Qualities of Service

Oxford University

Software Engineering Programme

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Qualities of Service

- Transactions
- Reliable Messaging
- Security

Transactions

- Idealized *indivisible activities*
  techniques for maintaining the illusion in the face of complexity,
- Ideas arose from distributed databases
- Concurrency, failures
- Underlying finance, logistics, manufacturing. . .
- *Transaction Processing: Concepts and Techniques*, Gray and Reuter, 1993
- (http://books.google.co.uk/books?id=S_yHERPRZScC)

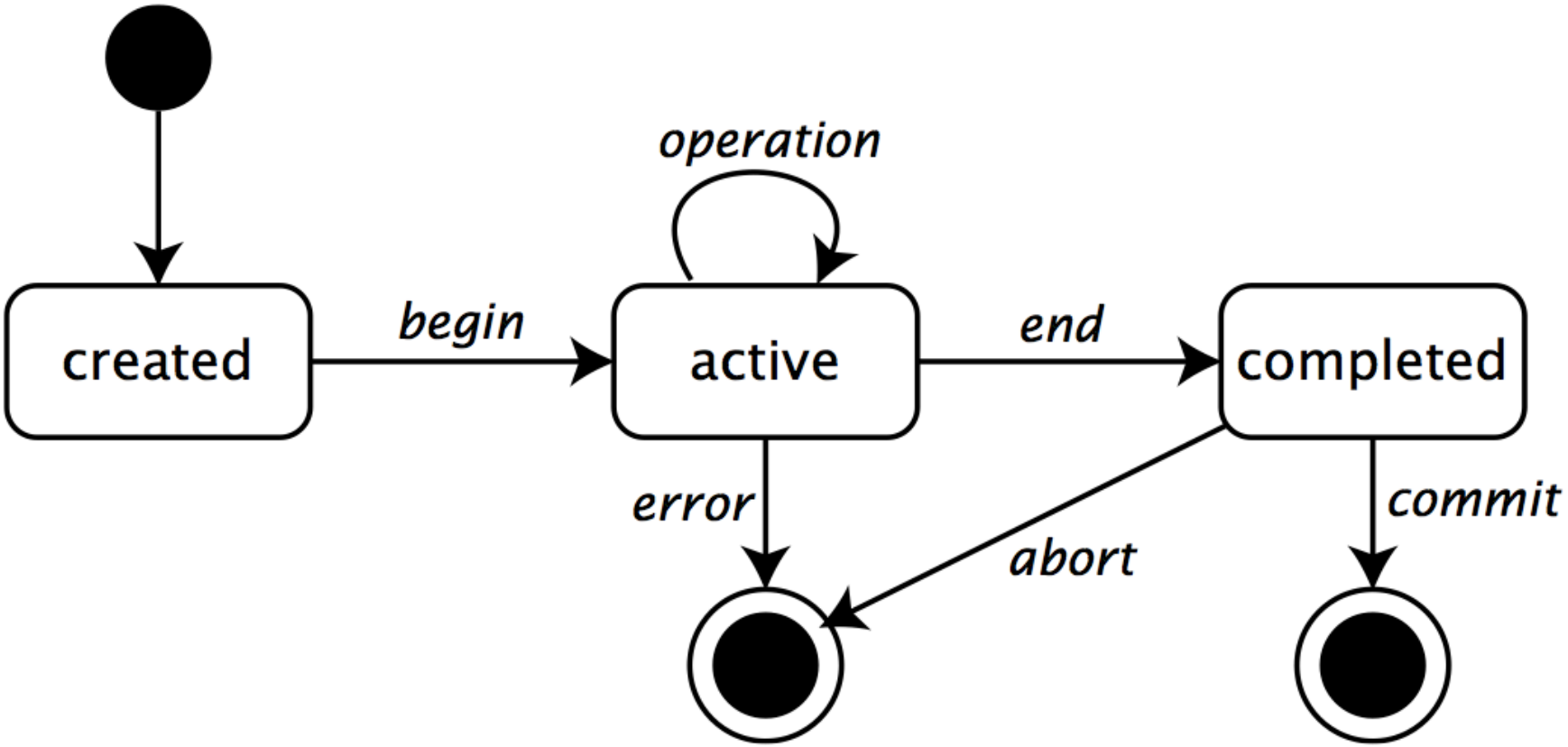
ACID

- *atomicity*
  - all-or-nothing
- *consistency*
  - integrity-preserving: invariants satisfied
- *isolation*
  - hidden intermediate results: multi-user behaviour consistent with single-user mode
- *durability*
  - permanent committed results

