Enterprise Undo

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Java

Sun microsystems

Learn how to enable your business logic to participate in extended transactions by using annotations

GOAL

Agenda

- Transactions 101
- Development of extended transactions
- Business Activity Framework
- Future Work
- Summary
- Questions and Discussion

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Transactions 101

- Transactions are a way of structuring application execution
- Client applications manage transaction boundary demarcation
  - begin, commit, rollback
- Business logic runs within the scope (context) of the transaction
- Transactions may run for a short time or a long time
  - Database updates
  - Business process workflows

Atomic transactions

- Scoping mechanism that provides “all-or-nothing” semantics
- ACID properties: Atomic, Consistent, Isolated, Durable
- Use locking of resources
- Rollback to original state on failure
- Two-phase commit protocol for consistent outcome determination
- Well standardized (JTA, XA), Widely used (Enterprise JavaBeans™ (EJB™) technology, databases)

Atomic transaction - Client Application

```
javax.transaction.UserTransaction transaction = ...

        // JTA call, associate tx context to thread
        transaction.begin();

        try
        {
                hotelService.bookRoom(1);
                hotelService.bookRoom(2);

                // run 2PC, clear thread tx context
                transaction.commit();
        }
        catch (Exception ex)
        {
                transaction.rollback();
        }
```

Atomic transaction – EJB 3.0 technology

```
@Stateless
public class HotelImpl implements Hotel
{
    @TransactionAttribute(REQUIRED)
    public int bookRoom(int roomNumber)
    {
        // method implementation:
        // pure business logic
        // no transaction logic
    }

    // ...
}
```

Extended Transactions

- A way of structuring business processes that may
  - Span multiple applications or organizational boundaries
  - Take a long time
- ACID will not work
  - Locking would limit throughput
  - Partial undo is desirable for failure isolation
- Extended transaction models are required
  - Non is as well supported as traditional transactions
  - Many use Roll forward compensation

WS-Business Activity

- Defines an extended transaction model for the Web Services environment - **Business Activity** (BA)
- Designed specifically for **long-duration interactions**
- Consensus within a single BA is achieved through **agreement protocol**
- Services use **compensation** - forward recovery
- **Compensation actions** are **application-specific** and **must be explicitly provided** by business application programmers

Extended transaction – Java™ Platform, Enterprise Edition Server side code

```
public class HotelImpl implements Hotel
{
    @TransactionAttribute(REQUIRED)
    public int bookRoom(int roomNumber)
    {
        // mixed business logic and transaction logic
        // elisting Participants,
        // maintaining multiple persistent
        //     copies of state
        // ...
        // (actual code censored to protect your sanity)
    }

    // ...
}
```

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Problem statement

- Business programmers should be able to declare desired transactional behavior using annotations (like EJB 3.0 technology)
- The transaction plumbing should be provided automatically
  - Difficult issues such as serialization of state, concurrency control, locking and versioning of data, logging, rollback and crash recovery handling
  - There's no need to write code for participants (resources) that respond to transaction protocol messages (prepare, compensate, close)

Problem statement (2)

- Business programmers should not need transaction expertise
- Decouple transaction code and business logic
  - but there is unlikely to be a silver bullet...
- Compensation actions are application-specific and thus need to be provided explicitly by business logic developers
- Nevertheless, we can still find ways to help make life easier for business programmers

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Objectives

- Make it easier for business programmers to use extended transactions
- Separate the transaction related code from the application's business logic
- Developers should **declaratively** specify transactional requirements of their applications
- All necessary transaction processing should be provided basing upon those requirements in a **transparent way** and should be applied at **runtime**

Business Activity Framework

- **Annotations** used to describe transactional requirements
  - **Units of work** can be **related** to their **compensation actions** with few simple declarative statements
- **Transparent transaction management**
  - Automated execution of compensation actions
- **Flexible management of data** required throughout a single transaction
- **Business-logic separation:** Framework provides implementation of the transaction participant

Business Activity Framework (2)

- The initial framework implementation is focused on allowing Web Services to take part in WS-BA driven extended transactions
- The concepts are generic and can be applied to other extended transactions protocols

Client application

```
com.arjuna.mw.wst.UserBusinessActivity businessActivity =
                                                        ...

businessActivity.begin();
try
{
        hotelService.bookRoom(1);
        hotelService.bookRoom(2);
        businessActivity.close();
}
catch (Exception ex)
{
        businessActivity.cancel();
}
```

