CS856

HyperQueries: Dynamic Distributed Query Processing on the Internet

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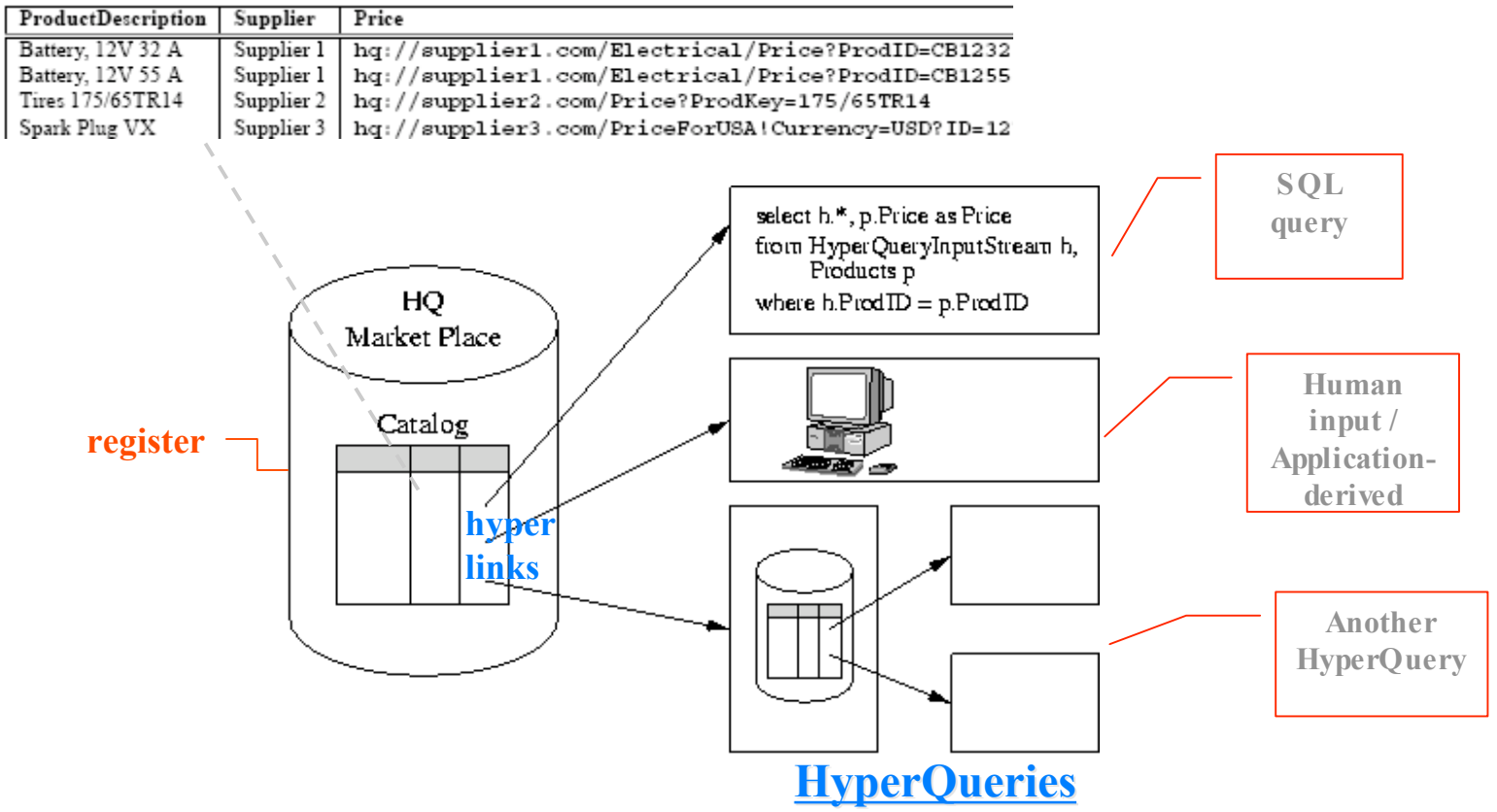
Introduction

- Context: Building an open market place on the internet (for data providers and clients)
- Aim: Providing a data integration and distributed query processing capabilities
- Requirements:
  - Keeping local sites autonomous and heterogeneous
  - Controlled access to site's sensitive data
  - Scalable to large number of sites
- Approaches:
  - Mediator-based: Integrated schema of the data on the mediator, and sub-query executer and wrappers on each data source
  - ..

