Athens University of Economics and Business
Department of Informatics – DB-NET Research Group
http://www.db-net.aueb.gr/dbglobe

DBGlobe: Simulator Prototype

Stratis Valavanis
Christopher Ververides
Christos Doulkeridis
Michalis Vazirgiannis
George C. Polyzos

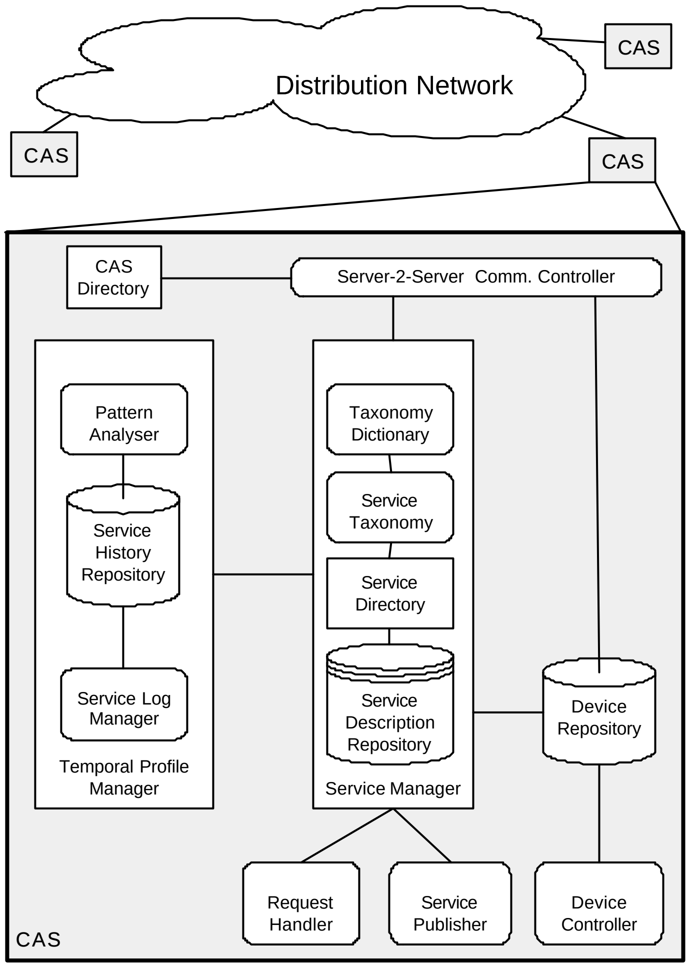
information society technologies

DBGlobe – Current AUEB Involvement

- Workpackage: W2 (UoI, CTI)
- Objective
  - A simulator of dynamic environments of cooperative mobile entities.
    - Model the distribution, mobility and data of mobile entities
    - Express the interaction among the entities
    - Adhoc creation of dbs, co-ordination, data acquisition
- Month 18: Deliverable D7

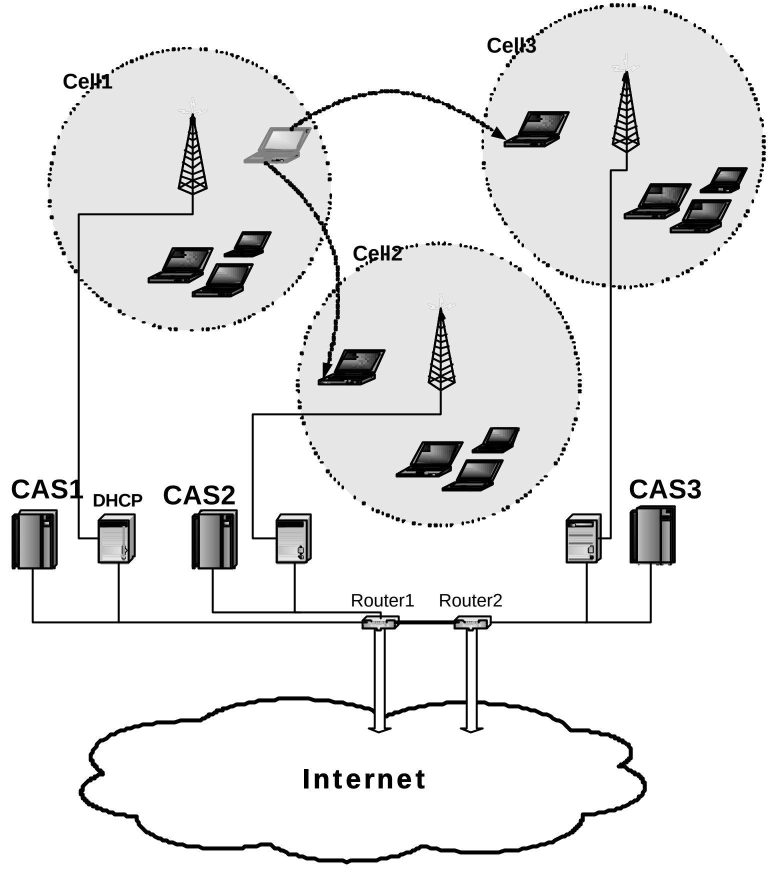
  "Simulation Environment"
    - Network Simulation (WLAN)
    - Component Interaction (PMO,CAS)
    - Context Manipulation