Server side

```
@BAMethod
@BACompensatedBy("cancelRoom")
public int bookRoom(int roomNumber)
{
    // ... method implementation: business logic only
    // ... return reservation number
}

public boolean cancelRoom(int reservationNumber)
{
    // ... method implementation: business logic only
}
```

Server side

```
@BAMethod
@BACompensatedBy(value="cancelRoom",type=DataMatch.CUSTOM)
@BAResult("reservation")
public int bookRoom(@BAParam("user") String userName,
                    @BAParam("password") String password,
                    int roomNumber)
{
    // ... method implementation
}

public boolean cancelRoom(@BAParam("user") String userName
            @BAParam("password") String password,
            @BAParam("reservation") int reservationNumber)
{
    // ... method implementation
}
```

Server side

```
@BADataManagement
DataManager dm;

@BAMethod
@BACompensatedBy(value="cancelRoom",type=DataMatch.CUSTOM)
@BAResult("reservation")
public int bookRoom(@BAParam("user") String userName,
                    @BAParam("password") String password,
                    int roomNumber)
{
    // ...
    dm.put("refund",refundValue);
    // ...
}
```

Server side

```
public boolean cancelRoom(@BAParam("user") String userName
            @BAParam("password") String password,
            @BAParam("reservation") int reservationNumber)
{
    // ...
    Integer refund = (Integer) dm.get("refund");
    if (refund != null)
    {
        // ...
    }
    // ...
}
```

Server side

```
@BAMethod(agreement=AgreementType.COORDINATOR_COMPLETION)
@BACompletedBy(value="getBooking",type=DataMatch.CUSTOM)
@BACompensatedBy(value="cancelRoom",type=DataMatch.CUSTOM)
@BAResult("reservation")
public int bookRoom(@BAParam("user") String userName,
                    @BAParam("password") String password,
                    int roomNumber)
{
    // Retrieve existing array of booked rooms. If null,
    // create new one. Add room of "roomNumber" to array.
    // Store the array with DataManager
    dm.put("0",rooms);
    // ...
}
```

Server side - using 3rd party service

```
@BACompletedBy(
    value = "getBooking",
    type = DataMatch.CUSTOM,
    mode = ExecutionMode.WS_PORT,
    serviceName = "RemoteHotelService",
    wsPort = RemoteHotel.class,
    wsdl = "http://host/RemoteHotel/RemoteHotelImpl?wsdl",
    namespace = "http://example.com"
)
```

3rd party server side

```
@WebMethod
public boolean getBooking(Integer[] roomNumbers)
{
    // ...
}
```

Business Activity Framework - API

- Clean and intuitive **annotation-based API** - keeps with the current trend in enterprise environments
  - **@BAService**
  - **@BAMethod**
  - **@BACompensatedBy**
  - **@BACompletedBy**
  - **@BAParam**
  - **@BAResult**
  - **@BADataManagement**

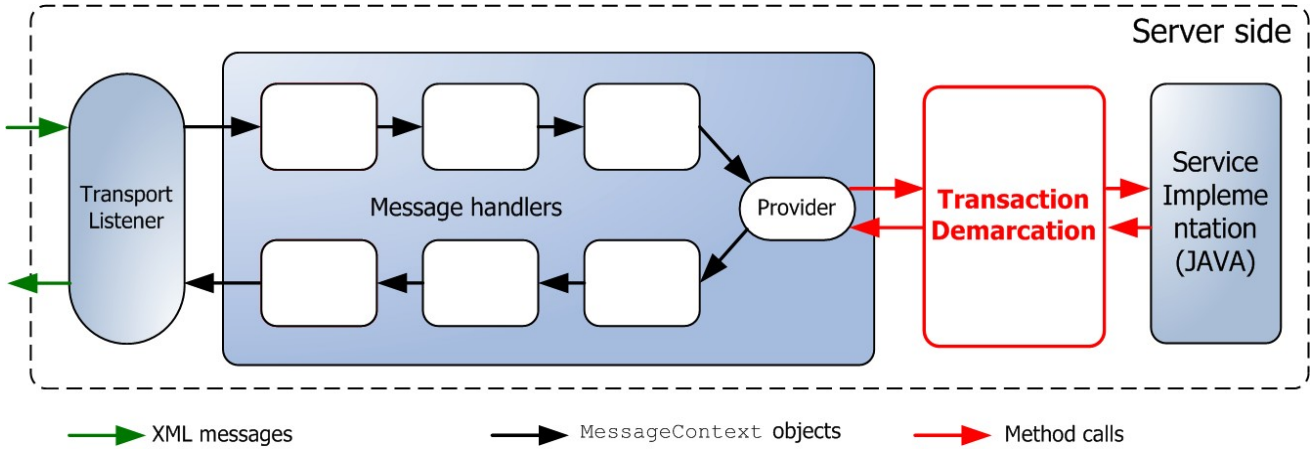
Business Activity Framework - API (2)