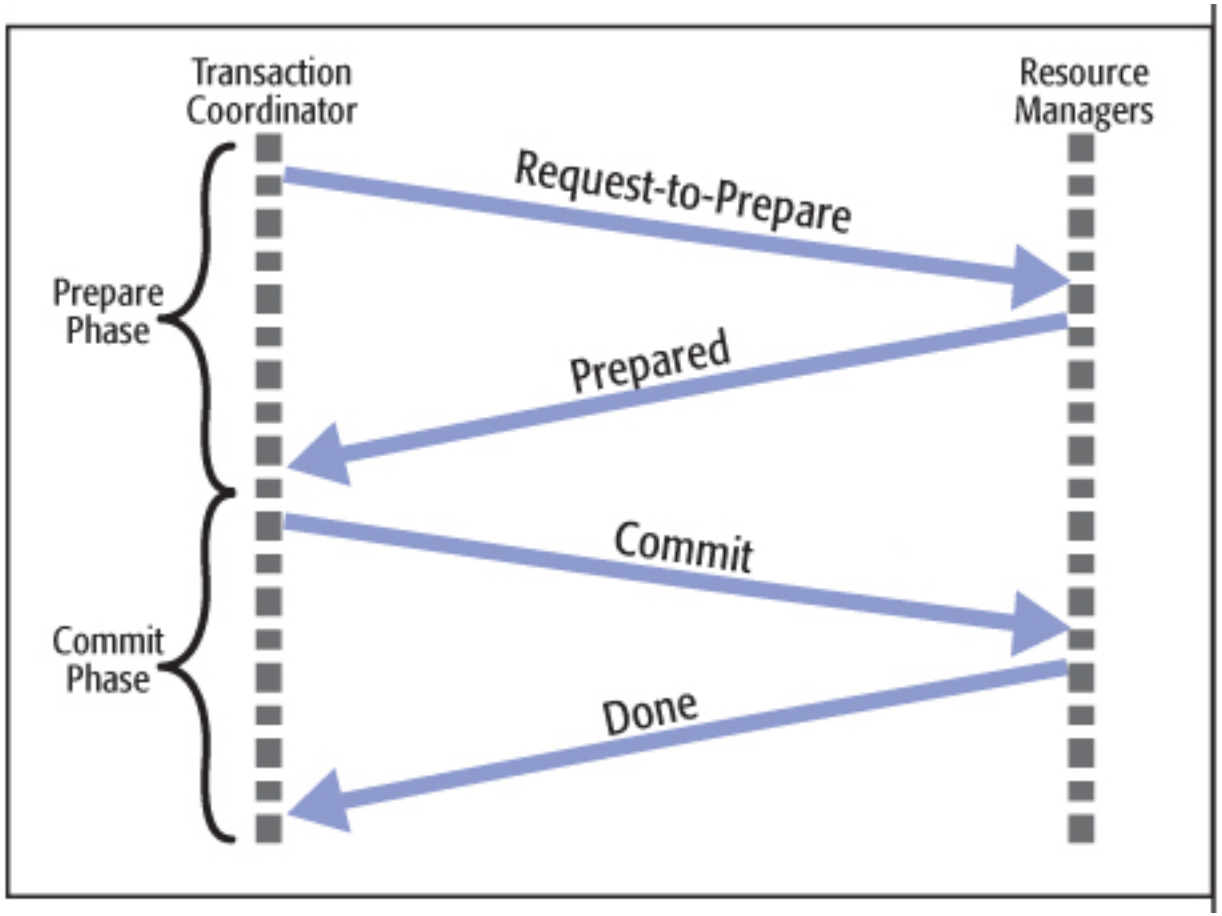
Problems Avoided with ACID

- *lost update*
  - write committed and acknowledged but then discarded
- *inconsistent retrieval*
  - reads of multiple fields at different times
- *non-serializability*
  - loss of single-user abstraction
- *conflict*
  - e.g. simultaneous bookings of the same room

Transaction Lifecycle



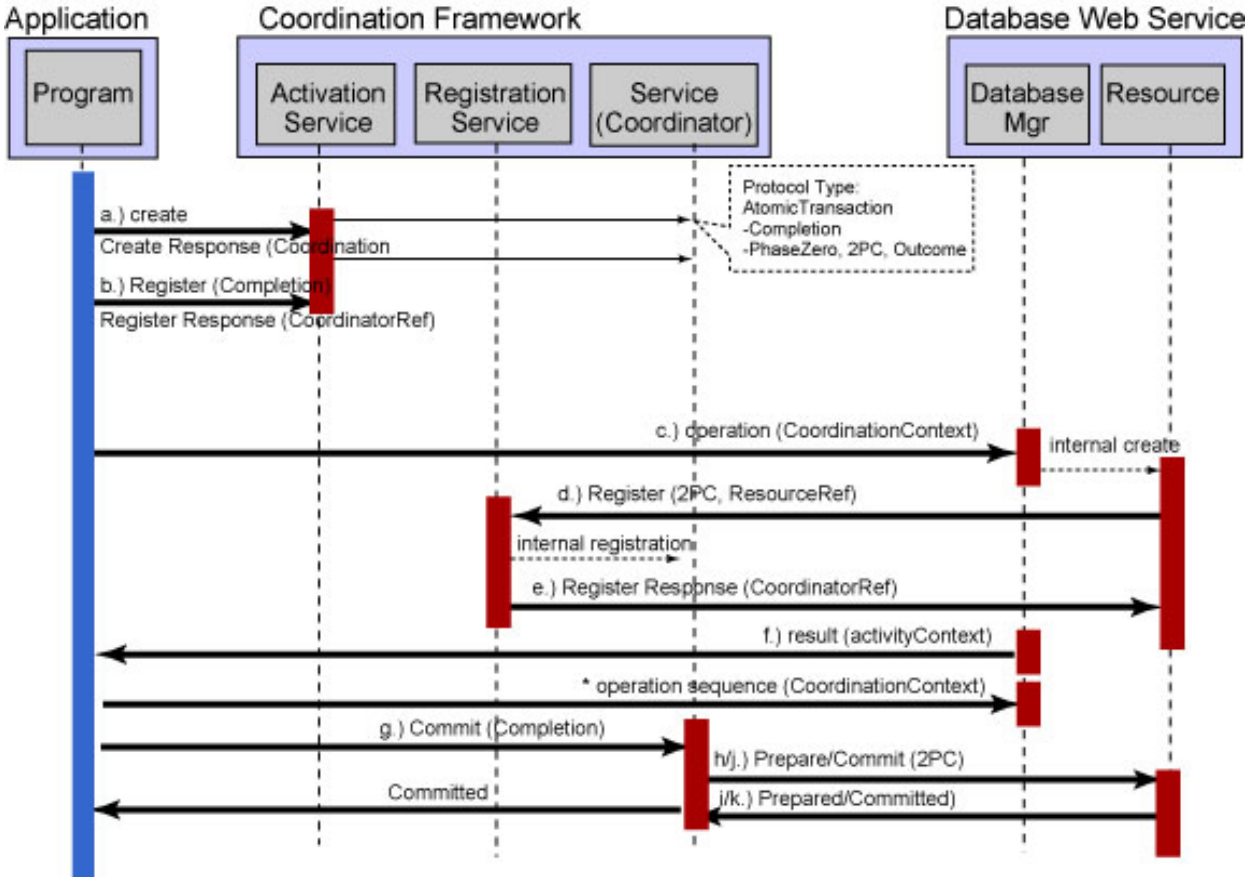
Two Phase Commit (2PC)



