

# A Feasibility Evaluation on Name-based Routing

Haesung Hwang<sup>†</sup>, Shingo Ata<sup>‡</sup>, and Masayuki Murata<sup>†</sup>

<sup>†</sup>Graduate School of Information Science and Technology, Osaka University  
<sup>‡</sup>Graduate School of Engineering, Osaka City University  
 {h-hwang, murata}@ist.osaka-u.ac.jp  
 ata@info.eng.osaka-cu.ac.jp

## Outline

- 🗄 Introduction
- 🗄 Related Work
- 🗄 Proposal & Contribution
  - 🗄 Hierarchical Architecture
  - 🗄 Distribution Algorithms
- 🗄 Evaluation
- 🗄 Conclusion & Future Work

Oct 30, 2009 IPOM 2009 2

## Sketch of Proposal

Oct 30, 2009 IPOM 2009 3

## Motivation & Purpose

Introduction

- 🗄 Solve the problem of IP
  - 🗄 Explosion of routing table size due to address structure
  - 🗄 IP address depends on ISP and is both ID and locator
- 🗄 Achieve sophisticated routing protocol
  - 🗄 Routing based on resource/content

We need a new network architecture !

Content-based routing

Name-based routing

FQDN

→

Domain name routing in Network Layer

Oct 30, 2009 IPOM 2009 4

## Related Work

- 🗄 Name-based Routing Protocol (NBRP<sup>[1]</sup>)
  - 🗄 IP address: temporary routing tag
  - 🗄 URL: end node ID
- 🗄 Name-based routing<sup>[2]</sup>
  - 🗄 Compares performance with IP
  - 🗄 Solves storage requirement problem through caching and aggregating domain names

[1] Gritter, M., Cheriton, D.R.: An Architecture for Content Routing Support in the Internet. In: 3rd USENIX Symposium on Internet Technologies and Systems, (2001)  
 [2] Shue, C.A., Gupta, M.: Packet Forwarding: Name-based Vs. Prefix-based. In: 10th IEEE Global Internet Symposium, (2007)

Oct 30, 2009 IPOM 2009 5

## In This Presentation

Is domain name routing feasible?

Network resource	Hardware resource
<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Hierarchical architecture</li> <li><input type="checkbox"/> Name registration</li> <li><input type="checkbox"/> Routing table exchange</li> <li><input type="checkbox"/> Packet forwarding</li> </ul>	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Domain name distribution algorithms using TCAM</li> <li><input checked="" type="checkbox"/> Hash-based</li> <li><input checked="" type="checkbox"/> Hierarchical longest alphabet match</li> <li><input checked="" type="checkbox"/> Hybrid distribution</li> </ul>

Oct 30, 2009 IPOM 2009 6

### TCAM (Ternary Content Addressable Memory)

<RAM>

0	1	0	1	1	0
1	1	1	0	0	1
2	0	0	1	1	0
3	1	0	1	0	1
4	0	1	0	1	0
5	1	1	0	1	1

Address In: 4

Data Out: 0 1 0 1 1 0

<TCAM>

0	1	0	*	*	*
1	1	1	0	0	1
2	0	0	1	1	0
3	1	0	1	0	1
4	0	1	0	1	0
5	1	1	0	1	1

Data In: 0 1 0 1 1 0

Address Out: 4

- Searched using the content of memory, returns the memory content or the memory address
- Cell representation: 0/ 1/ \*
- Fast search speed, excellent performance in longest prefix match

Oct 30, 2009 IPOM 2009 7

### Architecture

Proposed architecture

osaka-u.ac.jp

3rd level domain    2nd level domain    Top level domain

- Internet is roughly modeled by Abilene-inspired topology
- Top level domain name ⇒ backbone routers
- 2nd level domain names ⇒ local gateway routers
- 3rd level domain names ⇒ edge routers

Oct 30, 2009 IPOM 2009 8

### Domain Name

- Variable length, usually longer than IP address
- Mostly less than 50 characters (99%)

Domain names should be distributed to multiple routers!

