Towards an Internet-Scale XML Dissemination Service

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Outline
- Introduction
- System Model
- Core Techniques
- Broker Architecture
- Conclusion

Motivation
- Publish/subscribe systems
  - Content-based data dissemination services
- Selective dissemination of XML data
  - Richer functionality of transformation for result customization
  - More precise filtering – structure and value
Challenges

- Challenge of deploying such XML-based services on an Internet-scale
  - New techniques for XML-based content-driven routing
  - XML transformation
  - Profile partitioning problem
  - Efficient XML transmission

Contributions

- ONYX – Operator Network using YFilter for XML dissemination
  - A large-scale system based on an overlay network
  - Leverage the YFilter processor for content-driven routing
  - Incremental message transformation
  - Partitioning algorithm for profile population
  - Holistic message processing
  - Various formats for efficient XML transmission
  - An architecture design

Problem Space

- Expressiveness
- Scalability
  - Data volume
  - Query population
  - Frequency of query updates
  - Result volume

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System Model

- A overlay network of nodes
- Information brokers or registration service providers

Service Interface

- Register a data source
  1. Data source contacts registration service
  2. Service forwards source information to root broker
  3. Service returns source ID and address of root broker
- Publish data
  4. Source pushes data with ID attached to root broker

Service Interface

- Register a data interest
  5. User contacts registration service
  6. Service forwards user information to host broker
  7. Service returns profile ID and address of host broker
- Update a data interest
  8. Sent directly from user to host broker
- Retrieve data
  9. Messages are pushed to users from the system

Content-based processing

- Control plane
- Content-based processing plane
  - Data plane
  - Query plane
- Three tasks
  - Content-driven routing
  - Incremental transformation
  - User query processing
Two planes of Content-based processing

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YFilter Basics

- YFilter is an XML filtering and transformation engine
  - NFA – Nondeterministic Finite Automaton
  - A network of operators

Query Plane

- Routing table construction
  - Routing query – DNF of absolute linear path expressions
  - Construction operations
    - Map()
    - Collect()
    - Aggregate()
  - Sharing among routing queries – combined operator network
  - Content generation – size of routing tables
Query Plane

- Generation of incremental transformation plans
  - Early projection
  - Early restructuring
  - Incremental transformation queries – attach to output link
  - Propagate to parent brokers
  - Remainder queries – output links

Data Plane

- Holistic Message Processing
  - Execution algorithm – an extension of the YFilter
  - Network of operators
  - Multiple types of queries
  - Dependency-aware priority scheduling
    - Assign priorities according to contributions

Data Plane

- Efficient XML transmission
  - Challenges and solutions
    - Redundant bytes in messages
      - Compression
    - Expensive parsing at each broker
      - Element stream format
      - Schema-aware representation of XML
  - Six XML transmission formats:
    - Text, binary, binary with dictionary encoding, and their corresponding compressed versions

Data Plane

- Performance analysis
Query Population Partitioning

Properties of query partitioning
- Similarity - not effective in filtering
- Dissimilarity – not effective either
- Mutual exclusiveness - desired

A set of exclusiveness patterns should be used.

Partitioning based on exclusiveness patterns (PEP)
- Identifying a set of exclusiveness patterns
  - Search, aggregate, greedy algorithm
- Partition creation
  - M patterns – K query partitions

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Broker Architecture
- Packet listener
- Catalog manager
- Message pre-processor
- Query pre-processor
- Control plane
- Data plane
- Query plane
- YFilter processor
- Message and query prost-processor
- Packet sender
Conclusion

- Challenges
- ONYX – initial design
- Detailed architectural design
- Future work
  - Alternative forms of routing query representation
  - Schema for optimization in routing table construction
  - Multi-source routing
  - Networking issues of PEP and distributed protocols for PEP

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Questions?