Specification of the Simulation Environment



- Space Model
  - Cells
    - Administrative
    - Communication
- PMO
- Cell Administration Server
- Distribution Network

Testbed Environment



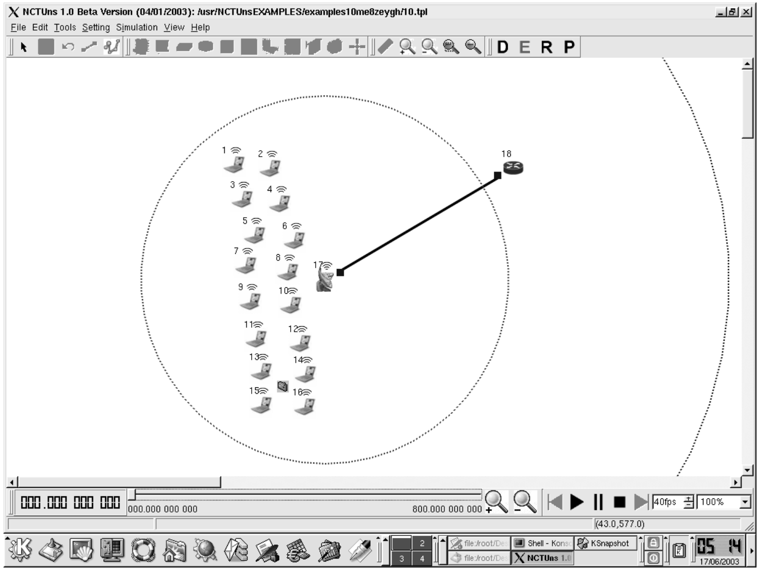
Network Simulation

- Network Simulators
  - Develop
  - Test
  - Diagnose

network protocols/deployments

- Simulation Platform: NCTUns
- Assumptions
  - Equal number of requestors-sources
  - Service request interval 5sec
  - Files exchanged: 100KB (service description)
  - PMO population ranges between 2 and 64
  - Each source serves at most one requestor
  - Simulation duration: 800 sec

NCTUns 1.0 Network Simulator



- Uses real-life TCP/IP Protocol Stack
- Tunnel network interfaces
- Widely used in academic community
- Supports IEEE 802.11 infrastructure mode

Network - Simulation Results

	PMO #	**Avg bandwidth Kbytes/sec**	**Transfer time (100Kbytes) seconds**
Scenario 1	16	45	2.5
Scenario 2	32	27	3
Scenario 3	64	17	6

System Component Interactions I

	Description	Type	Components
I_1	Service Search	P-2-C	*PMO (requestor)* Local CAS
I_2	Locate Current Cell	P-2-C	PMO (requestor) Local CAS Home CAS Current CAS
I_3	Find PMO IP	P-2-C	PMO (requestor) Current CAS
I_4	Policy related requests	C-2-C	CAS current CAS Home Or CAS Home CAS Current

System Component Interactions II

	Description	Type	Components
I_5	PMO request dissemination	C-2-C	Local CAS CAS for all adjacent cells
I_6	Retrieve Service Grounding Information	P-2-P	PMO requestor PMO source
I_7	Consume Service	P-2-P	PMO requestor PMO source

Case Study: Service Search

- User submits a query consisting of x keywords
- *Components:*
  - *PMO (requestor)*
  - Local CAS
- *Modules:*
  - *PMO request definition tool*
  - CAS request Handler
  - CAS Service Manager
  - CAS device repository
- Input:
  - Keyword vector
- Output:
  - Service ID list, PMO ID list

Assumptions

- Taxonomy tree is balanced
- Taxonomy tree is full
- Nodes of taxonomy contain short category descriptions (few keywords)
- Services belong only to leaf categories
- A service may belong to multiple categories
- Polysemy is defined as number of appearances
- Services are categorized by the owner