Locking

- *serialization mechanisms* for resources, enforcing unique access
- *read locks* (shareable) and *write locks* (exclusive)
- may need to wait for locked resource to be released
- may result in *deadlock*: two parties, each waiting for the other
- lock resources in canonical order (requires foresight), or abort one party (requires rollback)

WS-Atomic Transactions



WS-AT

- Relies on WS-Addressing and WS-Coordination
  - WS-Coordination is a generalized coordination protocol for multiple parties
  - Also used by WS-BusinessActivity
- How does WS-AT fit with?
  - Loose Coupling
  - Service Oriented Architecture
  - Asynchronous calling

CAP Theorem
Brewer's Theorem

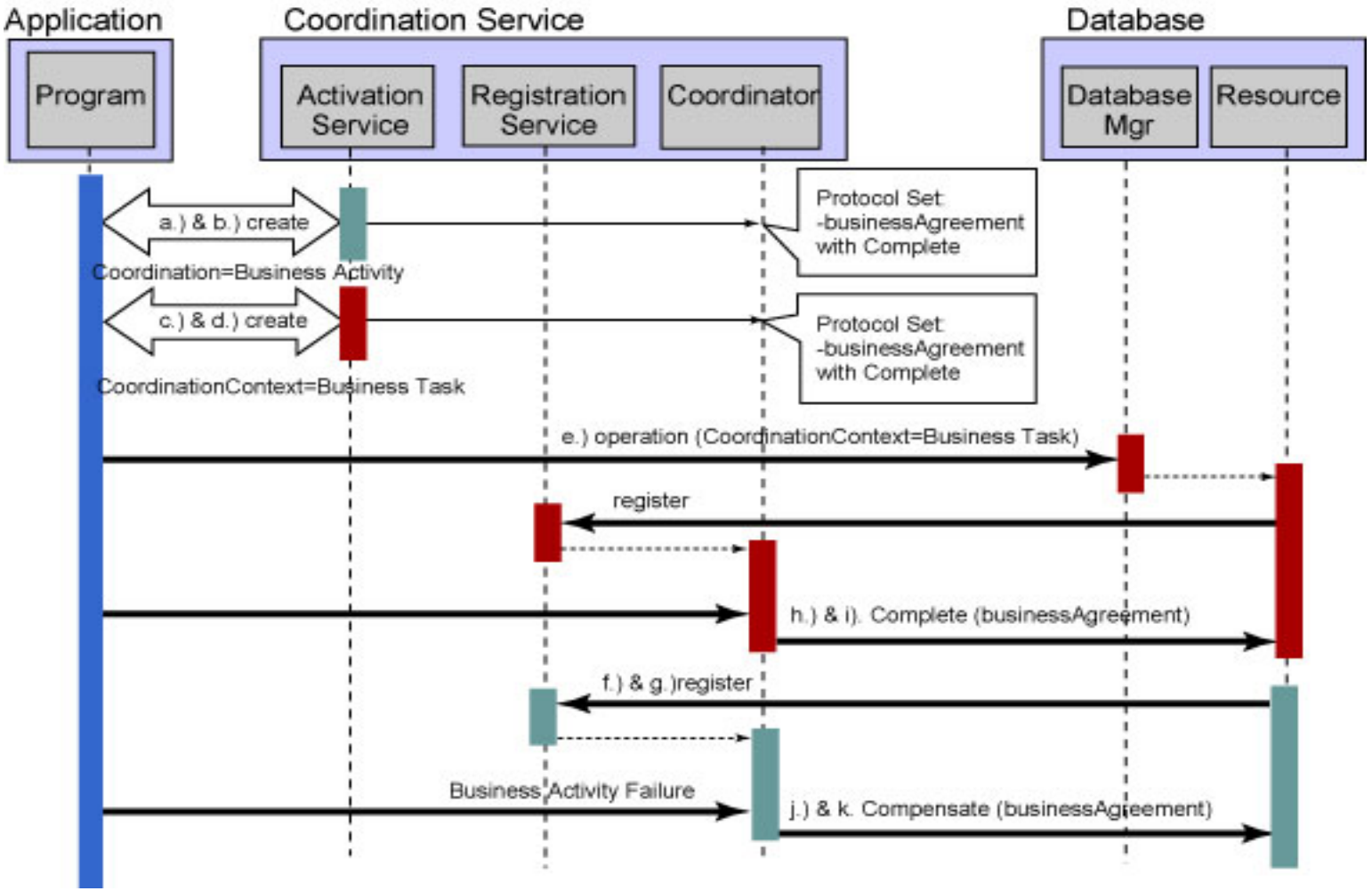
- Consistency
  - ACID
- Availability
  - High Available
- Partition Tolerance
  - Can work at Internet scale across Datacenters

You can only guarantee two of these three
While this is true, its also misleading.
Recommend you read
http://www.infoq.com/articles/cap-twelve-years-later-how-the-rules-have-changed by Eric Brewer

Eventually Consistent

- Despite the arguments, etc about CAP
- Eventually Consistent / NoSQL databases are gaining huge mindshare (and a lot of marketshare of new greenfield apps too)
  - e.g. Cassandra vs MySQL w/50Gb
  - MySQL r/w 300ms/350ms
  - Cassandra r/w 15ms/0.15ms
- Also scalability, elasticity, no master

