LiquidXML: distributed XML management in P2P

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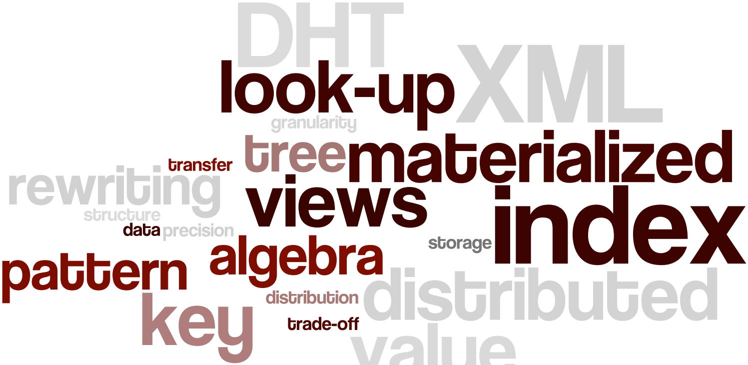
This talk at a glance



Background

1998-2001	PhD at INRIA Rocquencourt with Daniela Florescu: XQuery rewriting, XML materialized views
2002	PostDoc in Politecnico di Milano, Italy
2003-now	*Chargéee de Recherche* INRIA, Gemo group. Lots of research and teaching on (distributed) XML
2005-2006	W3C XQuery Working group (Update task force)

Distributed data management

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- massively parallel with map/reduce

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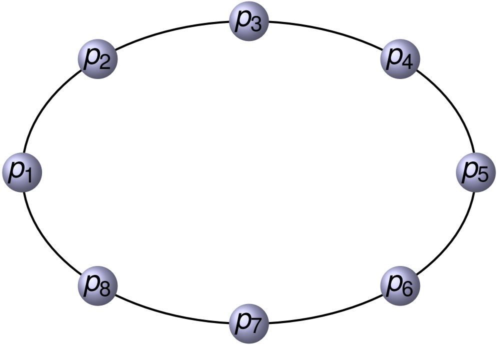
Still missing: the flexible federation

- high independence of the sites: when to be in, what to store
- data distribution transparency
- . . . with the usual performance requirements

Distributed hash tables



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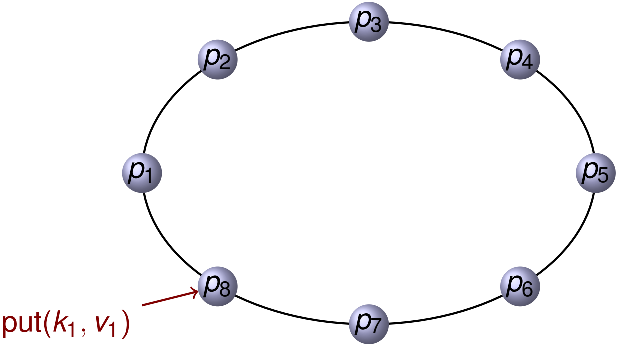

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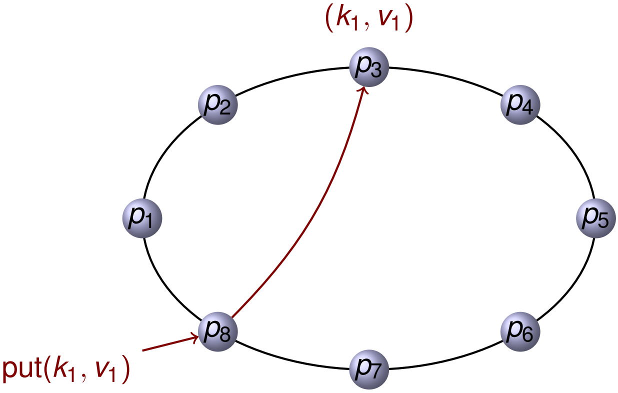