Memory requirements

- **Dictionary size:**

  $$K*(2*s_l + p_f * p_s) \text{ bytes}$$

  - s_l : average string length of keywords.
  - p_f : average polysemy factor of keywords.
  - p_s : pointer size in bytes.
  - Unicode char set

Memory requirements

- **Taxonomy Size:**

  $p_s * f * (N - f^{h-1})$ + (leaf node pointers)

  $2 * N * s_l * k_f$ + (node keywords)

  $KeySize_{category} * N * 2$ + (node keys)

  $S * m_f * p_s$ + (pointers to services)

  $(N-1) * p_s$ (pointers to parents)

f: tree fanout

k_f: avg keywords/node

N: Taxonomy nodes

m_f: multicategorization

Memory requirements

- **Service Array Size**

(KeySizePMO + KeySizeservice + NameSizeservice)*S*2

+ S* m_f * p_s (pointers to ontology)

Memory Requirements

- Assume:
  - KeySize = 36 characters (UDDI), $p_s=2$, $p_f = 4$, $f=10$, $s_l=7$, $k_f=2$, $m_f=2.5$

Mem = **22*K + 50*N + 226*S – 4** bytes

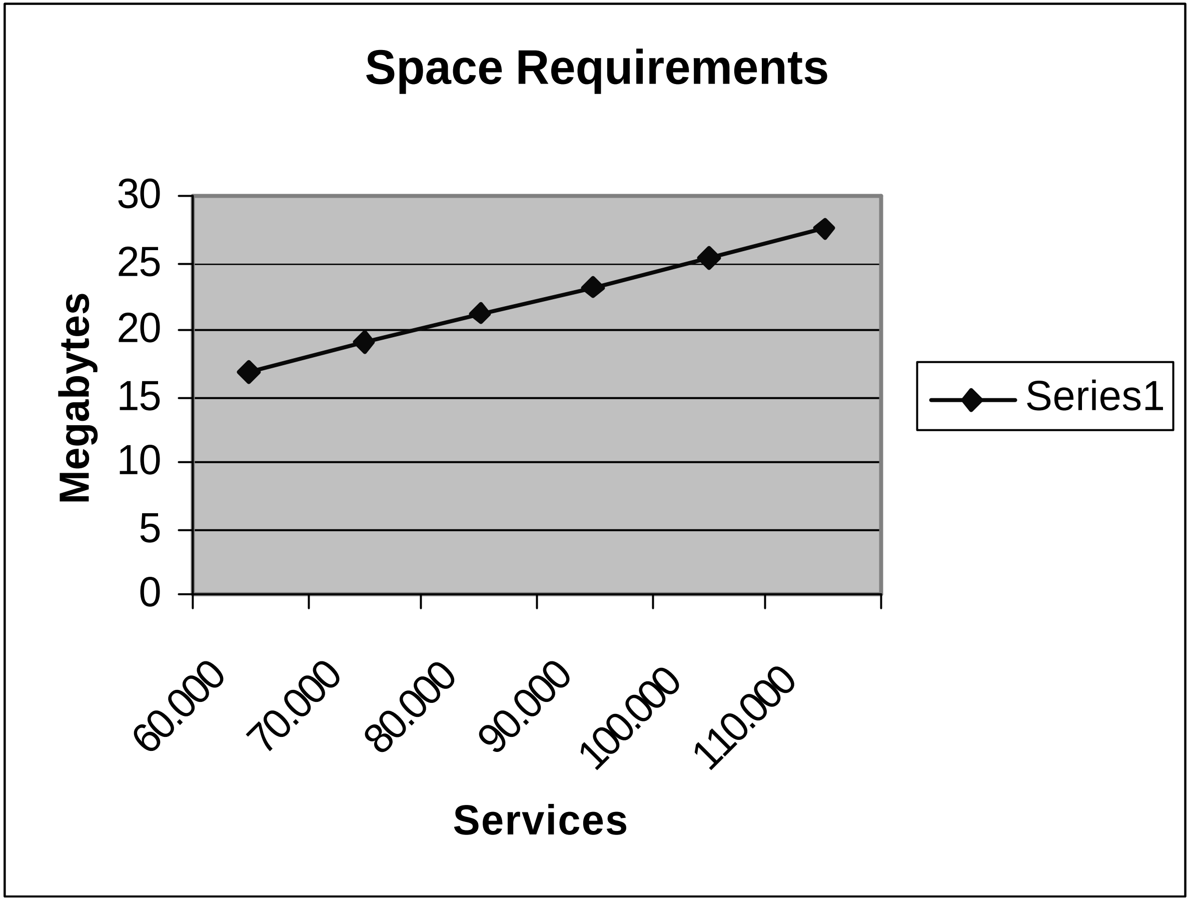
Linear to : no of

- keywords,
- taxonomy categories,
- services

Small CAS: O(n) – Ontology size

Large CAS: O(S) – Services population

Memory Requirements



f=9

h=6

N=66430

Complexity analysis

Service search consists of:

- Dictionary search
- Taxonomy search
- Service retrieval from catalog
- Duplicate service elimination

○ Dictionary Search

ë**log2K**û avg. mem. access (binary)

Complexity - Taxonomy Search I

- 1 keyword with 1 appearance at a hops from the leaves:

  $(f^a-1)/(f-1) + S^* m_f / f^{(h-1)-a}$

- Best Case, Leaf (a=0)

  S^*m_f/f^{h-1} iterations

- Worst Case, Root (a=h-1):

  $N + S^* m_f$

Complexity - Taxonomy Search II

- 1 keyword with m appearances :
  - m times the previous cost

(we cannot optimize because we do not traverse the whole tree to find appearances: we follow dictionary pointers)

Complexity - Taxonomy Search III

- x keywords with several appearances each
- x: small integer (x>1).

k_1, k_2, ... , k_x

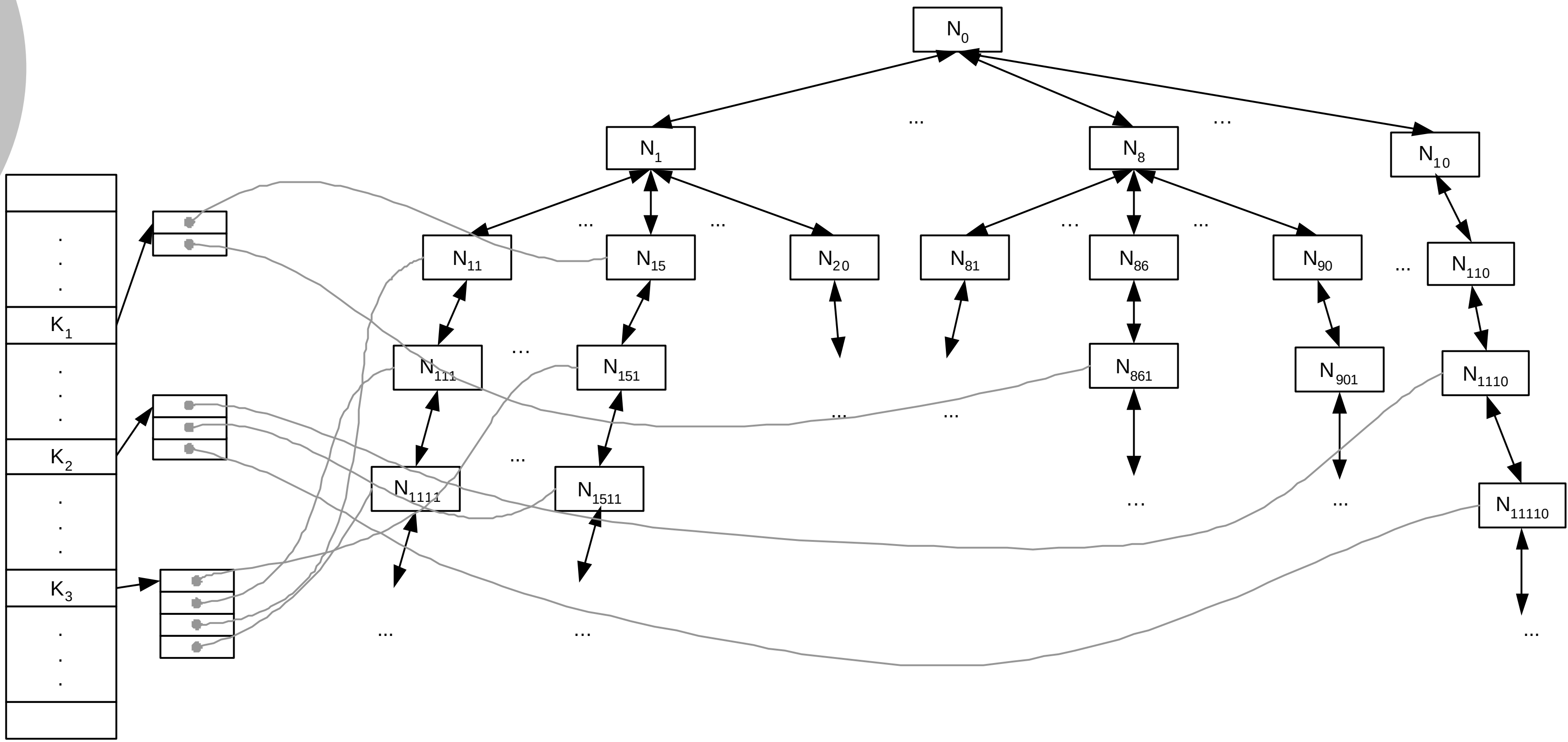
k1: {a1,...ai} , (i appearances)

k2: {b1,...bj},   (j appearances)