- Leverages programmer familiarity with EJB 3.0 technology and Java Specification Request (JSR) 181 - reduces the learning curve for new users, adaptable to other environments than Web Services
- All annotations have reasonable default values - programmers do not need to explicitly provide all configuration options
- Flexible **Data Manager** for storage and retrieval of transaction business data between calls
  - Map semantics: put / get
  - Crash tolerant

Business Activity Framework Demo

Business Activity Framework - design

- Transaction Interceptors using AOP
- Not SOAP (or even Web Service) specific
- Annotations on business logic control transactional behavior



Business Activity Framework - design (2)

- Business method calls are transparently associated associated with participants provided by the framework
- Participants are responsible for responding to transaction control messages e.g. ***complete()***, ***close()***, ***compensate()***
- Each participant stores data related to method calls for later use e.g. Compensation
- Automatic reverse ordering of compensation actions

BA Framework - Developing Web Services

- Business Activity Framework consists of two modules:
  - Compile time client library with API
  - Server side AOP, resides in the container or deploys with the app
- Transactional Web Services use a SOAP header processor to manage transaction context
- AOP may be compile time (offline instrumentations) or runtime

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Future Work

- Support for other extended transaction protocols and transport, to move beyond WS-BA & Web services.
- Gather feedback from the community about their requirements
- Search for generic solutions that can apply to any extended transaction model
  - Re-use annotated business logic in different transaction types.
- Standardize (through JSR?) once we have a model that is widely applicable

- Meanwhile you can download and use it today...

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Summary

- Extended transaction models are highly useful in enterprise integration scenarios
- More development-friendly support for business programmers is required
- The Business Activity Framework uses annotation driven approach to compensations (forward recovery)
- Existing business logic can be reused (like JSR 181)

For More Information

- Business Activity Framework website
  - http://labs.jboss.com/jbosstm
    http://labs.jboss.com/jbosstm/baframework
- Java API for XML Transactions (JSR-156)
  - http://jcp.org/en/jsr/detail?id=156
- Email
  - jonathan.halliday@redhat.com
  - m.p.machulak@newcastle.ac.uk

THANK YOU

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Reserve slides follow

BA Framework - Developing Web Services

```
...
<handler-chain>
<protocol-bindings>##SOAP11_HTTP</protocol-bindings>
<handler>
<handler-name>
WebServicesTxContextHandler
</handler-name>
<handler-class>
com.arjuna.mw.wst.service.JaxWSHeaderContextProcessor
</handler-class>
</handler>
</handler-chain>
...
```