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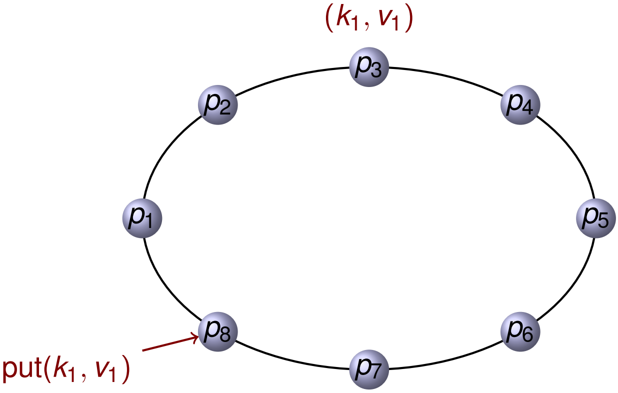

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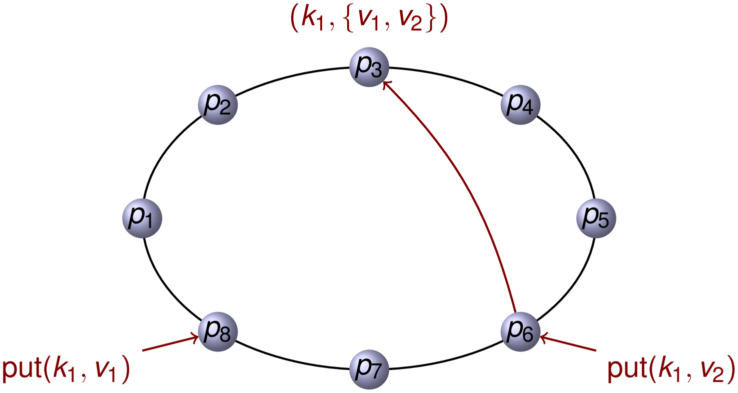

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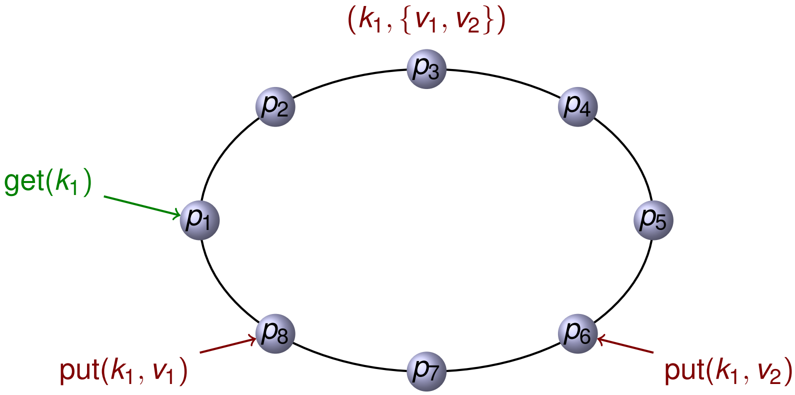

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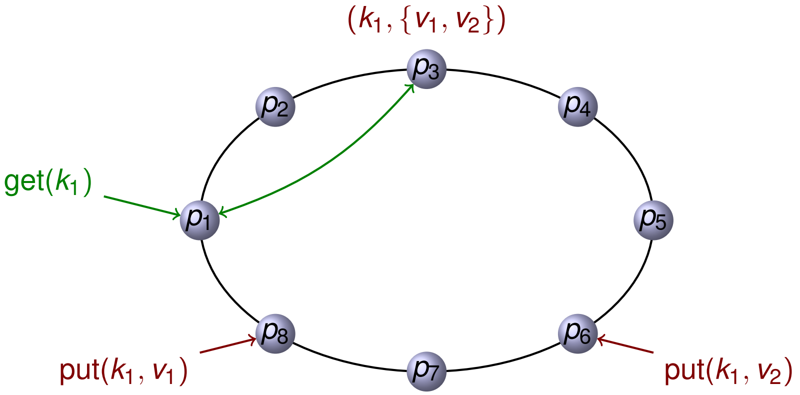