WS-BusinessActivity



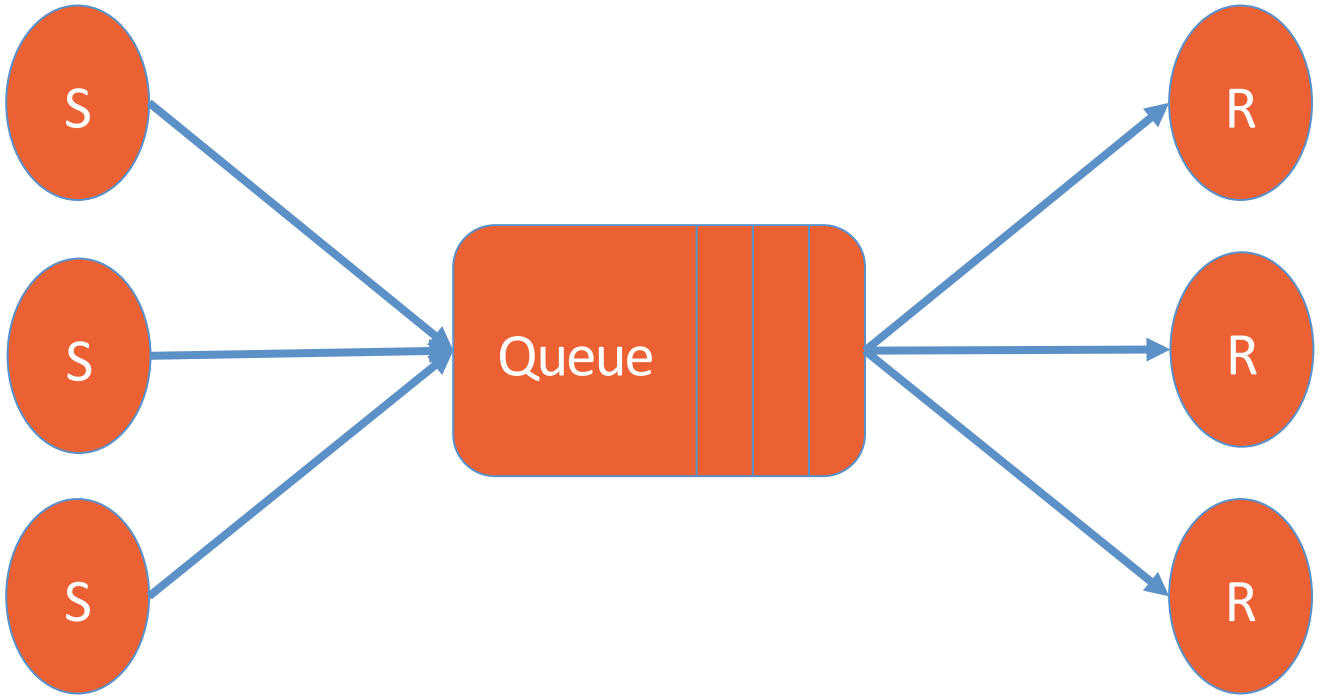
WS-BusinessActivity

- Suitable for long running loosely coupled scenarios
- Can use WS-AT to handle system exceptions – WS-BA handles business exceptions
- Business logic must support the cancel/ compensate logic
- Not ACID
  - For example, no clear isolation as locks are not held
- Can take place even if not all participants are always available

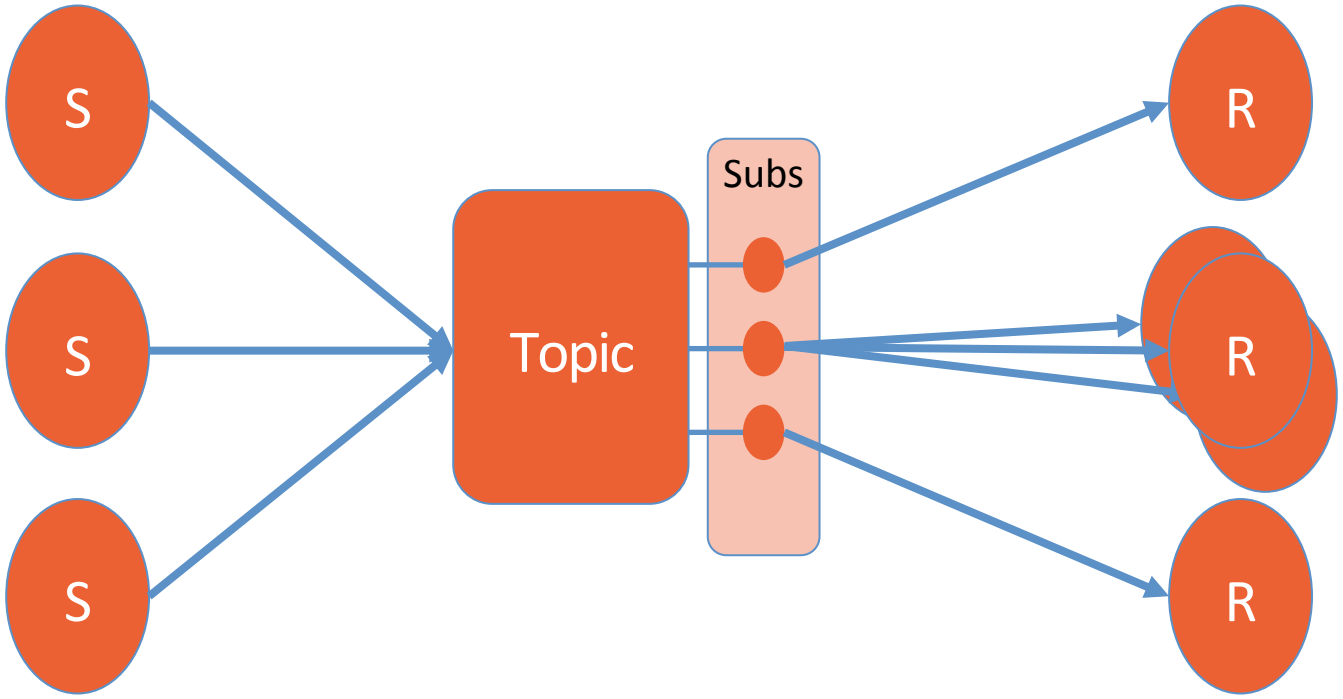
REST Transactions

- Transactions
  - Various ideas: RETRO
    - http://freo.me/TLnyWp
- Patterns
  - Towards Distributed Atomic Transactions over RESTful Services, Pardon and Pautasso, REST From Research to Practice, ISBN: 978-1-4419-8302-2 (Print) 978-1-4419-8303-9 (Online)