Oct 30, 2009 IPOM 2009 9

### Distribution Algorithms

- Hash-based Distribution
  - Hashes FQDN
  - Advantage: Balanced distribution. Disadvantage: long stretch
- Hierarchical Longest Alphabet Match (HLAM)
  - Inspired by longest prefix match
  - Takes full advantage of TCAM
- Hybrid Distribution (HD)
  - Grouping by TLD + hashing function
  - Routing possible in closed network balanced distribution is achieved

Oct 30, 2009 IPOM 2009 10

### Hash-based Distribution

Distribution Algorithm (1)

ist.osaka-u.ac.jp  
google.com  
yahoo.co.jp

↓ SHA-1

53013e5605f469aa2c278555e31cd443679398c8  
bae4954b95731c68a6e645bd1e252eb4560cdc45  
2c9997073526c945f37a46811d099ad4iec87d8

↓ decimal

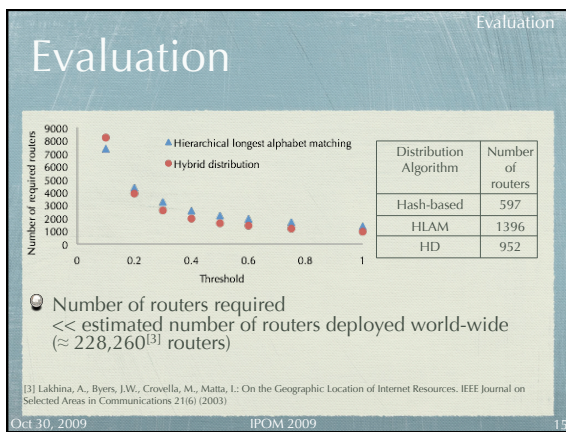
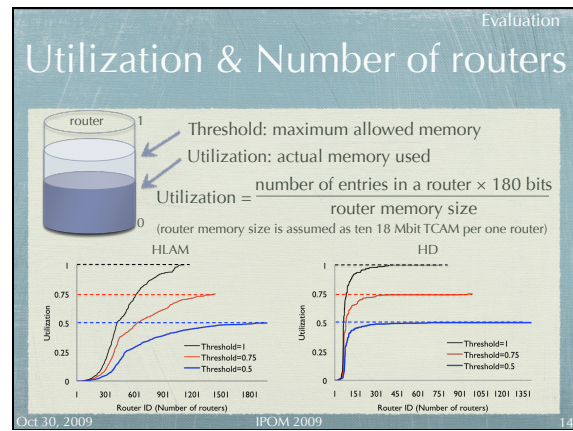
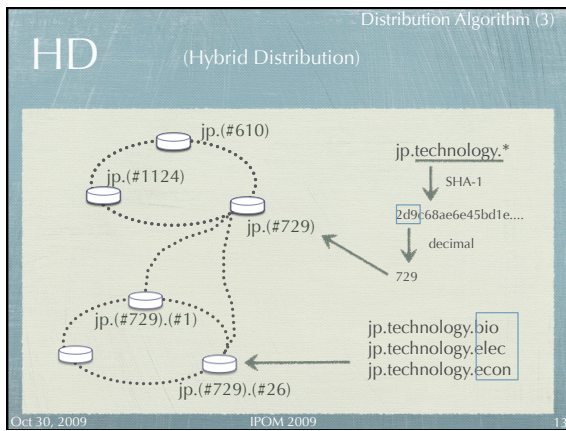
2864: ist.osaka-u.ac.jp → router #2864  
2990: google.com → router #2990  
713: yahoo.co.jp → router #713

Oct 30, 2009 IPOM 2009 11

### HLAM (Hierarchical Longest Alphabet Match)

Distribution Algorithm (2)

Oct 30, 2009 IPOM 2009 12



- ## Conclusion & Future Work
- 📌 Conclusion
    - 📍 Domain name as a substitute for IP address
    - 📍 Feasible in Network Layer
  - 📌 Future Work
    - 📍 Evaluate routing table updates
    - 📍 Investigate the effect of eliminating domain name servers
- Oct 30, 2009 IPOM 2009 16

Thank you!

Haesung Hwang  
[h-hwang@ist.osaka-u.ac.jp](mailto:h-hwang@ist.osaka-u.ac.jp)