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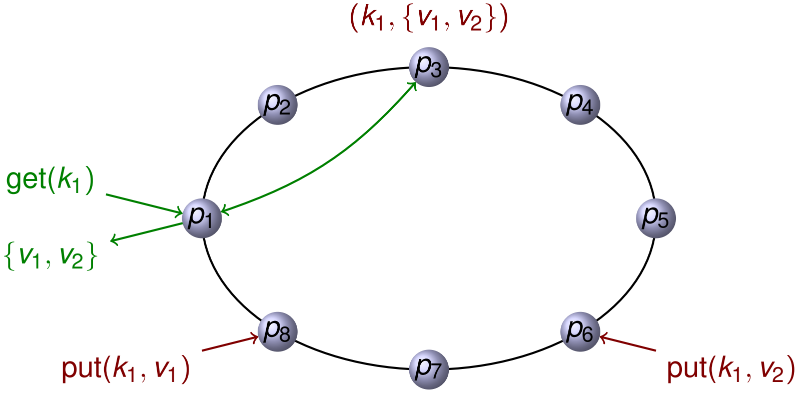

From DHTs to distributed data management

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- efficient message routing
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Stil need:

- data indexing algorithms
- storage for application data and even DHT index data
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- distributed query processing: operators, including data transfers, optimization . . .

Building XML stores on DHTs

- Peers retain control over the data they store/publish
  - no global schema
  - documents published independently
  - annotations, triples, links can freely connect content
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Systems

- XML indexing: KadoP [AMP05, AMP+08]

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Systems

- XML indexing: KadoP [AMP05, AMP+08]
- XML materialized views in P2P networks: ViP2P [MZ09] http://vip2p.saclay.inria.fr

ViP2P

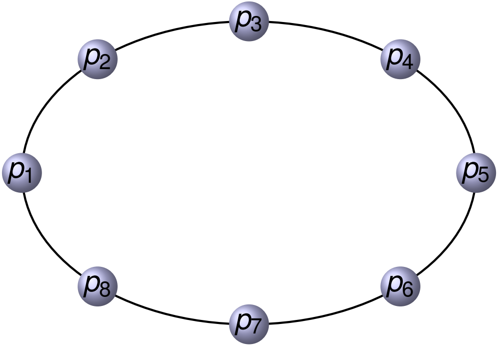
Functionalities

1. Re-distribute XML content to subscriber queries (XPath and more)
2. Answer snapshot queries based on the existing subscriptions

Joint work with:

S. Zoupanos, A. Tilea, K. Karanasos, J. Camacho-Rodriguez, A. Katsifodimos, S. Julean, J. Leblay

ViP2P: views in peer-to-peer



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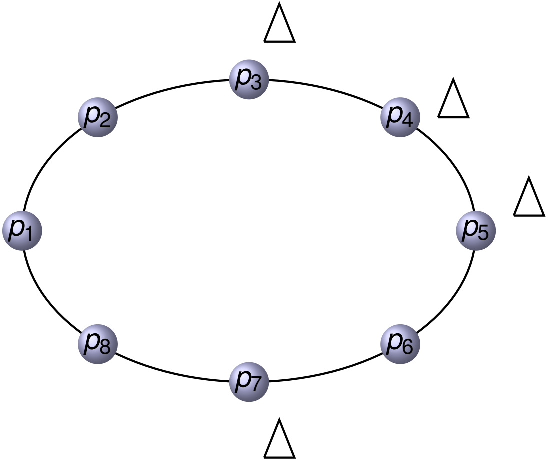

The peers may store:

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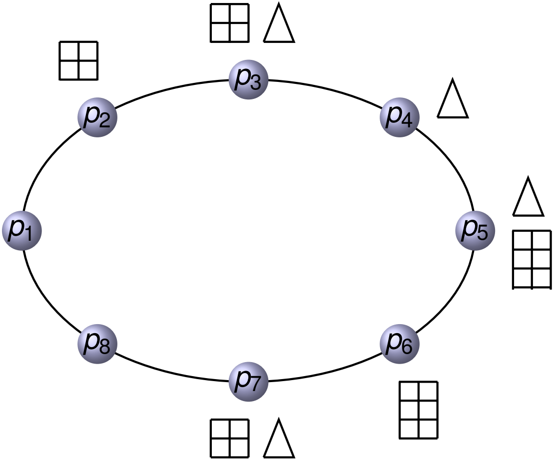

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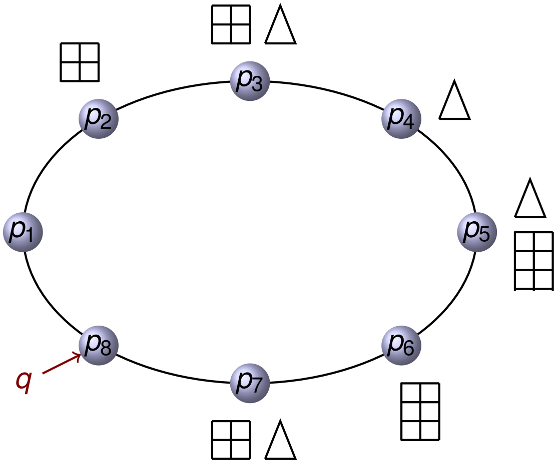
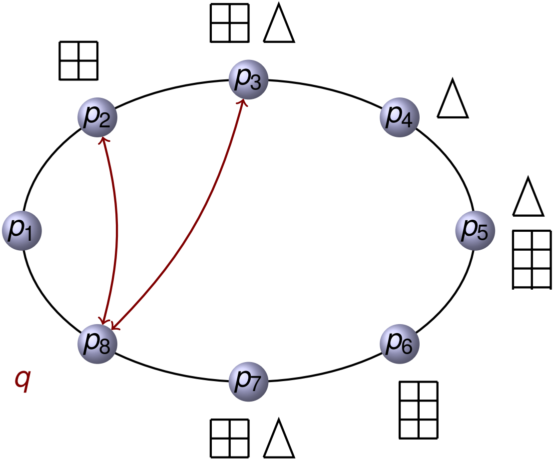


When q arrives:

ViP2P: views in peer-to-peer



When *q* arrives:

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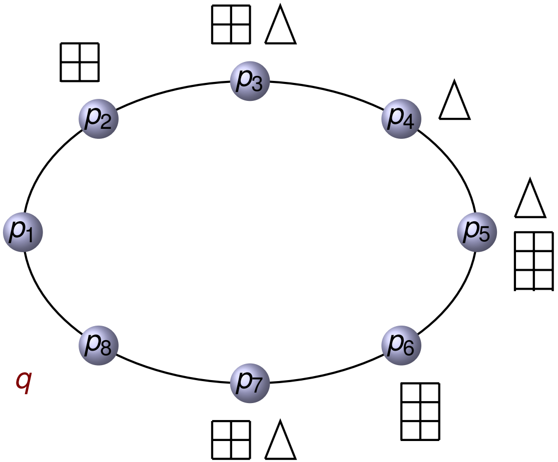