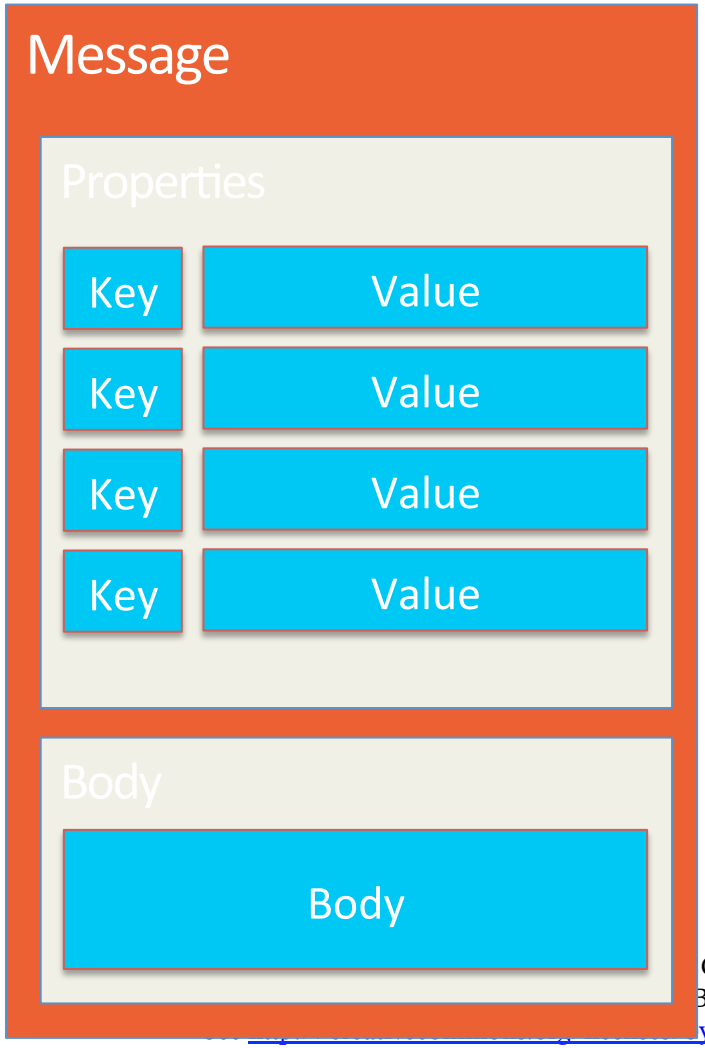
Messaging concepts: queuing



Messaging concepts: pub/sub



Messaging concepts: message

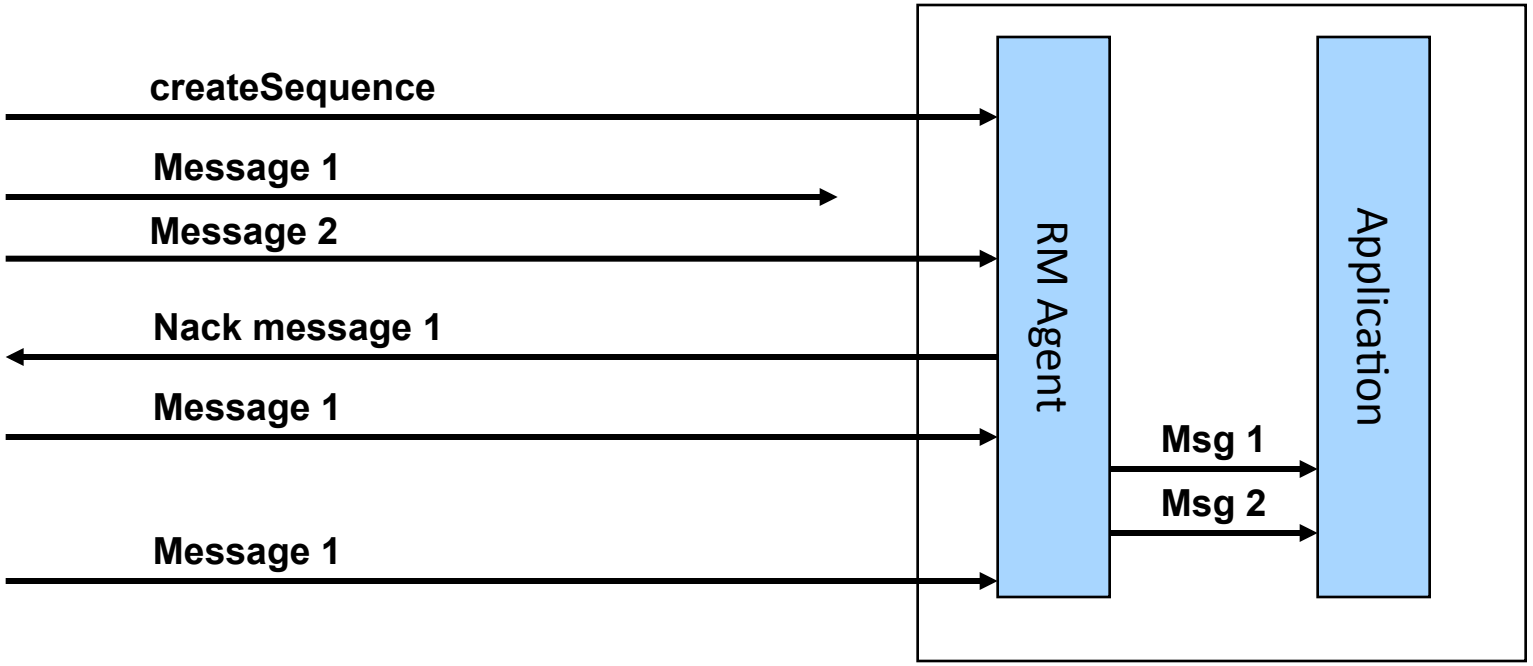


- Properties
- Key/value pairs exposed to the broker
- Subscription rules can filter based on properties

- Body
- Opaque payload not exposed to the broker
- Can be used for encrypted data

