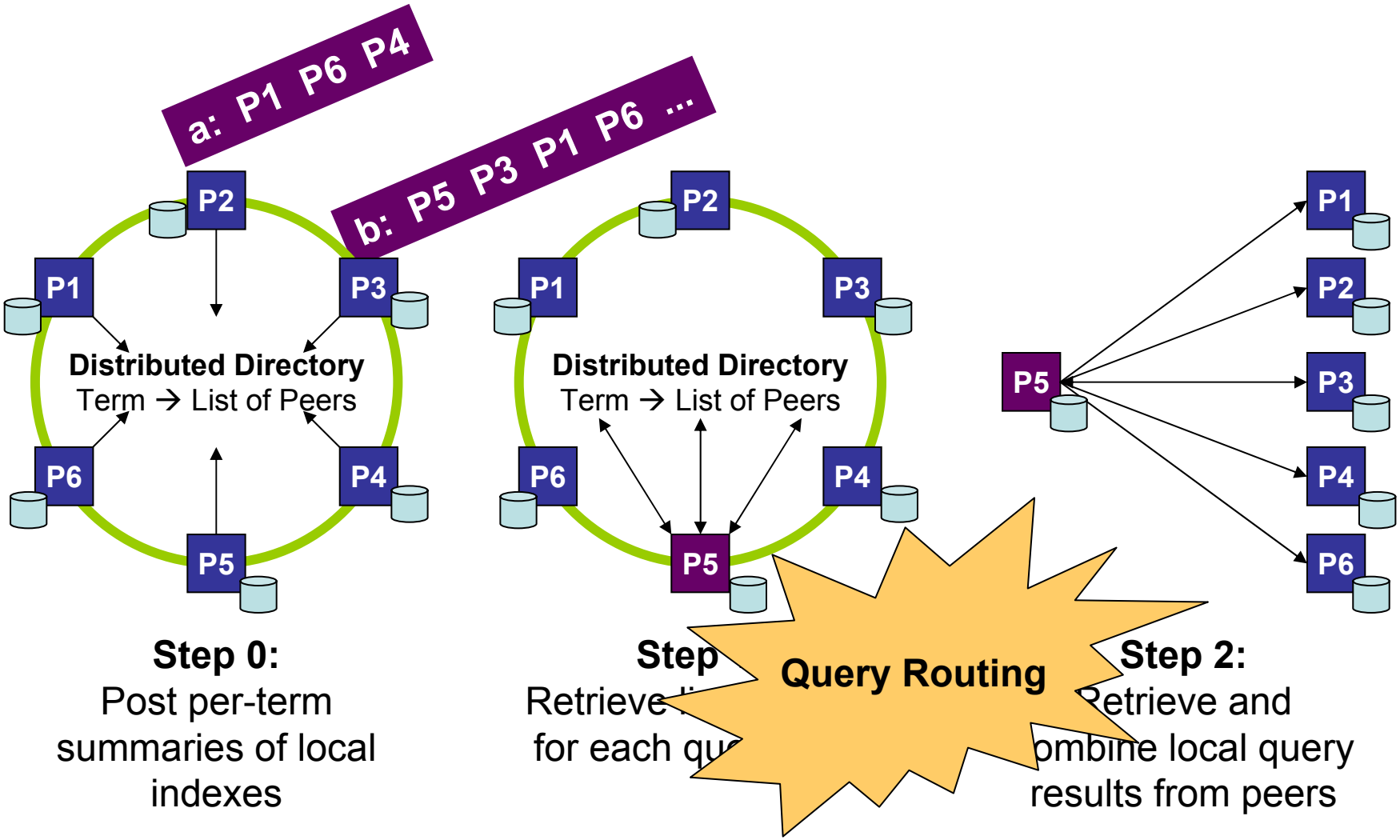
- Using **finger tables** to speed up lookup process
- Store pointers to few distant peers
- Lookup in O(log *n*) steps



Related Work

- Distributed IR:
  - CORI *(Callan et al., 1995)*
  - GLOSS *(Gravano et al., 1999)*
  - *"A decision-theoretic approach to db selection in networked IR" (Fuhr 1999)*
- *P2P Search:*
  - GALANX *(DeWitt et al., 2003)*
  - Odissea (Suel et al., 2003)
  - PlanetP (Cuenca-Acuna et al., 2002)
- Metasearch Engines