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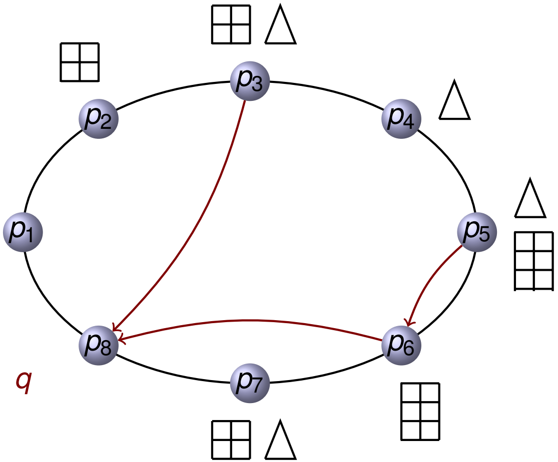
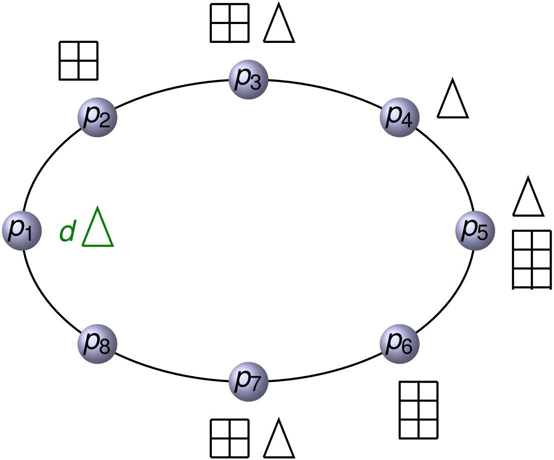


When q arrives:

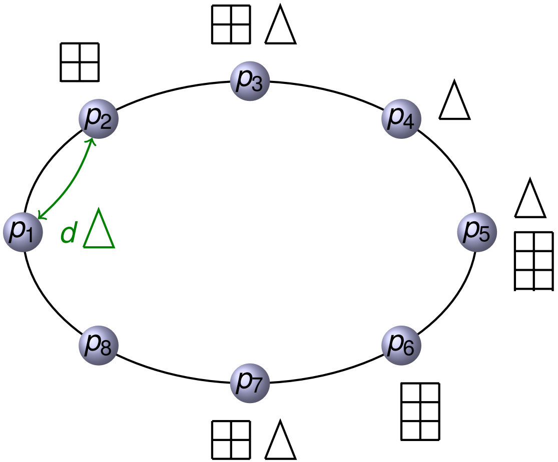
- view definition lookup
- rewriting
- execution of physical plan

ViP2P: views in peer-to-peer



When *d* arrives:

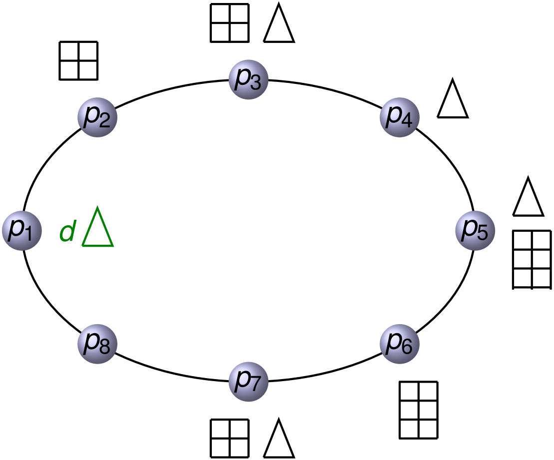
ViP2P: views in peer-to-peer



When *d* arrives:

- search view definitions for which $v_i(d) \neq \emptyset$

ViP2P: views in peer-to-peer



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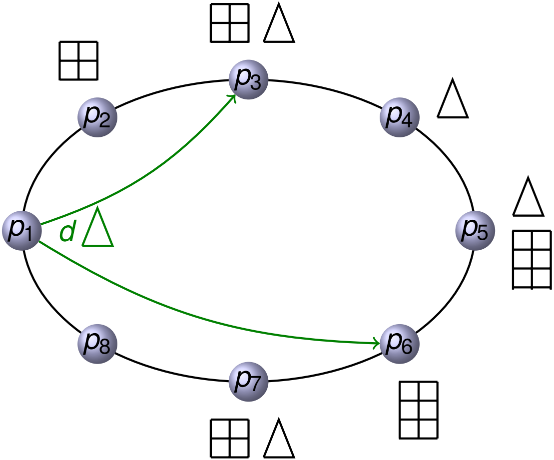

