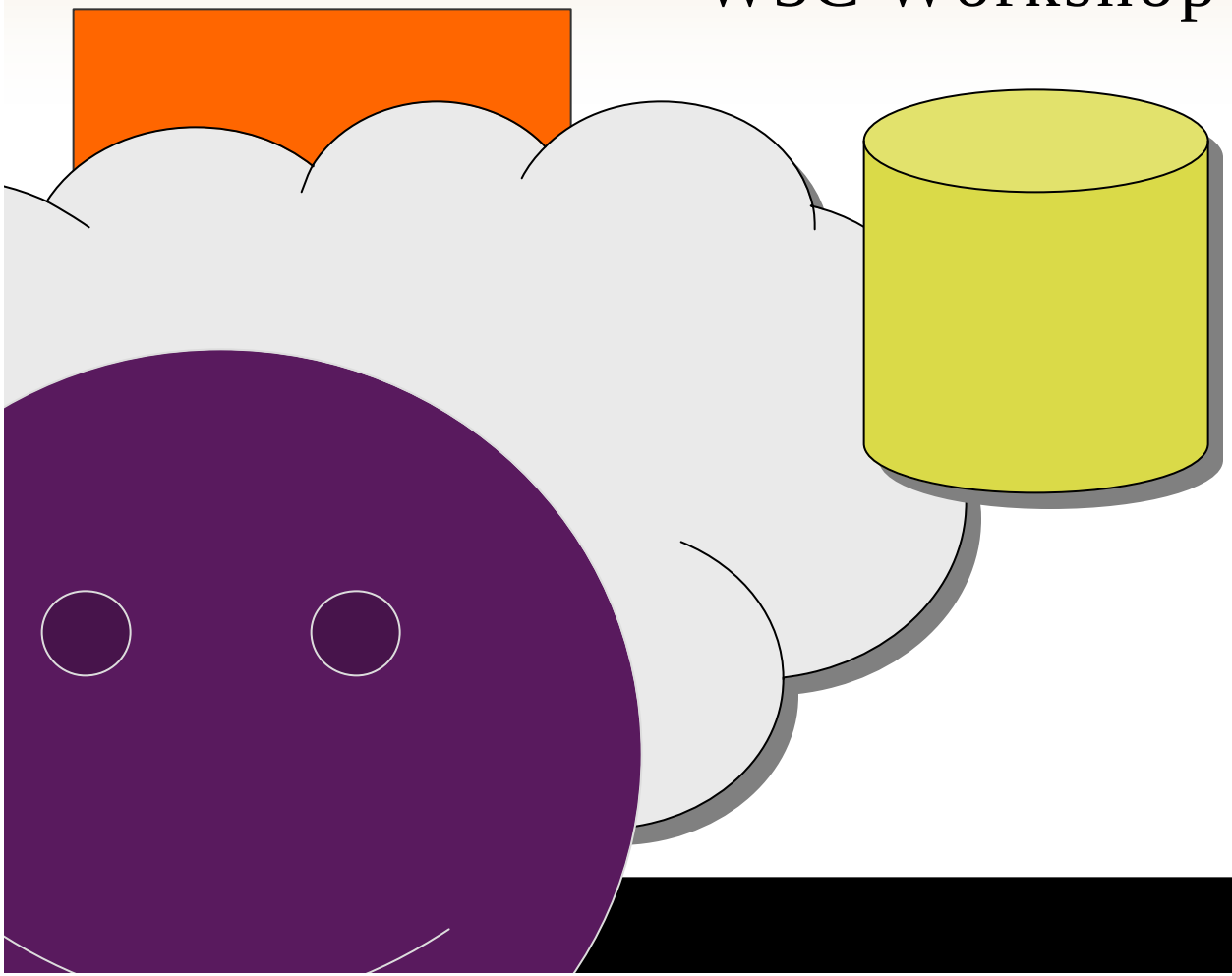
Scaling Web Services

W3C Workshop on Web Services



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Motivation

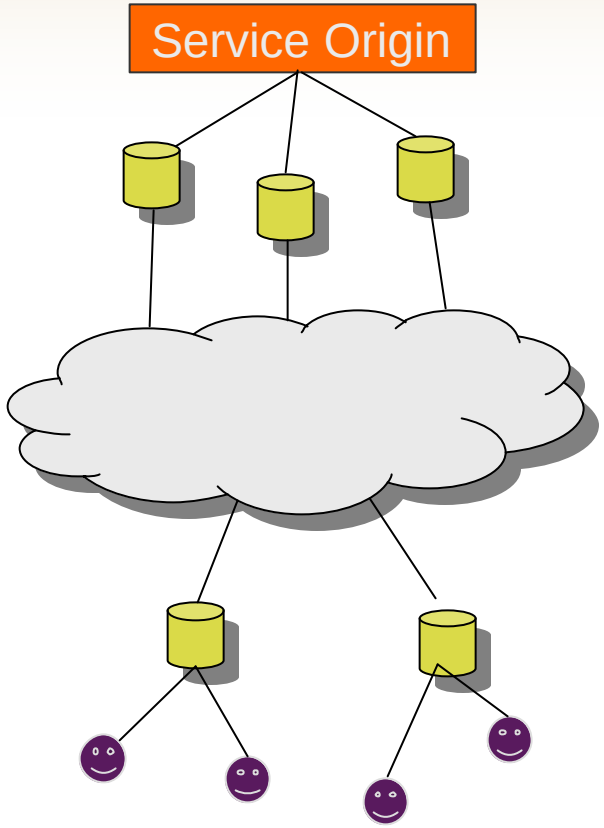
Web Services need:

- **Scalability**: handling increased load, while managing investment in providing service
- **Reliability**: high availability
- **Performance**: end-user perceived latency

- Problems (and solutions) similar to those in scaling the Web infrastructure in general.

Intermediary Solutions

- Intermediaries can address these needs by making a service available from a number of devices.
- They can be deployed on behalf of the client (proxy) or server (surrogate/CDN).
- We classify intermediaries into two broad categories: *functional* and *optimizing*.



Functional Intermediaries

- Make services available by taking responsibility for (parts of) them.
- Typically, functional solutions execute service-specific code (and need to distribute and manage it).
- If removed, service cannot be provided, because it performs meaningful processing on messages.

Optimizing Intermediaries

- Enhance service by exploiting certain aspects of services' semantics, to:
  - Eliminate or delay connections to the origin server
  - Reduce the number of bytes sent to or from the origin server
- Removing from the message path has no effect, except to reduce scalability, performance and reliability.

Why Optimizing Intermediaries?

- Generally, it is easier to retrofit optimization onto existing services.
- Potential to support a wide range of applications, while avoiding code deployment and management issues.
- Optimizing isn't for every service!
- Functional intermediaries are useful when optimization isn't powerful or flexible enough.

Use Case: getStockQuote()