WS-ReliableMessaging

- Provides an MQ-like model for Web Services
  - Redelivers missing messages
  - Numbers messages so they can be delivered InOrder and ExactlyOnce



Other approaches to reliability

- ebMS Reliable Messaging
- AMQP 1.0
- MQTT
- STOMP
- REST patterns
  - Some believe you don't need RM
  - http://www.infoq.com/articles/no-reliable-messaging

Security

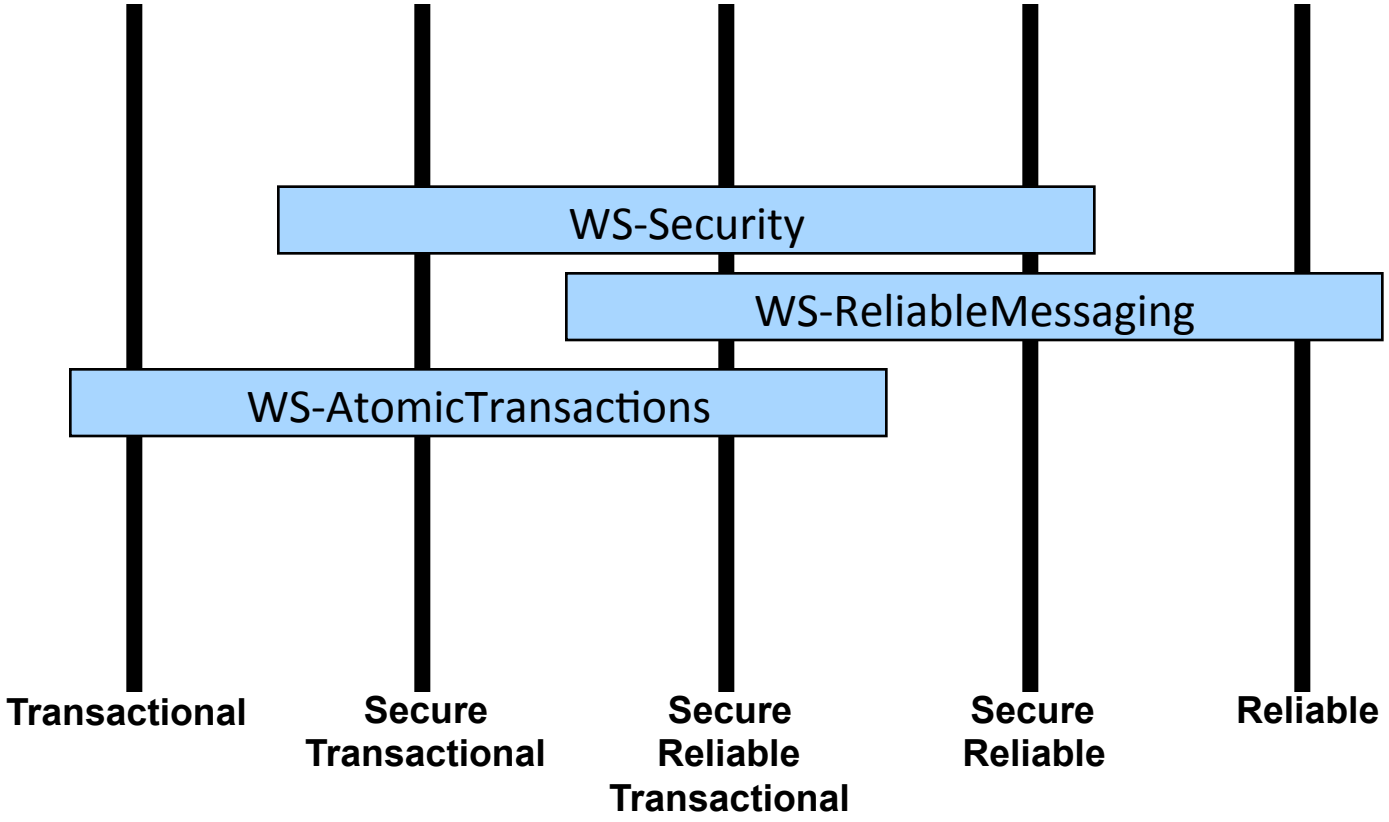
- Dealt with at length in a separate lecture!

Composability

Composability

- The whole architecture of WS-* has been designed around this model
  - Use what you need
    - And no more
  - Don't replicate technology in different standards
  - All the standards should work together