When d arrives:

- search view definitions for which $v_i(d) \neq \emptyset$
- compute $v_i(d)$
- send results

View and query language

Tree pattern language extending XPath

1. Parent-child and ancestor-descendant axis
2. Nodes: element, attribute, word in text
3. From each node, one may store:
   - full image (content)
   - text value
   - identifier

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More features (nesting and optionality) get closer to XQuery

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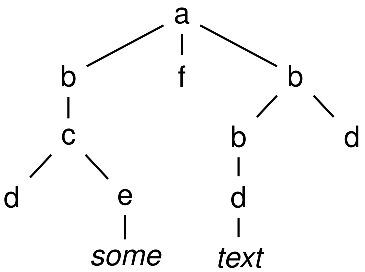
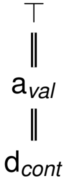
Tree pattern = the data needs of a query

Sample view (1)

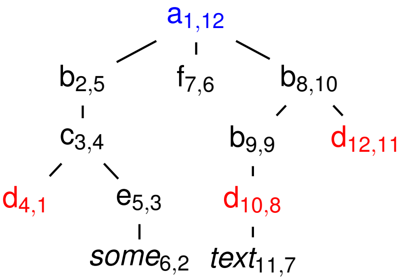


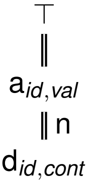


for $x in //b,
$z in $x//d
return $x/text(), $y

a_{val}	d_{cont}
some text	⟨d/⟩
some text	⟨d⟩text⟨/d⟩
some text	⟨d/⟩

Sample view (2)





<table>
<tr><th>a_{id}</th><th>a_{val}</th><th></th></tr>
<tr><td>1,12</td><td>some text</td><td>
<table>
<tr><th>d_{id}</th><th>d_{cont}</th></tr>
<tr><td>4,1</td><td>⟨d/⟩</td></tr>
<tr><td>10,8</td><td>⟨d⟩text⟨/d⟩</td></tr>
<tr><td>12,11</td><td>⟨d/⟩</td></tr>
</table>
</td></tr>
</table>

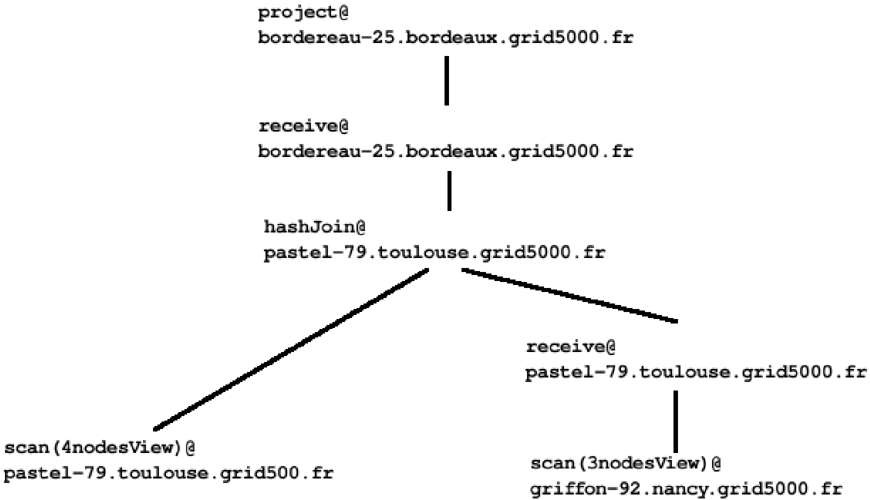
View-based rewriting

1. Rewrite $//a//b_{cont}$ using $//a_{cont}$
2. Rewrite $//a[//c/d[e = 5]/f]$ using $//a_{cont}$
3. Rewrite $//a[//b]//c_{cont}$ using $//a_{id}[//b]$ and $//a_{id}//c_{cont}$
4. Rewrite $//a[//b]//c_{cont}$ using $//a_{id}[//b]$ and $//c_{id,cont}$