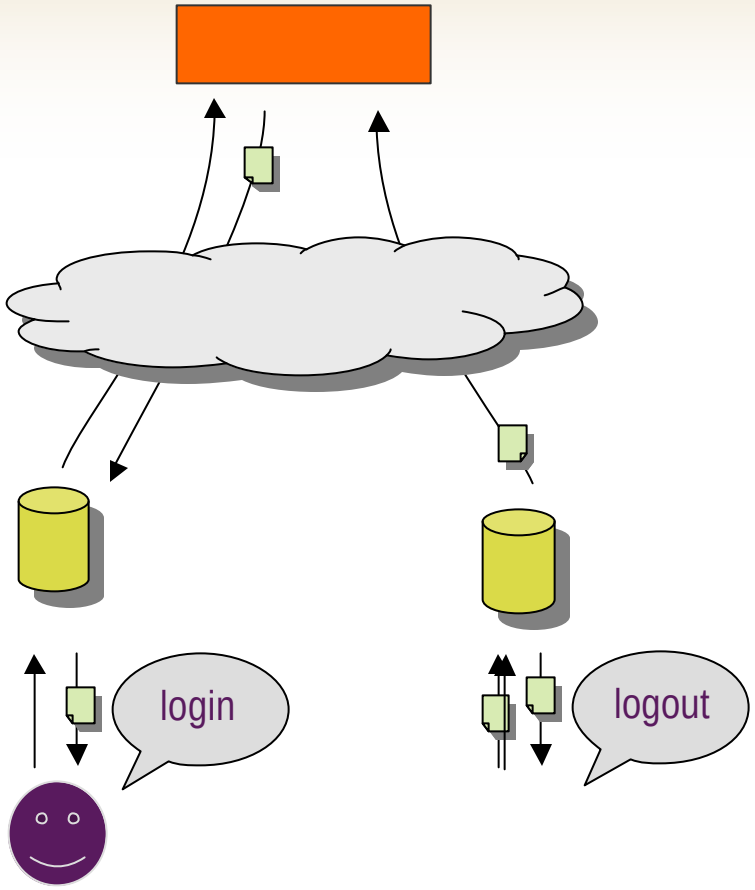
- Information services (stock quotes, RSS, etc.) can exploit request locality and reuse response components
- Different components have different triggers:
  - Delayed stock price – cache for 5 minute delta
  - Last close – invalidate at 5am daily
  - Company information – update upon notification

Use Case: Authentication Service

- Optimized by caching state in distributed intermediaries
- Request locality should keep cached state near users
- Updates can be triggered by other messages (new password), notifications, and/or incorrect passwords
- Accounting takes place through traditional logging, or aggregated store-and-forward.

Use Case: Distributed File Store

- Users interact with a local intermediary, writing to and reading from the cache. Events such as ‘logout’ synchronize the cache to a master server.



Proposed Optimization Model

1. Optimization hints about a service are made available to an intermediary.
2. Intermediaries process messages and apply optimization techniques based on the hints.
3. Techniques may be applied to XML elements at a fine granularity, and are triggered by a variety of events.

Applying Optimization Techniques

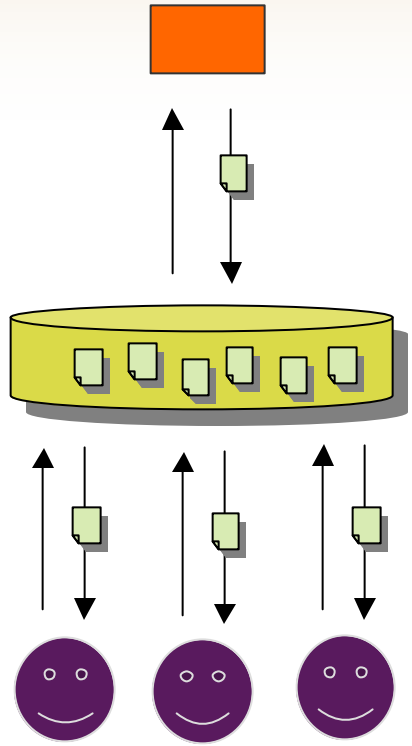
- XML offers much finer granularity of application (per-element) than traditional HTTP optimization (per-message).
- To associate a technique with an element, different mechanisms might be used:
  - External XML
    - Markup in XML Schema
    - Markup in WSDL
    - Message Header (using Xpath, etc.)
  - Inline XML
    - Attributes <foo m:cache="30">
    - Namespaces <m:cache value="30"><foo/></m:cache>

Triggering Optimization Techniques

- Time (delta, absolute, schedule)
  - 30 seconds
  - Tuesday at 5pm
  - Jan 1 12:00 2002
- Message to the intermediary directly
  - XMLP service exposed on the intermediary
- Message passing through the intermediary
  - Presence or value of another message's element (Query?)

