Atomic Transactions for the REST of us

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Acknowledgements

- This is joint work with Guy Pardon, Atomikos

http://www.atomikos.com
Does REST need transactions?

- If you find yourself in need of a distributed transaction protocol, then how can you possibly say that your architecture is based on REST? I simply cannot see how you can get from one situation (of using RESTful application state on the client and hypermedia to determine all state transitions) to the next situation of needing distributed agreement of transaction semantics wherein the client has to tell the server how to manage its own resources.
- ...for now I consider "rest transaction" to be an oxymoron.

Roy Fielding, REST discuss, June 9th, 2009
Does REST need transactions?

- The typical conversation thread, real or virtual, about transactions over HTTP goes something like this (elided for brevity):
  - "You don't want transactions over HTTP"
  - But I need to organize number of steps into a single unit I can deal with easily.
  - "OK, but you don't need transactions over HTTP"
  - But I need the ability to back out changes in multiple locations safely and consistently.
  - "OK, but you can't do transactions over HTTP!"
  - Really?
- And here the topic usually dies or descends into a heated debate.

Mike Amundsen,
http://amundsen.com/blog/archives/1024
Adapted from Stefan Tilkov, Using REST for SOA, QCon SFO 2010
The problem

Thanks to the idempotency of GET/PUT, each individual state transfer is reliable and atomic.
The problem

How to we make both interactions atomic?
Constraints

- Interoperability:
  - No changes//extensions to HTTP
    - No additional verbs
    - No special/custom headers

- Loose Coupling:
  - REST shifts all the “work” to the client
  - RESTful Web services *should remain unaware* they are participating in a transaction

- Simplicity:
  - Transactions will not be adopted in practice unless they can be made simple enough
Assumption: Try-Confirm/Cancel

- Resource state transitions follow the TCC pattern
- Before they are made permanent state transitions go through an intermediate “reserved” state which either will be confirmed or canceled by a client within a given time
- Hint: Cancel/Confirm are idempotent
Example: Flight Booking Resource

Try
- POST /booking
- 302 Location: /booking/X

Confirm
- PUT /booking/X
- 200

Cancel
- DELETE /booking/X
- 200
Protocol

1. A client interacts with multiple RESTful Web services. Interactions may lead to state transitions (the intermediate state is identified by a URI known to the client)

2. Once the client has completed all interactions, it uses the URIs identifying the intermediate states to confirm the state transitions (and thus commit the transaction)

Note: If the client stops before step 2, the state transitions will eventually be undone by the services themselves (after a timeout). As an optimization, the client can use the same URIs to cancel the state transitions (and thus explicitly rollback the transaction).
Simple Example

1. POST www.swiss.ch/booking
   302 Location: /booking/1

   POST www.ezyj.com/booking
   302 Location:/booking/X

2. PUT www.swiss.ch/booking/1
   200

   PUT www.ezyj.com/booking/X
   200
What if something fails?

1. POST www.swiss.ch/booking
   302 Location:/booking/1

   Whatever happens, these state transitions are temporary.

2. PUT www.swiss.ch/booking/1
   200

   Only idempotent methods are allowed in the confirmation phase.

   If something fails, stop before moving to phase 2

   If something fails, retry as many times as necessary
A matter of timing

Agreement is reached if the confirmation phase ends before the resources undo the state transitions because of the timeouts.
A matter of timing

State transitions

Time transitions

1. Try
2. Confirm

Timeouts

If the confirmation runs longer than the earliest timeout we cannot guarantee agreement
Timeouts and heuristics

- **Bad News:** As with every distributed agreement protocol, it is impossible to avoid heuristics.

- **Good News:**
  - thanks to the REST uniform interface we can always do a GET on the URI of the reserved resource to see how much time we have left before it cancels.
  - Avoid starting phase 2 if there is not enough time left to confirm with every service.

- More complex preparation: if the resource allows it, extend the reservation time (also idempotent) before starting phase 2.

- In any case, use a lightweight transaction coordinator to log everything for recovery and human diagnosis of heuristics.
Architecture (Client-side Transaction)
Architecture (Service Composition)

Client -> Workflow Engine

0

Workflow Engine -> Transaction Coordinator

1

Transaction Coordinator -> Composite RESTful Service

2

Composite RESTful Service -> TCC Resources

3

Try

4

Confirm

5

Try

6

Confirm

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Conclusion

- The protocol guarantees **atomicity** in the event of failures among multiple interactions with RESTful Web services that comply with the TCC pattern.
- (We are not interested in isolation)
- No HTTP extension is required
- Fits very nicely with the REST uniform interface and the idempotency of the PUT/DELETE methods
- Hypermedia can be easily built in to guide the discovery of the cancellation/confirmation URIs (e.g., with HTTP Link Headers)
References

WS-REST 2011

Second International Workshop on RESTful Design

http://ws-rest.org/2011

- @WWW2011, Hyderabad, India
- 28 March 2011
- Paper Submission is open (deadline: 31 Jan 2011)
ECOWS '11

9th IEEE European Conference on Web Services (ECOWS 2011)
Lugano, Switzerland
September 14-16, 2011

http://ecows2011.inf.usi.ch
http://twitter.com/ecows2011