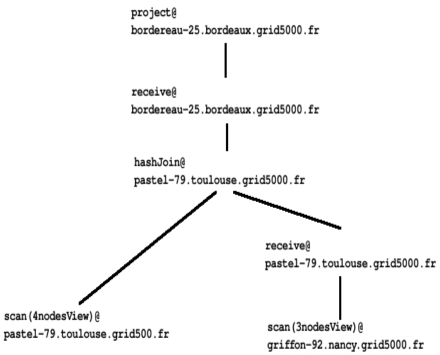
ViP2P platform

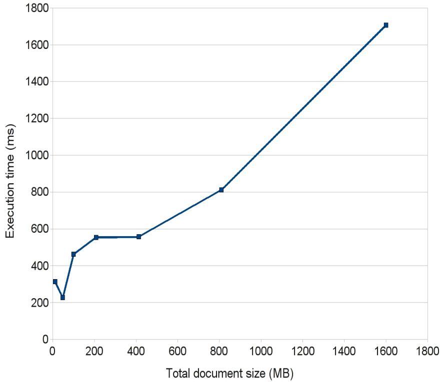
- Fully implemented using Java 6
- Used Berkeley DB (version 3.3.75) to store view data
- Used FreePastry (version 2.1) as our DHT network
- Experiments carried on *Grid5000* using **250 machines**
- **1000 ViP2P peers** were deployed [MZ09]

Query execution: sample plan



Query execution





Related works

Distributed data management [ÖV99, Kos00]

XPath query rewriting [BOB+04, XO05, CDO08, TYÖ+08]

- XPath: wildcard *, union
- Rewritings: intersection, navigations, joins

DHT-based relational data management [LHSH04, HRVM08, APV07]

DHT-based XML indexing [GWJD03, BC06, SHA05, AMP+08]

DHT-based shared XML caches [LP08]

Layered architecture for Web content warehousing [AAC+08]

RDF querying and reasoning on DHT [KMK08, LIK06]

Perspectives

1. Views and queries over annotated documents (K. Karanasos, J. Camacho-Rodriguez)
    - Subscription language for XML with annotations
    - New algorithms for evaluating subscriptions, for rewriting queries
2. Self-adaptive views (A. Katsifodimos)
    - Automatically determining subscriptions/views for the local and global interest
    - Views: selfish, compulsory, collaborative
    - Cost model for adaptation

[AAC+08] Serge Abiteboul, Tristan Allard, Philippe Chatalic, Georges Gardarin, A. Ghitescu, François Goasdoué, Ioana Manolescu, Benjamin Nguyen, M. Ouazara, A. Somani, Nicolas Travers, Gabriel Vasile, and Spyros Zoupanos.
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[AMP+08] Serge Abiteboul, Ioana Manolescu, Neoklis Polyzotis, Nicoleta Preda, and Chong Sun.
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[APV07] Reza Akbarinia, Esther Pacitti, and Patrick Valduriez.
Data currency in replicated DHTs.

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[BC06] Angela Bonifati and Alfredo Cuzzocrea.
Storing and retrieving XPath fragments in structured P2P networks.
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[BOB+04] A. Balmin, F. Ozcan, K. Beyer, R. Cochrane, and H. Pirahesh.
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XPath rewriting using multiple views: Achieving completeness and efficiency.
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[GWJD03] L. Galanis, Y. Wang, S.R. Jeffery, and D.J. DeWitt.
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[LIK06] Erietta Liarou, Stratos Idreos, and Manolis Koubarakis.
Evaluating conjunctive triple pattern queries over large structured overlay networks.
In *International Semantic Web Conference*, pages 399–413, 2006.

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