BA Framework - Developing Web Services

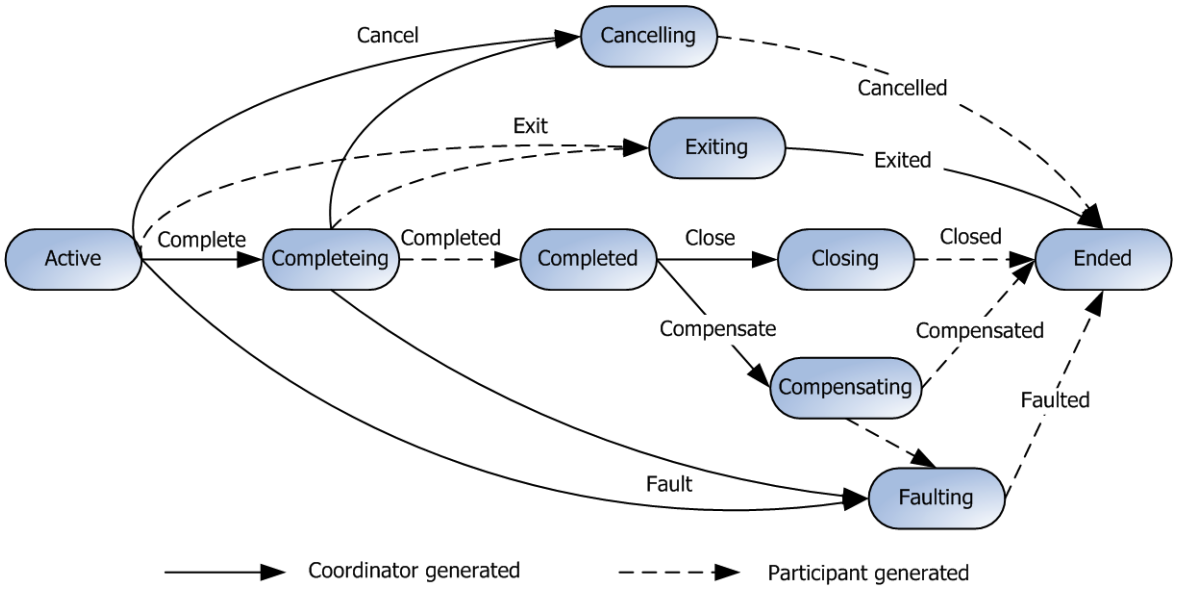
```
@WebService(serviceName="Hotel",
            targetNamespace="http://hotel.tm.jboss.org")
@SOAPBiding(style=SOAPBinding.Style.RPC)
@HandlerChain(file="jaxws-handlers-server.xml")
public  class HotelImpl implements Hotel
{
    // ... class implementation
}
```

BA Framework - Developing Web Services

```
<?xml version="1.0" encoding="UTF-8"?>
<application>

        <!-- omitted elements -->

        <module>
                <java>baframework.aop</java>
        </module>

</application>
```

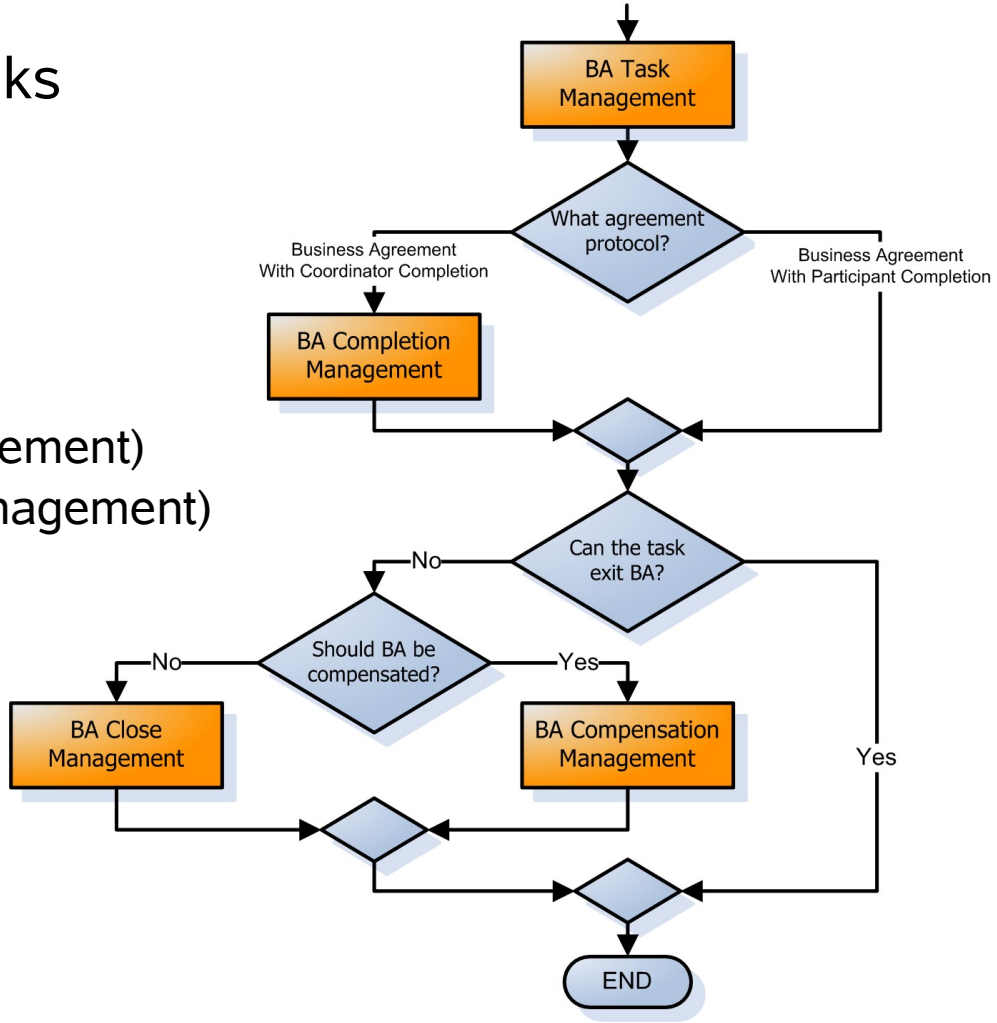
WS-Business Activity (2)