Design Fundamentals



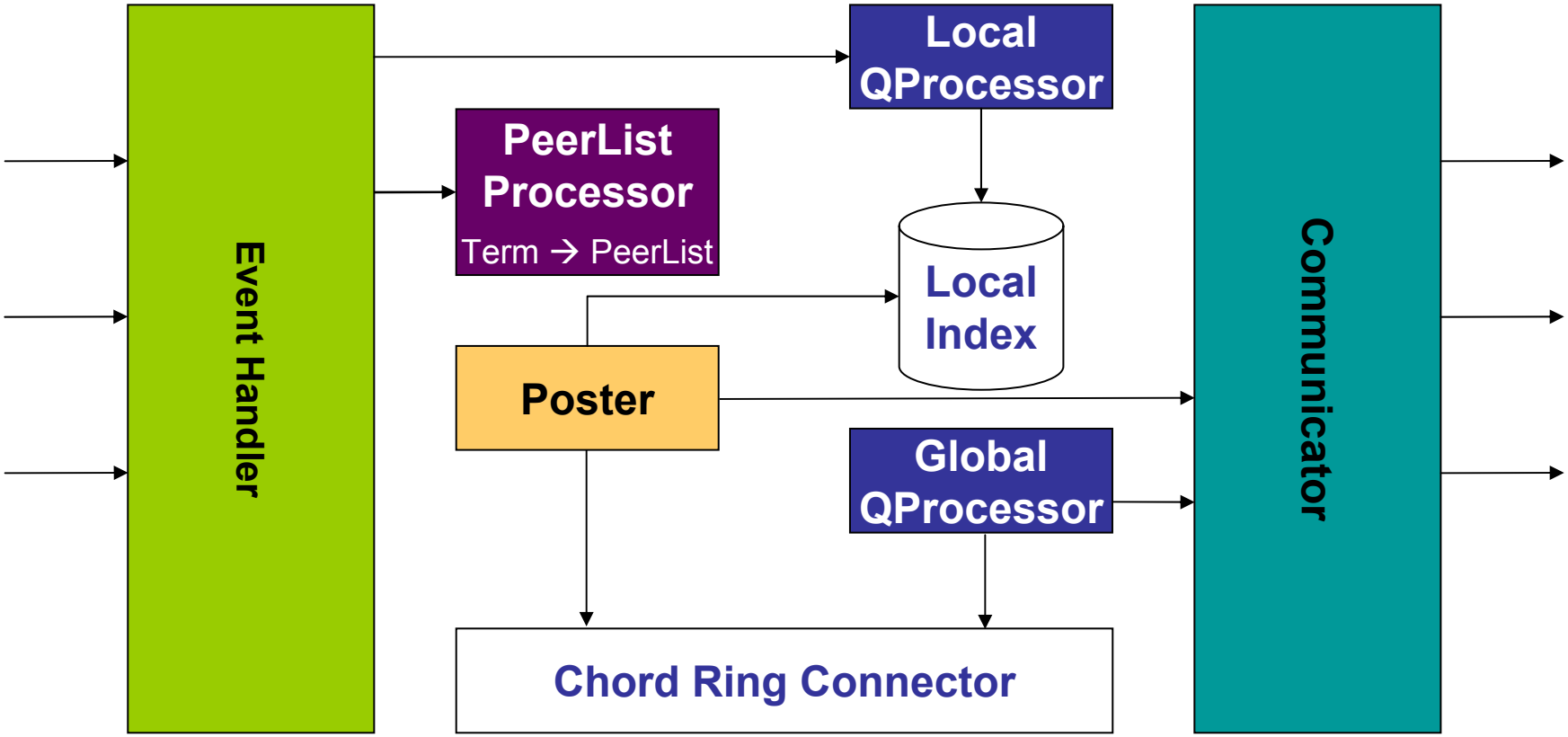
Step 0:
Post per-term summaries of local indexes