...

kx: {z1,...,zr}, (r appearances)

Complexity - Taxonomy Search IV



Complexity - Taxonomy Search VI

- **$(x-1)*p_f$**

comparisons / node traversal

- **1 -> h-1**

node traversals / appearance

- **p_f*x**

appearances / keyword

Best Case	Worst Case
All x keywords have 1 appearance each, close to the root	All x keywords have ki appearances, ki >>1, p_f=AVG(k_i)
x (x-1) comparisons	(p_f)2 * x * (x-1) * (h-1) comparisons
x node traversals	p_f*x*(h-1) node traversals

Service retrieval from catalog

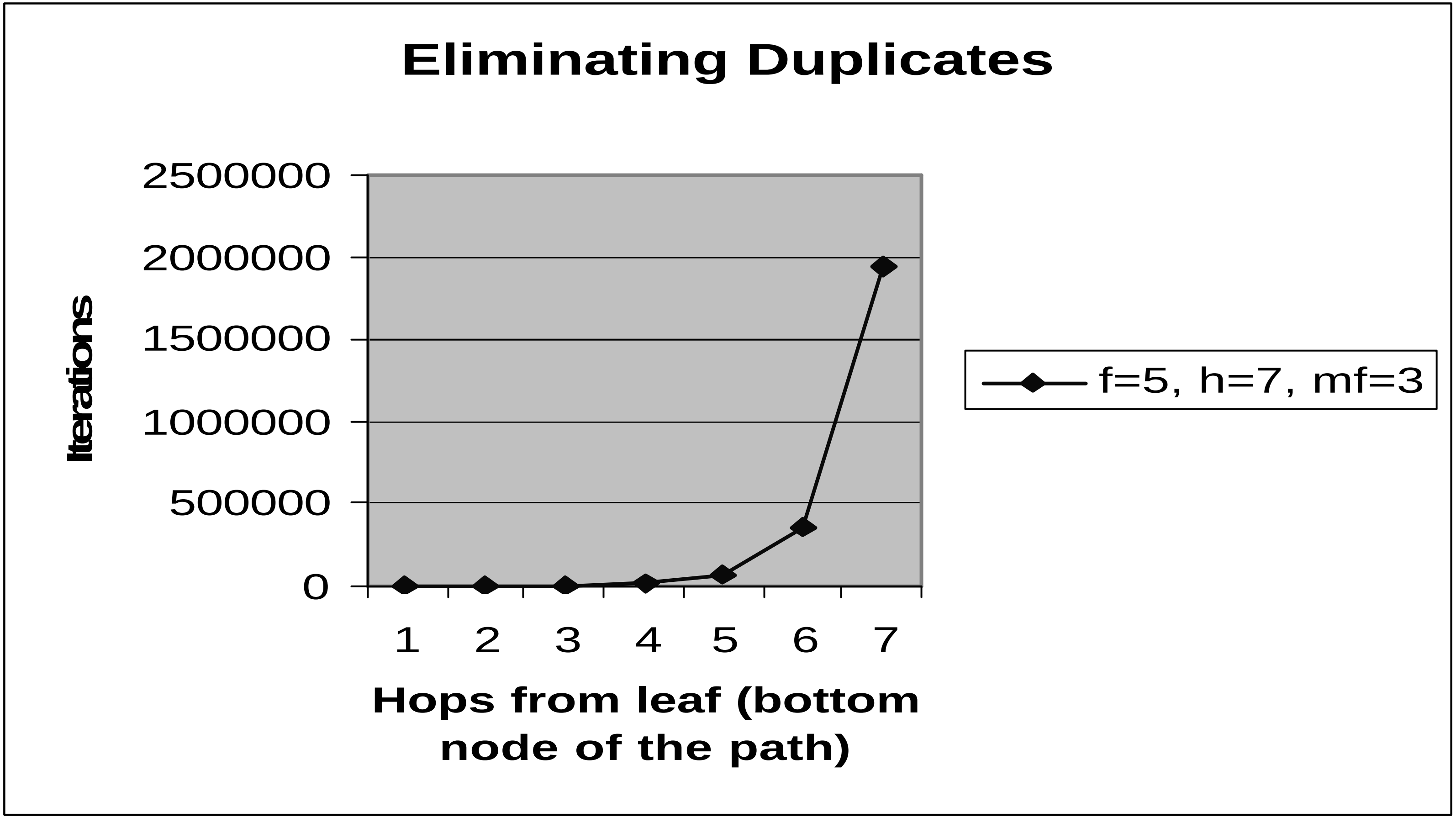
- Appearance paths usually end close to the leaves.