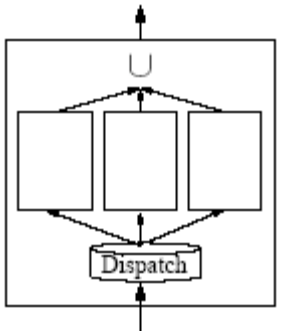
QueryFlow

- Market place host act as a mediator; contains integrated schema tables (e.g. Product catalog table), and provides registration services
- Each provider register their data to a virtual table, and defines hyperlinks for virtual attributes (and provide associated HyperQuery)

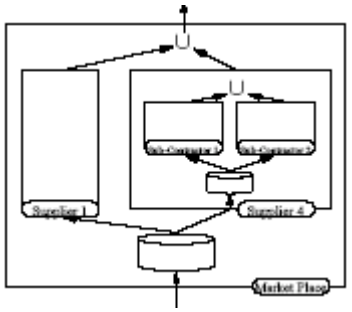


HyperQuery Processing

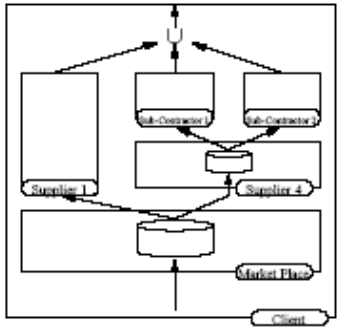
- Simplified algorithm:
  - For each tuple of the virtual table being processed (Dispatch operator)
    - Process the hyperlink in the virtual attribute (s), and push the object-specific parameters, and input objects to the remote site that the hyperlink points to
    - Input object and object-specific parameter is evaluated by the query sub-plan (HyperQuery) on remote site , and output object is sent back to the market place (or surrounding sub-plan)
    - The sub-plan is instantiated once for the same URI (with different parms)
  - Merge all the result objects and return back to the user (Union operator)
- One-level (simple) or multi-level queries