Step
Retrieve
for each qu

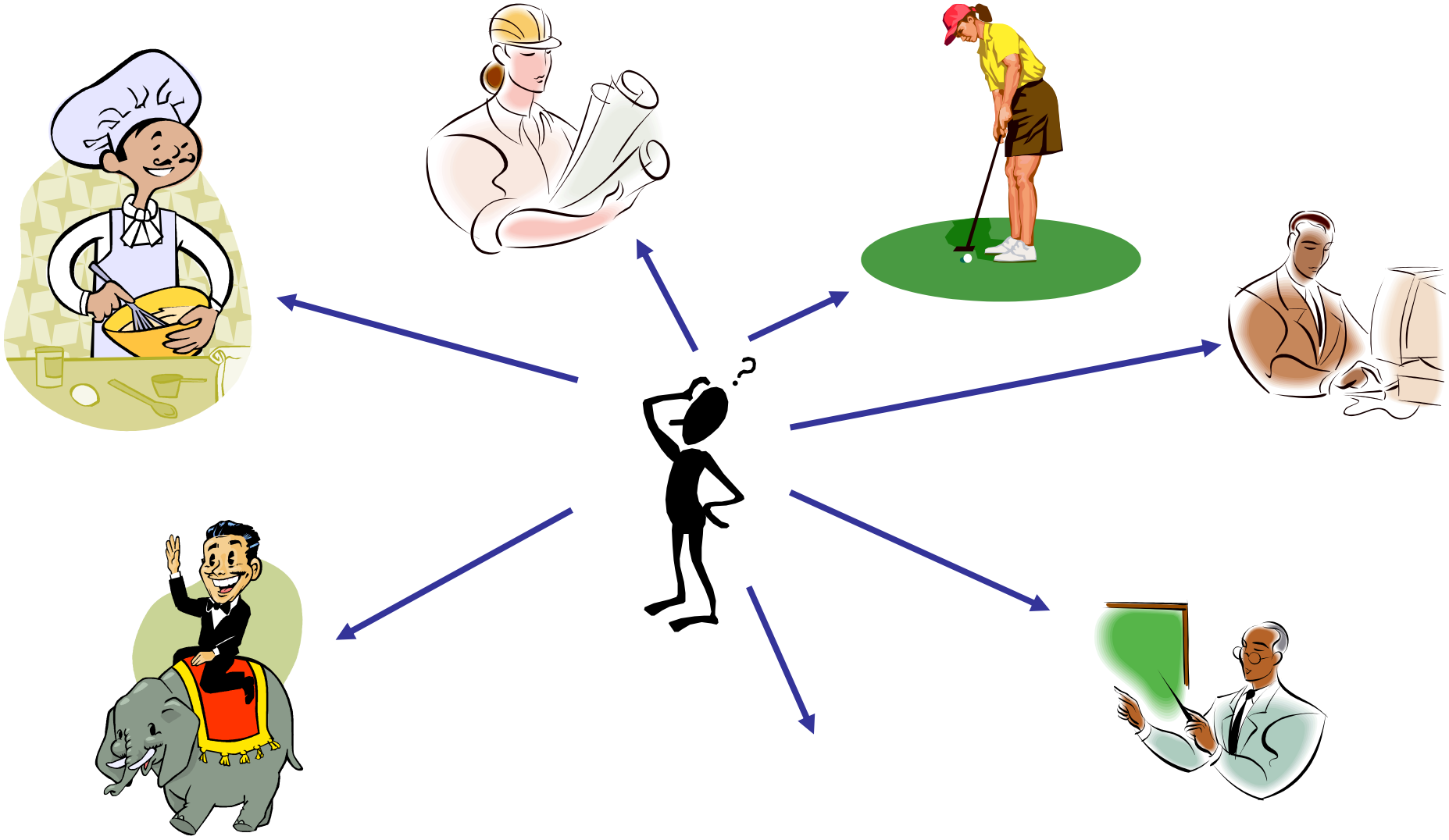
Step 2:
Retrieve and
ombine local query
results from peers

System Architecture

Architecture of a single peer



Why bookmark driven QR?



Bookmark-driven Query Routing

- bookmarks reflect user interests
- "Tell me what ~~books you read~~ **bookmarks you have** and I tell you who you are"

⇒ use bookmarks to find "relevant" peers

Relevance

- Notion of “relevant”

  - **Similar content**
  - **No or small overlap**

Bookmark-driven Query Routing

- Similarity between two peers?
  - Compare bookmarks instead of comparing local indexes (too expensive).
    - Assumption: Index has been created by focused crawling using bookmarks as crawl seeds.
- We can compare bookmark lists by
  - comparing the URLs
  - comparing term distributions of the documents referenced by the URLs

Information Similarity

- Kullback-Leibler distance (relative entropy)

$$KL(f,g) = \sum_x f(x) * \log(\frac{f(x)}{g(x)})$$

where *f* and *g* are probability distributions.

- Measure for information inequality.