  $S*m_f/f^{h-1}$ services

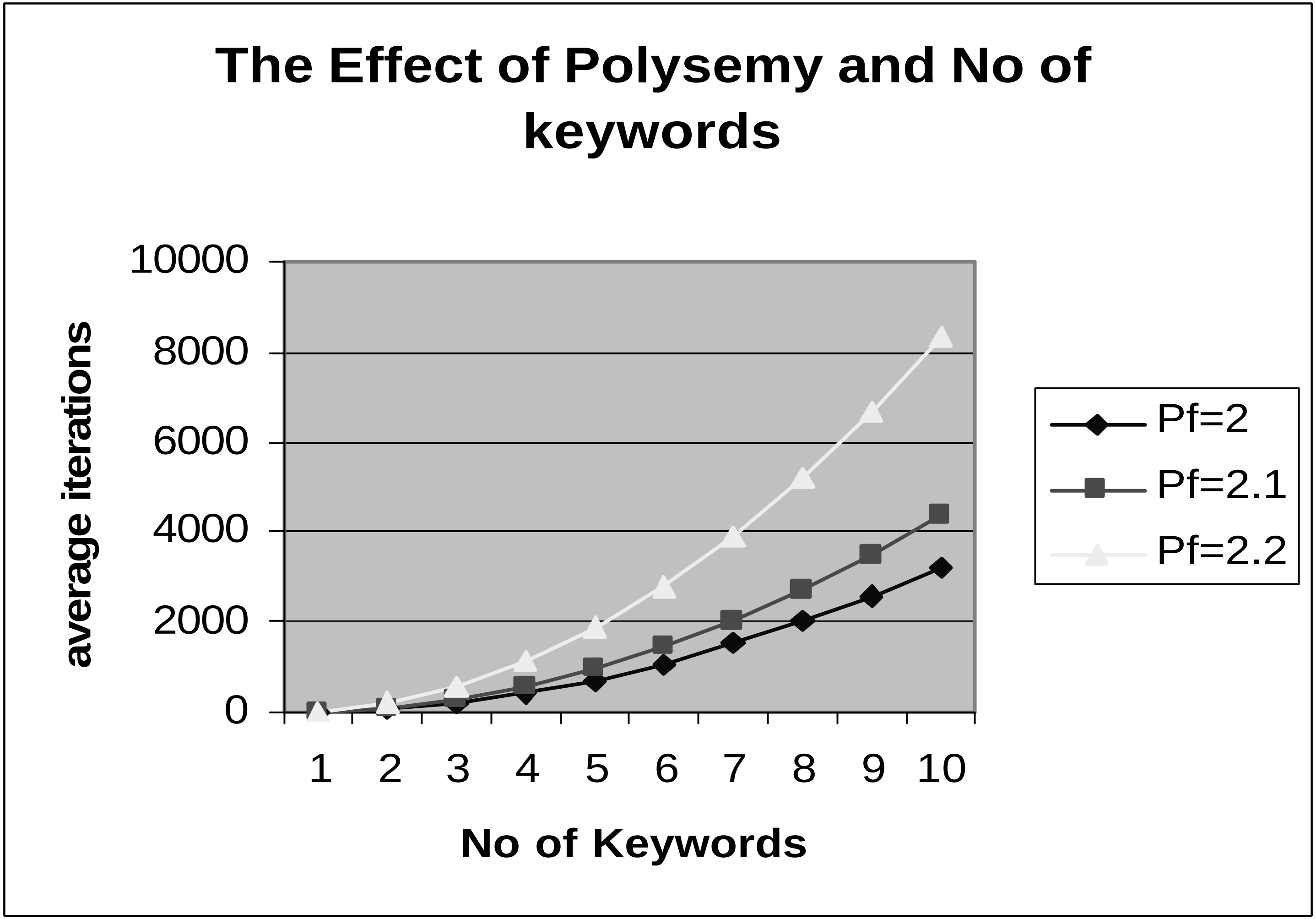
- Worst case: All keywords describe the root node:

  $S*m_f$ services

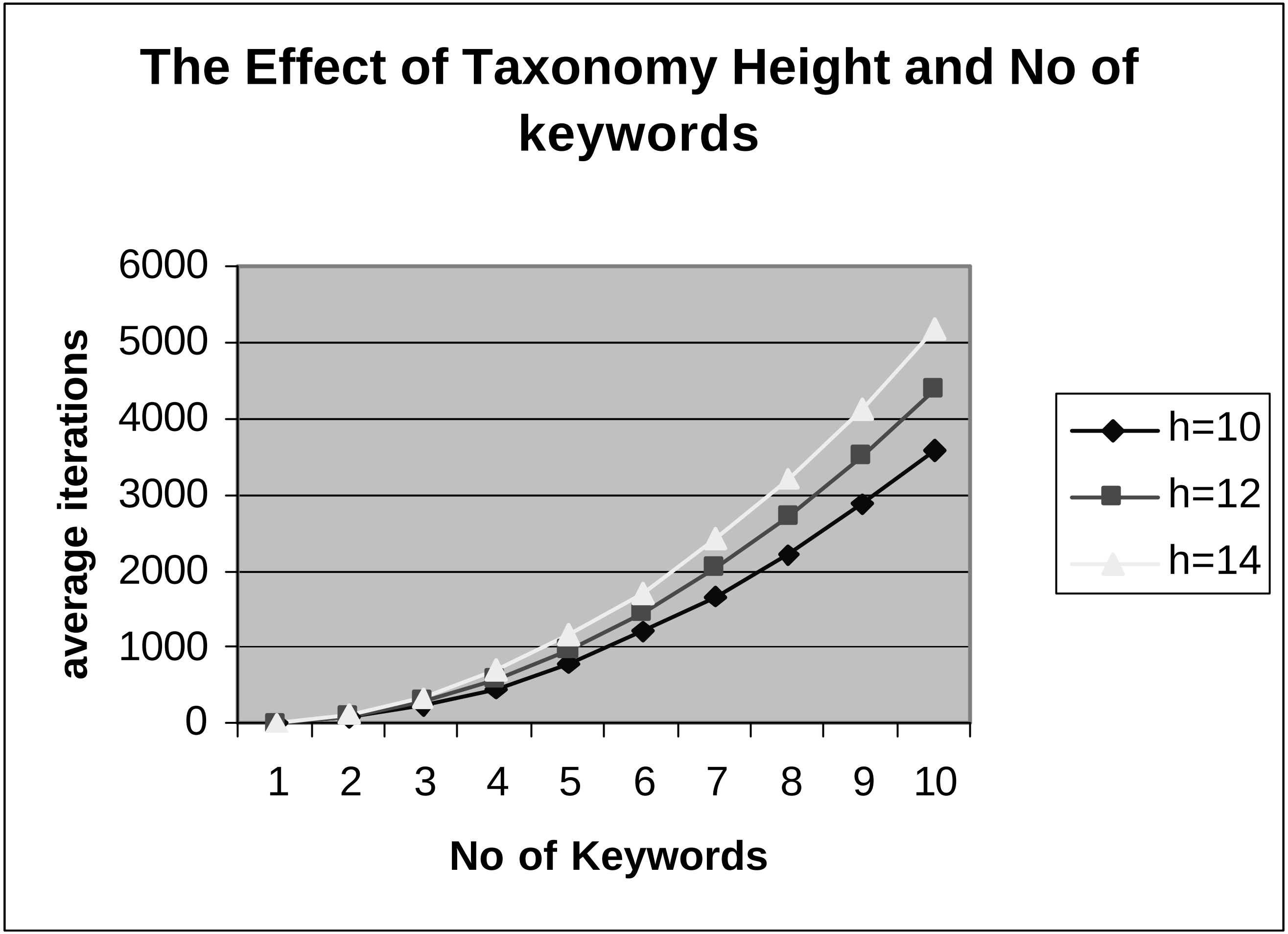
Eliminating Duplicates



Polysemy effect



Taxonomy Size



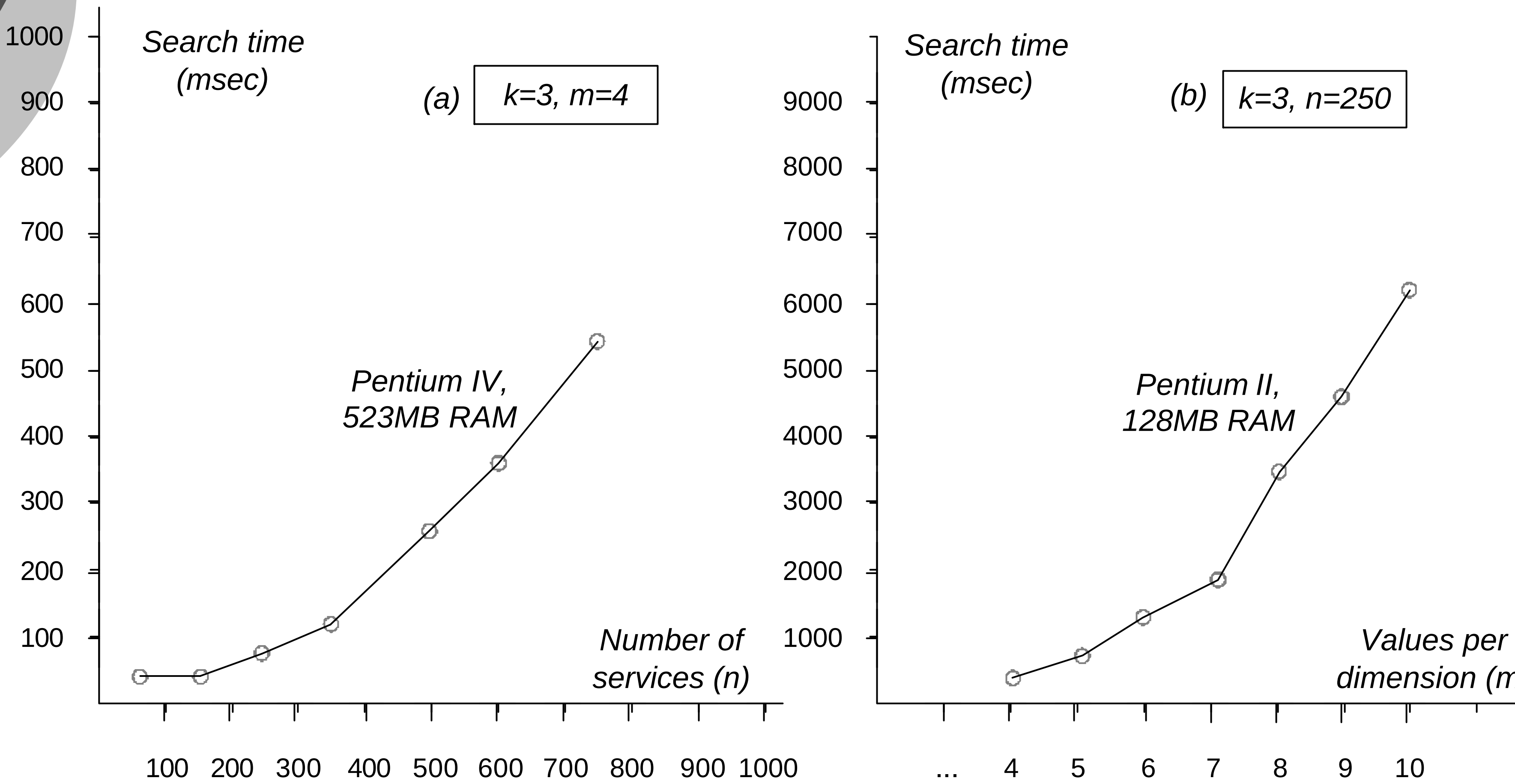
Context awareness - simulation

A context-aware service directory facilitates the process and increase the precision of service discovery

Types of context

- requesting device (device properties, characteristics, capabilities)
- Source PMO (location, time, version, type of returned results)

Context awareness – simulation II



Conclusions

Further Work

- Service discovery enhanced with semantic proximity
- Contribution to the design of the DB-globe prototype
- Integration of network, component interaction and context-matching simulation modules

Dissemination

- E. Valavanis, C. Ververidis, M. Vazirgiannis, G.C. Polyzos, K. Nørvåg, "MobiShare: Sharing Context-Dependent Data & Services from Mobile Sources", to appear at the 2003 **IEEE/WIC** International Conference on Web Intelligence WI 2003 October 13-17, 2003, Halifax, Canada.
- C. Doulkeridis, E.Valavanis and M.Vazirgiannis. Towards a Context-Aware Service Directory. Submitted in the 4th VLDB Workshop on Technologies for E-Services (TES'03).

DBGlobe Simulator Web Page

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THANK YOU