One-level



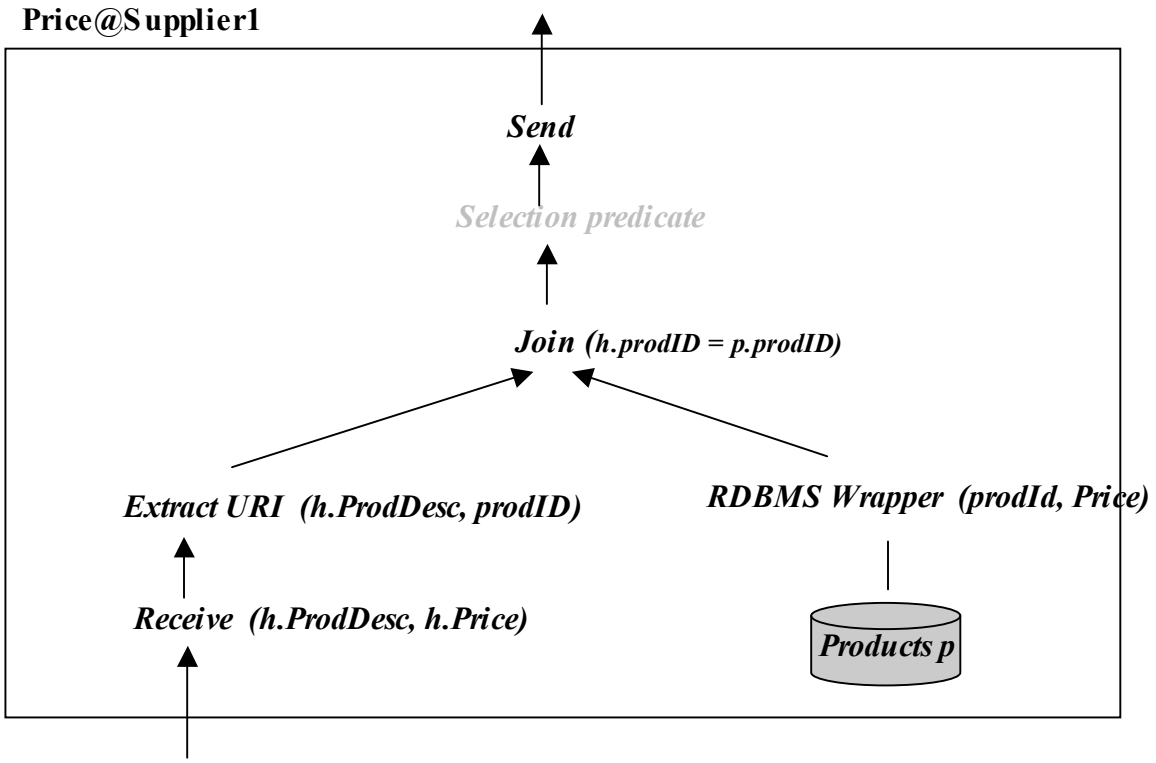
multi-level hierarchical



multi-level broadcasting

HyperQuery Processing

- On remote site (SQL query example):



The operators such as join, selection are built-in operator implementation of the ObjectGlobe.

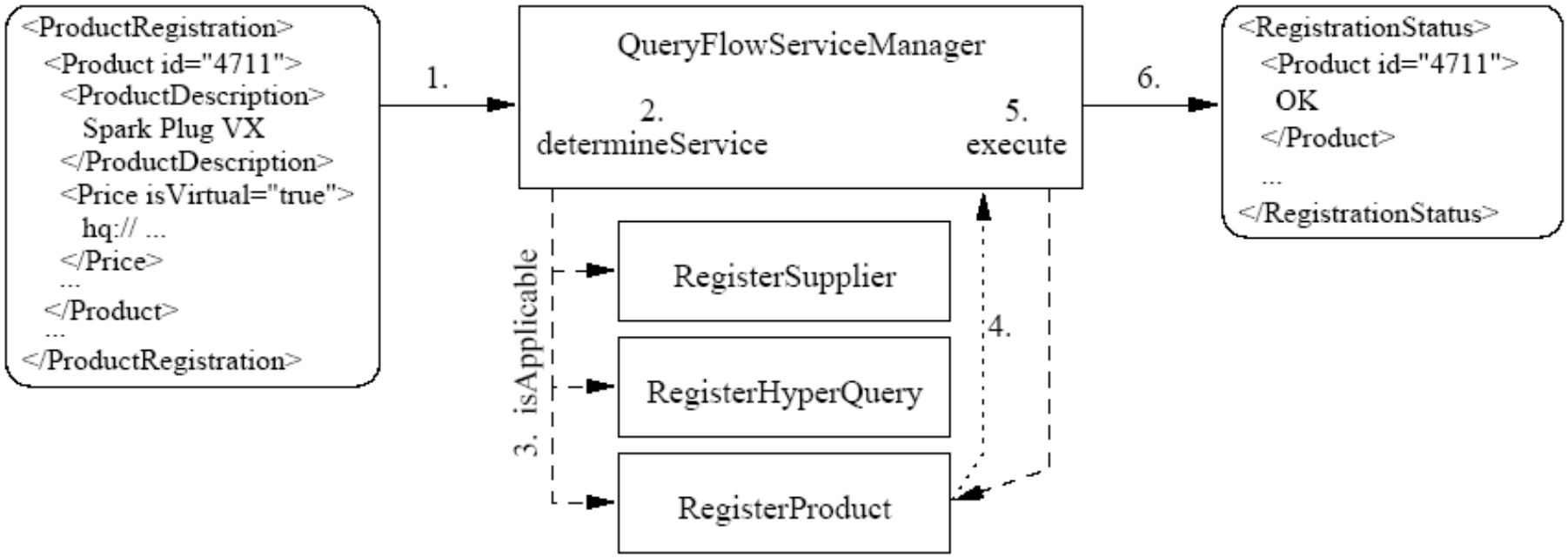
More details on QueryFlow

- Implementation specific optimization in order to reduce the amount of data transferred on network
  - Push selection predicates into the sub-plans on remote host
  - Avoid passing attributes that are not involved in the subplan to remote host
  - Use cache to avoid processing of the same virtual attribute (at least in intra-query) due to duplicates