Overlap and Benefit

$$overlap(A,B) := ca$$

this
is query independent:
can be precomputed, cached,…

Query based peer assessment

- Calculate similarity between the query and the bookmarks.
- Use term distribution of the top-*k* local results

$$benefit(B) \sim \frac{1}{KL(Q,B)} * \frac{1}{overlap(A,B)}$$

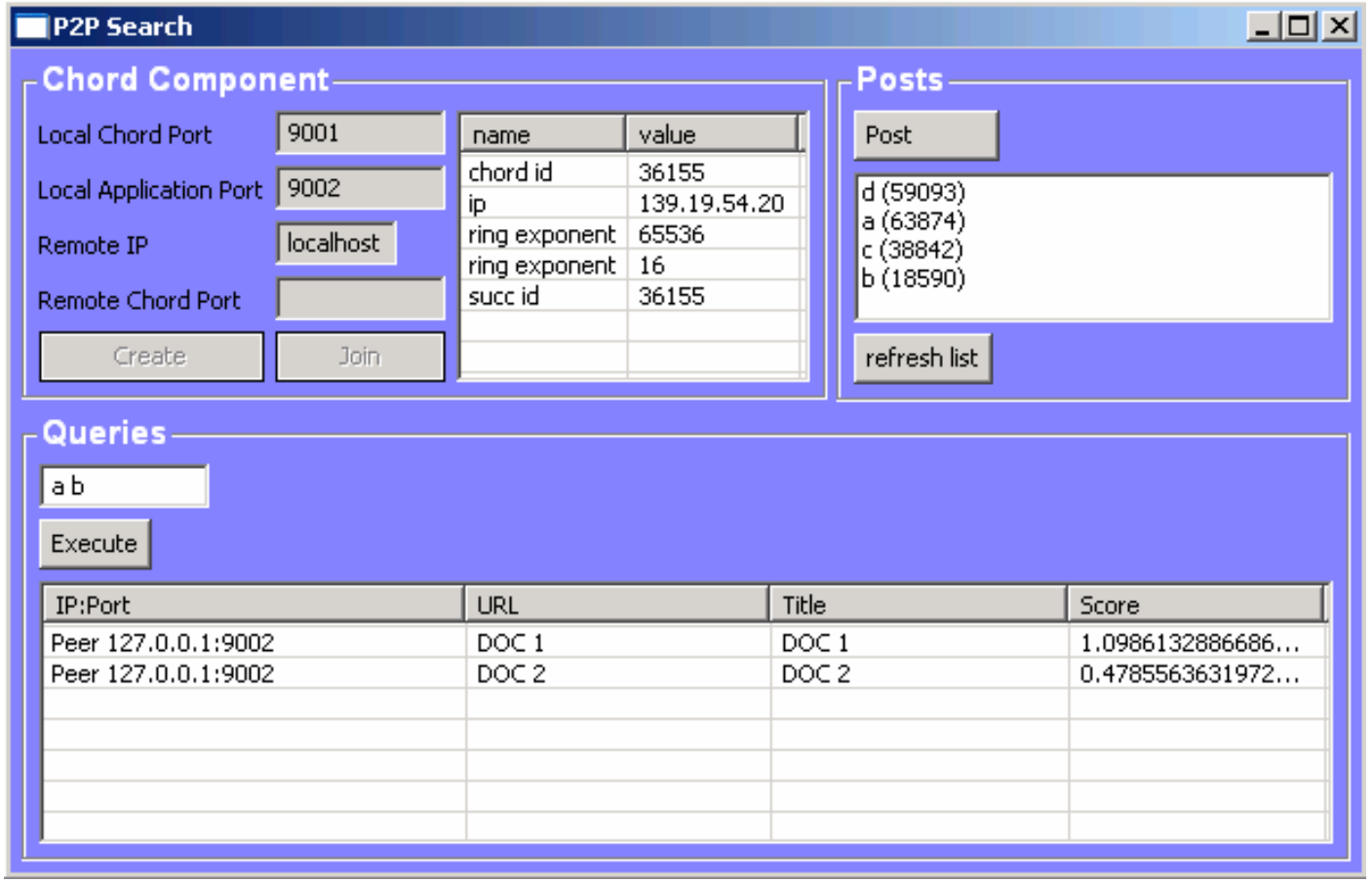
Conclusion/Summary

- P2P approach for collaborative search
- Scalable Search engine
- Extensible system architecture
- Bookmark-driven query routing

Ongoing and Future Work

- Complete the implementation
- Experiments on real web data
- Replication

Prototype


P2P Search
Chord Component
Local Chord Port
9001
Local Application Port
9002
Remote IP
localhost
Remote Chord Port
Create
Join
name
value
chord id
36155
ip
139.19.54.20
ring exponent
65536
ring exponent
16
succ id
36155
Posts
Post
d (59093)
a (63874)
c (38842)
b (18590)
refresh list
Queries
a b
Execute
IP:Port
URL
Title
Score
Peer 127.0.0.1:9002
DOC 1
DOC 1
1.0986132886686...
Peer 127.0.0.1:9002
DOC 2
DOC 2
0.4785563631972...

Thanks for your attention.

Questions?