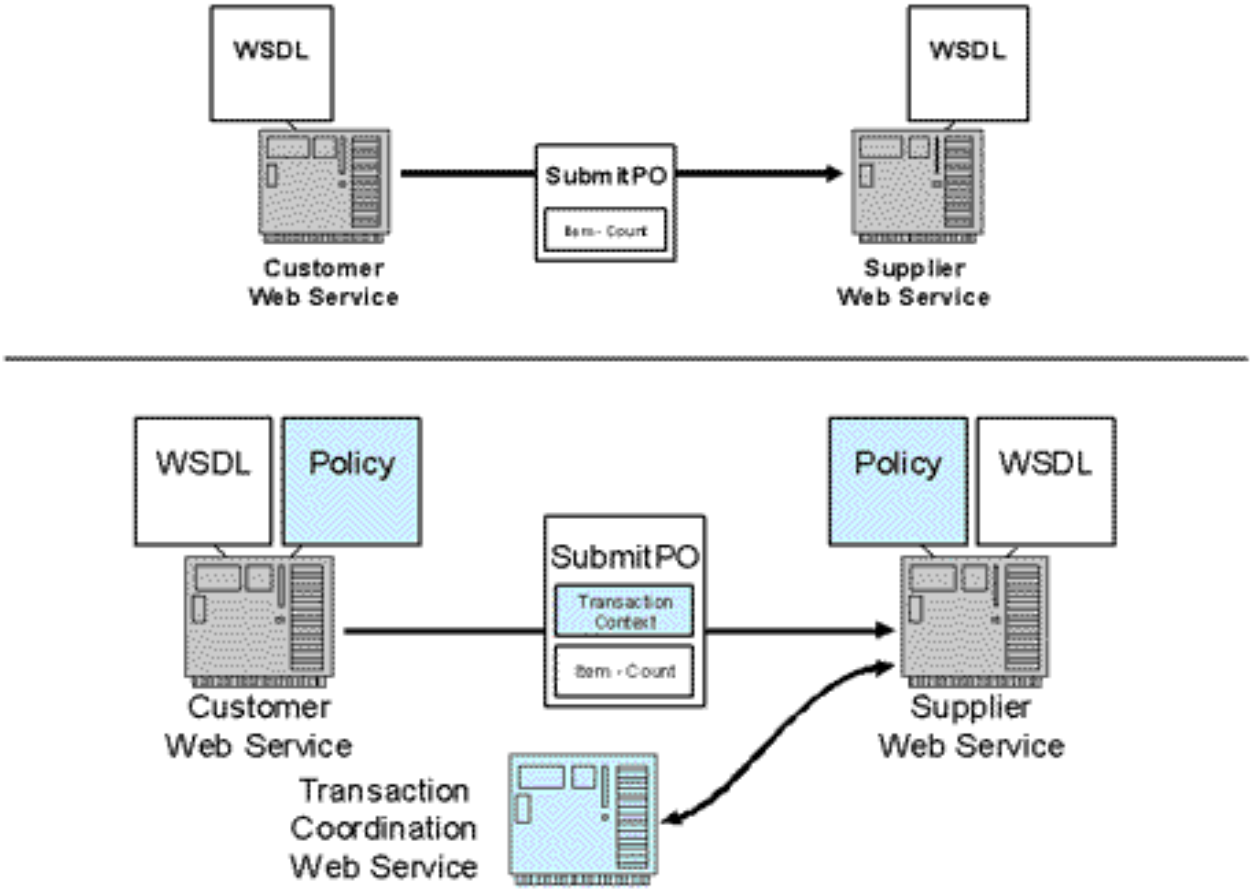
Basic Composability



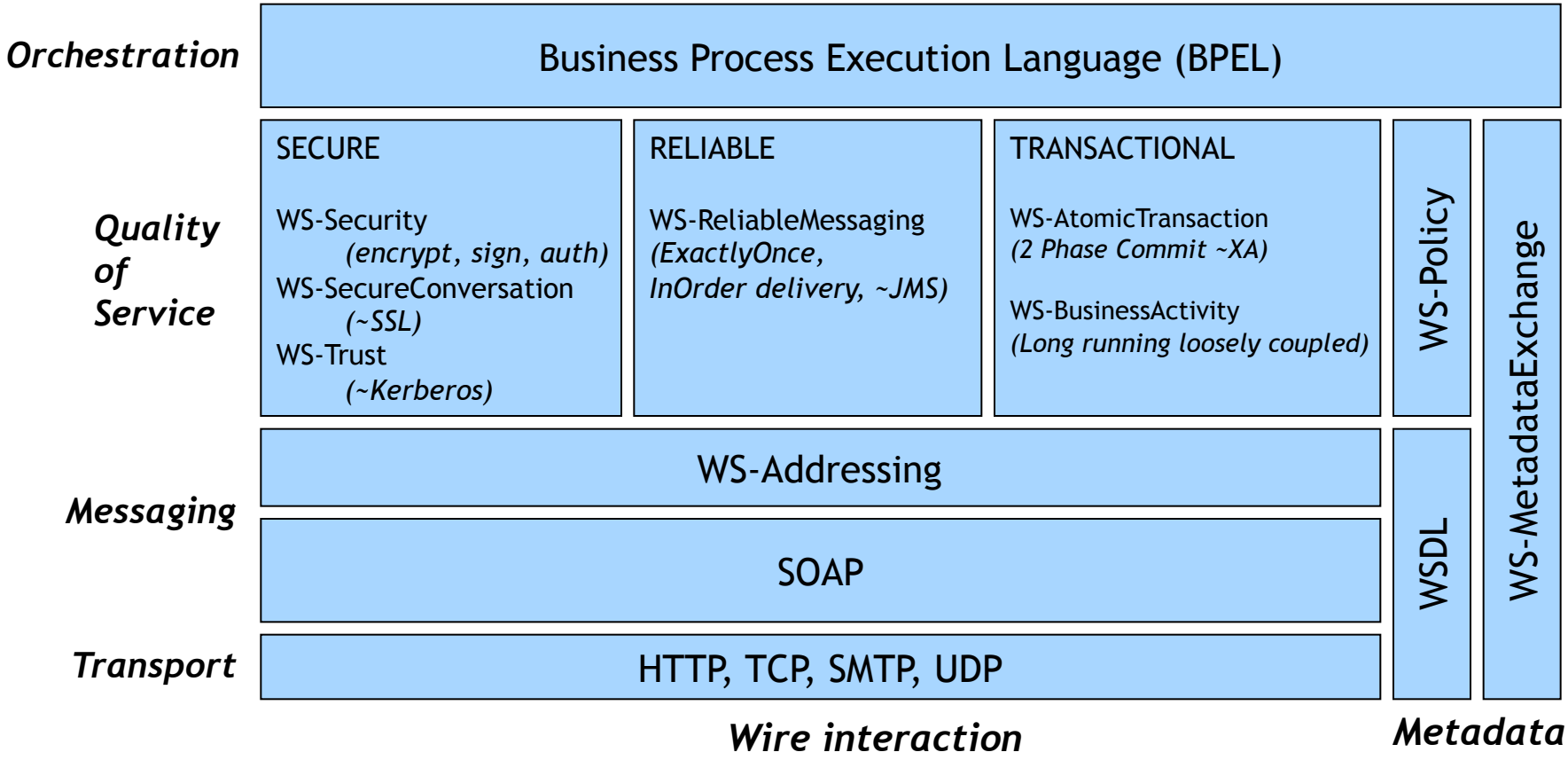
Composability

- SOAP Headers that work together
- Common usage of base components
  - SOAP
  - WS-Addressing
- The right building blocks, e.g.
  - Reliable pub/sub
    - WSRM + WS-Eventing
  - Secure Single Sign-on
    - WS-Trust + WS-Security