- Additional attributes (that are not requested by the user) can be returned from sub-plans using a container attribute (initially specified by the schema on the mediator)

Registration

- A new service should be easily integrated into the system, and clients and providers should be able to access them without effort
  - E.g. Registration of new suppliers, products and HyperQueries



Other Systems (ObjectGlobe, Mariposa)

Running example: searching for the specific car part's details (material, price)

- **QbjectGlobe**:
  - Each supplier associate their corresponding that data source with the theme of car parts (with a set of predefined attributes), and register the attributes
  - Each data source has to be (as long as quality parameters are not violated) queried to see if a requested part is provided by this supplier

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  - The query processing enforce the user's quality constraints (time, charge, cardinality data) and adapts accordingly
  - Employ different query capabilities of different sites (not only data) for better query execution plan (e.g. performing a join of two themes on cycle provider that is physically close to the data providers, rather than shipping each scanned data back to client to perform this join operation)

Note: Query processing capabilities of the QueryFlow system are based on the *ObjectGlobe*

Mariposa query processing

- Data layout: horizontally partitioned table fragments, and replicas
- 3-modules: clients, middleware, local site manager.
- Each participant site can join the system by advertising it services and bidding on queries
- Client submits query with a required budget (how much the user is willing to pay for the query execution within *t* timeframe, whether a user is willing to sacrifice performance for a lower charge)
- Parser finds the metadata (e.g. location of each fragment) from the name server for each table requested in the FROM clause of query
- Query processing/optimization:
  - (1st phase): Generate a single-site query plan (ignores data distribution, assumes all fragments are located on a single site)
  - (2nd phase): Decompose the single query plan into fragmented query plan: decompose each referenced table node into subqueries (one per fragment), and joins are into join subquery for each pair of fragment join
  - Sends out bid request to sites that might be interested
  - Each bidder (local site) returns (Cost,Delay,Expiration)
  - Middleware accepts bids, constructs a final plan, and informs local sites of their jobs

- Sites (storage manager) can buy and sell fragments based on the estimated revenue from the fragments

Comparison

- Mariposa
  - Each supplier only register that their horizontal fragmentation for the car part table
  - Depending fragmentation criteria and user query, some of the fragment providers may not be required to be involved in the query execution plan

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  - Objective is to construct a query plan within user's cost/$ and time budget
  - De-centralized / point-to-point decision-making to find a optimized global query plan

- QueryFlow:
  - Each car parts supplier register its product (e.g. product name) & hyperlinks for attributes (virtual attribute) that should be obtained from the supplier itself each time the query is issued
  - Only the suppliers that have product name matching with the user query would be contacted to find the actual value for the other attributes

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  - The cost (time, price, ..) of the query is not considered
  - Does not deal with limited/different query capabilities of sites
  - Seem to be applicable to specific type of application (e.g. supply-chain)

References

- The URL for ObjectFlow project:
  http://www-db.in.tum.de/research/projects/OG/OnlineDemo/queryflow.shtml

- **HyperQueries: Dynamic Distributed Query Processing on the Internet**, Alfons Kemper and Christian Wiesner, Internal Technical Report, University of Passau, October 2001.

- **QUEL as a Data Type.** M. Stonebraker, E. Anderson, E. Hanson, and B. Rubenstein. In Proc. of the ACM SIGMOD Conf. on Management of Data, 1984.

- **Mariposa: A Wide-Area Distributed Database System**. M. Stonebraker, P. Aoki, W. Litwin, A. Pfeffer, A. Sah, J. Sidell, C. Staelin, and A. Yu. In the VLDB Journal 1996.

- An overview of Mariposa system:
  http://redbook.cs.berkeley.edu/redbook3/mariposa.html

Comments