PERSISTENT NAMING FOR P2P WEB HOSTING

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Web Hosting on P2P Networks

- Problems with client/server architecture:
  - Flash crowds
  - Poor scalability even with high end servers and geographically distributed CDNs
  - Human intervention (DNS redirection)
  - Administrative overhead
  - Hosting expenses
Web Hosting on P2P Networks

- Advantages of P2P web hosting
  - No single point-of-failure
  - Self-CHOP (configuring, healing, organizing, protection)
  - In-network caching improves performance
  - Lower cost
  - Freedom of speech
  - Publisher anonymity
Research Challenges for Web Hosting on P2P Networks

- Highly dynamic network structure
- Content dynamism
- Content placement
- No uptime guarantees
- No end-to-end trust framework
- Firewalls and NATs
- ...

only to name a few
Our objective:

Provide a persistent naming scheme for web hosting on P2P networks
So What are the Research Challenges for Naming?

- Location and time independent naming
  - Internet: URLs are bound to particular hosts
  - P2P: Any peer with a valid copy can be a source

- Distributed name registration and resolution
  - DNS is not a suitable solution in the P2P context
So What are the Research Challenges for Naming?

- Names must be attached to content
  - Independent of peer

- Flexible and human friendly names

- Persistent hyperlinks or bookmarks
Outline

- Plexus Routing
- pWeb Architecture
- Naming Scheme
- Experimental Results
- Conclusion
Plexus: Index Clustering

Cluster: $C = \text{set of cluster heads}$

Linear code, $C <n,k,d>$

Cluster head $\Leftrightarrow$ Codeword

Generator matrix based routing

$Q \subseteq P \Rightarrow qSet(Q) \cap advSet(P) \neq \emptyset$

Cluster Pattern

Cluster head

Advertisement, $P$

$advSet(P) \subseteq C$

Query, $Q$

$qSet(Q) \subseteq C$

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Plexus: Routing

- Observation: C is closed under $\oplus$ operation

Example: Route from $X$ to $Y$ where,

$$Y = X \oplus g_2 \oplus g_3 \oplus g_5$$

$$X_{k+1} = X \oplus g_1 \oplus g_2 \oplus \cdots \oplus g_k$$

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pWeb Architecture

Name Management Layer

Group Management Layer

Plexus Routing Layer

Name Resolution

Naming Authority

Naming Scheme

Name Indexing

Advertisement, \( P \)

Query, \( Q \)

\( \text{advSet}(P) \subseteq C \)

\( \text{qSet}(Q) \subseteq C \)
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Naming Scheme -> Name Structure

- Names are called pRL
  - pWeb Resource Locator

![Diagram of Name Structure]

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Naming Scheme -> Name Registration

- Apply Hash
- Encode
- List Decode
- Route
- Check Uniqueness
- Publish

1. Apply Hash
2. Bloom Filter
3. Pattern List Decode
4. Plexus Routing Codewords
5a. Check Uniqueness
5b. If Successful

Try with new pRL

If failed

If successful

Replication Group Publish Website
Target Peers Store Mapping

pRL -> GroupUUID
Naming Scheme -> Name Registration

- Apply Hash
- Encode
- List Decode
- Route
- Check Uniqueness
- Publish
- Replicate

Target peers = ListDecode(BF(r,s,t)+BF(S))

Peer: X, Group: G
Register Site: S, Keywords: {r, s, t}

Peer: Y, Group: G
Replicates site: S

Website Name | Keywords | Group ID
--- | --- | ---
S | r, s, t | G

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Naming Scheme -> Name Resolution

- Apply Hash
- Encode
- List Decode
- Route
- Return GroupUUID
- List Decode
- Map to Codewords
- Route
- Group Leader’s IP:port

1. pRL Apply Hash
2. Bloom Filter Encode
3. Pattern List Decode
4. Return GroupUUID
5. List Decode
6. Pattern List Decode
7. Plexus Routing Pattern Map to Codewords
8. Target Peers Return Group Leader IP:Port

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Naming Scheme -> Name Resolution

- Apply Hash
- Encode
- List Decode
- Route
- Return GroupUUID
- List Decode
- Map to Codewords
- Route
- Group Leader’s IP:port

<table>
<thead>
<tr>
<th>Website Name</th>
<th>Keywords</th>
<th>Group ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>r, s, t</td>
<td>G</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group ID</th>
<th>Peer</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>X</td>
<td>offline</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>offline</td>
</tr>
<tr>
<td></td>
<td>Z</td>
<td>online</td>
</tr>
</tbody>
</table>
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Experimental Results

(a) Name record count

(b) Percentage of lost names
Experimental Results

(a) Worst case name registration hop count
(b) Worst case name resolution hop count
(c) % of peer accessed/registration
(d) % of peer accessed/resolution
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Related Work

- Information Centric Networks
  - NetInf
  - DONA
  - CCN

- P2P Networks
  - BitTorrent: Hash of file chunk
Summary

- We have proposed a naming scheme
  - That is
    - Distributed
    - Persistent
    - Scalable and
    - Fault-tolerant
- It provides a flat namespace with support for both Human friendly and secure distribute names