Composability example



Key Web Services Standards



The Web services platform forms a complete framework for open standards enterprise middleware

WS-Policy Framework

- A way of publishing requirements and capabilities for service endpoints
  - A simple language to specify combinations
  - Plus a way of attaching to WSDL, etc
  - Plus a set of Policy Assertion Languages
- For example:
  - WS-SecurityPolicy
  - WS-ReliableMessagingPolicy
  - etc
- More in later chapter

WS-MetadataExchange

- How to query a service at runtime for its policy, WSDL, schema, etc

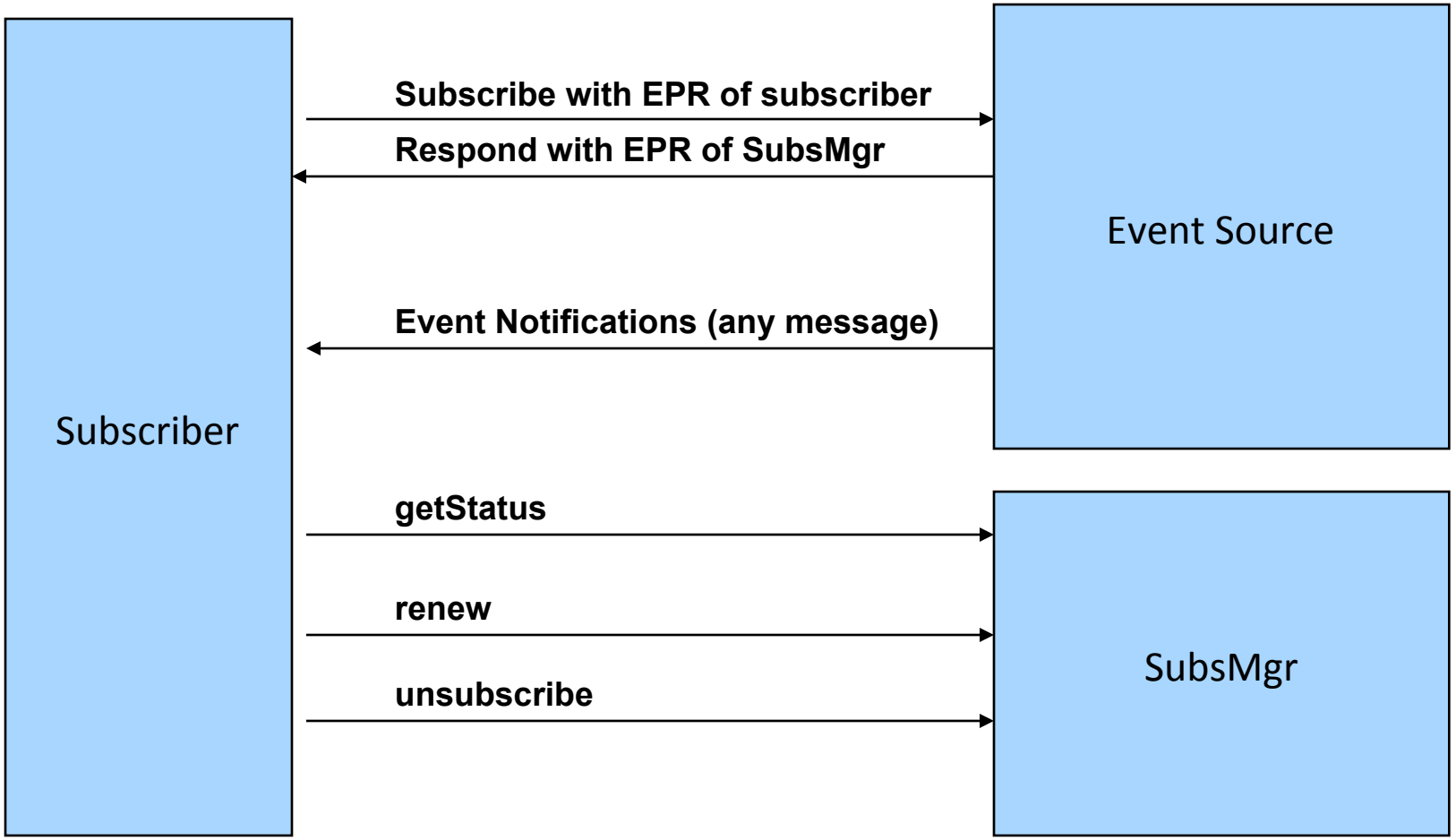
WS-Eventing

- Guess what! There are two specs:
  - WS-Notification (IBM, HP, Oracle, Tibco and Globus)
    - WS-BaseNotification
    - WS-BrokeredNotification
    - WS-Topics
  - WS-Eventing (Microsoft, BEA, IBM, Tibco)
- BaseNotification and Eventing are very similar

WS-Eventing

- Publish-Subscribe in Web services/XML
- Create, Delete, Renew and expire subscriptions
- Subscriptions may have XPath-based filters
- Specify how event messages should be delivered
- Compose with other standards for secure, reliable transacted delivery

WS-Eventing Example



Event Driven Architecture in REST

- Comet
  - Not considered good!
- WebSockets
  - Not particularly RESTful, but W3C approved
- EventSource
  https://developer.mozilla.org/en-US/docs/Server-sent_events/EventSource
- WebHooks
  - Web Callbacks

Local / Remote Transparency

“*The hard problems in distributed computing concern dealing with partial failure and the lack of a central resource manager. . . differences in memory access paradigms between local and distributed entities.*

Many aspects of robustness can be reflected only at the protocol/interface level. . . An interface design issue has put an upper bound on the performance. . . Part of the definition of a class of objects will be the specification of whether those objects are meant to be used locally or remotely.

”

Jim Waldo et al, ‘A Note on Distributed Computing’, 1994

One more thing to note

- Service Level Agreements and active management have become *much* more important than RM and Transactions
  - Widespread APIs over the web
  - DoS attack prevention
  - Guaranteed availability
- More when we look at API Management

Questions?