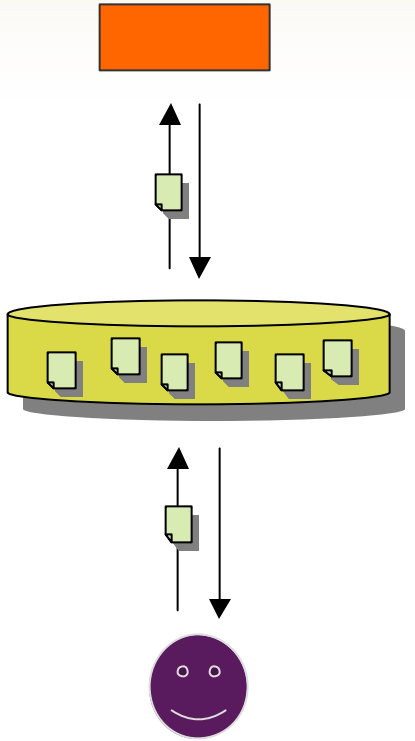
Technique: Caching

- Exploits request/response message exchange patterns with locality in requests and similarity in responses.
- Cache can be indexed by some combination of
  - Service (URL)
  - Element location (Xpath)
  - Element identity
  - Artificial index (URI)
- Cache is kept coherent through invalidation with various triggers.



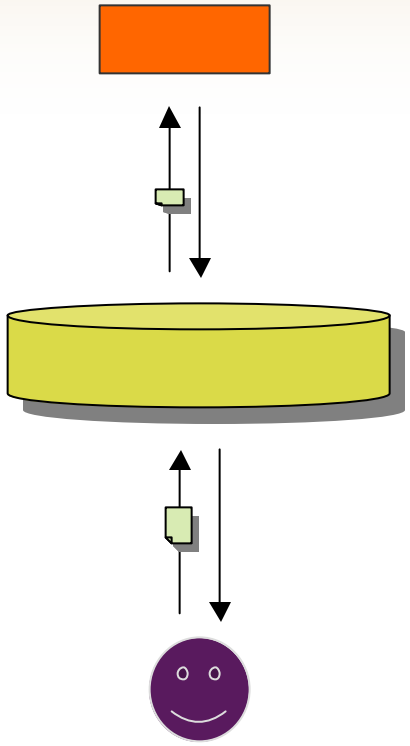
Technique: Store-and-Forward

- Exploits large or frequent client to server transfers that do not require immediate processing (but may require acknowledgement)
- Forwarding is triggered.
- Acknowledgement message might be standardized, or constructed from cache.



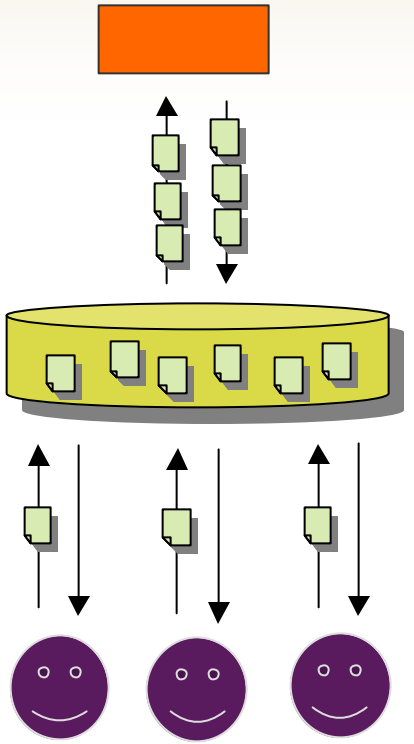
Technique: Partial Messaging

- Specify that only part of a message should be sent
- Can be used to send only the changed parts of a message (e.g., to update a cache)
- Can be used to send parts of messages at different times (e.g., store-and-forward)



Technique: Aggregation

- Exploits locality in messages to combine multiple messages, where possible, into a single message.
- Messages should have at least one common endpoint.



Next Steps

- Validate techniques' applicability to real-world Web Services
- Design a language for Web Service optimization
- Implement
- Interested? mailto:mnot@akamai.com