- Agreement protocols:
  - Business Agreement with Participant Completion
  - Business Agreement with Coordinator Completion

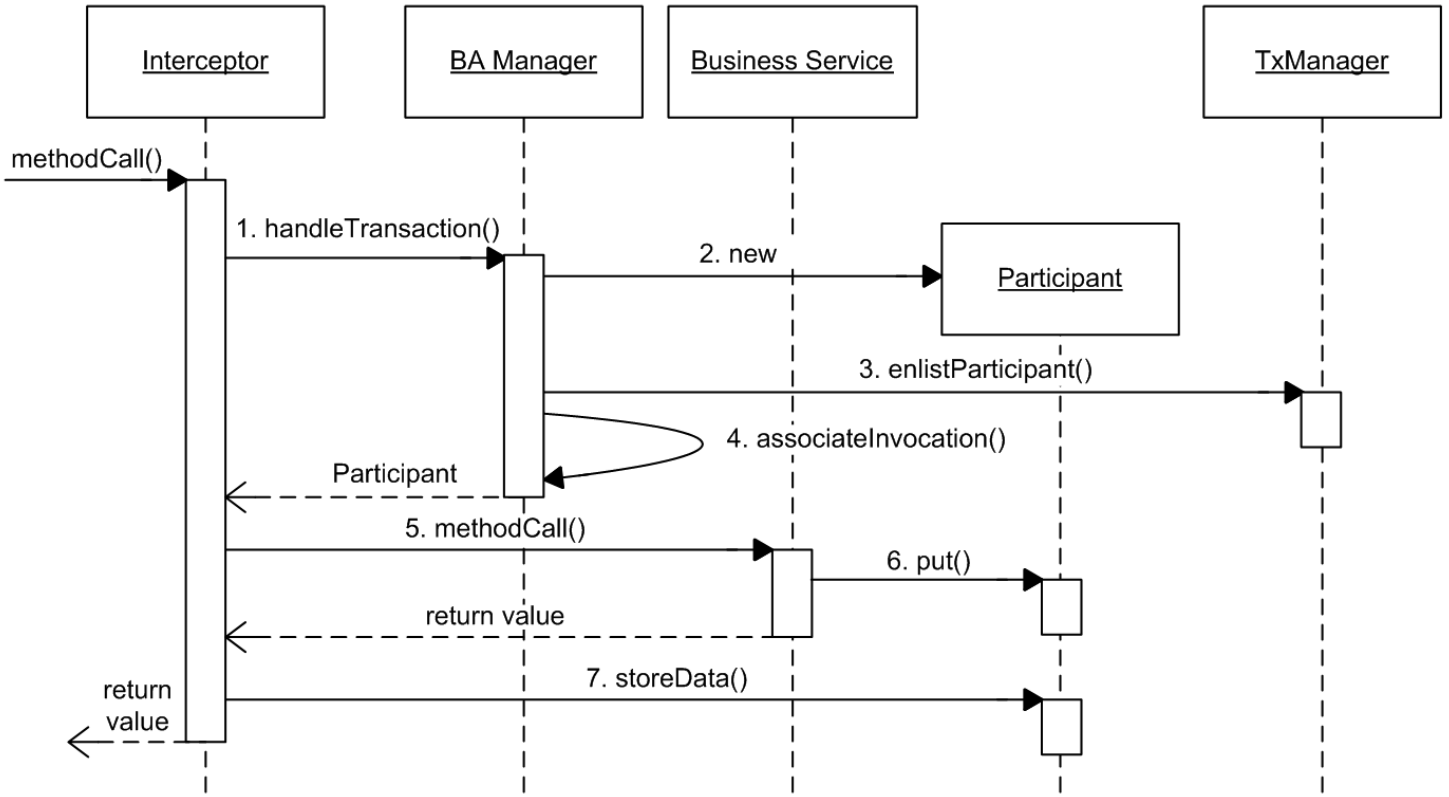


BA Framework - transaction management

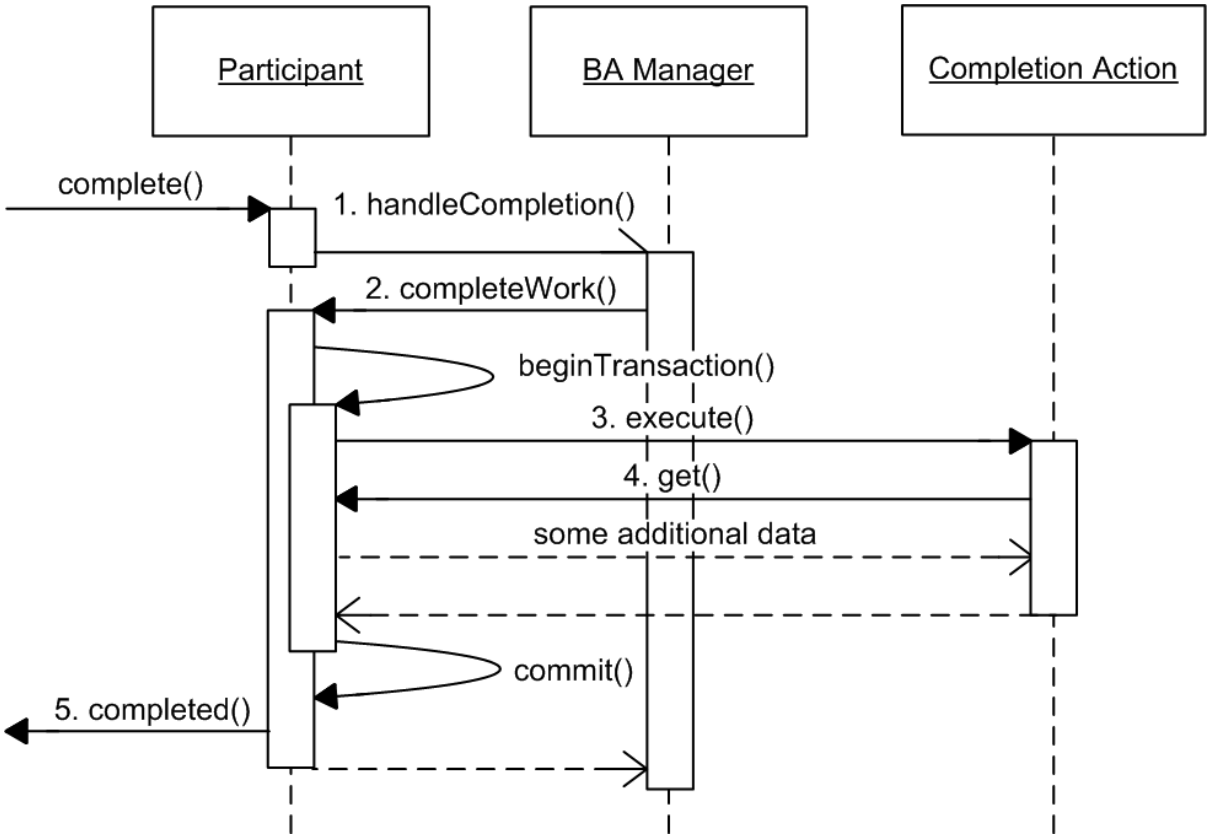
- Framework manages tasks
  - task: original invocation
    (+ completion action)
    (+ compensation action)
  - 4-step processing:
    - BA Task Management
    - (BA Completion Management)
    - (BA Compensation Management)
    - BA Close Management



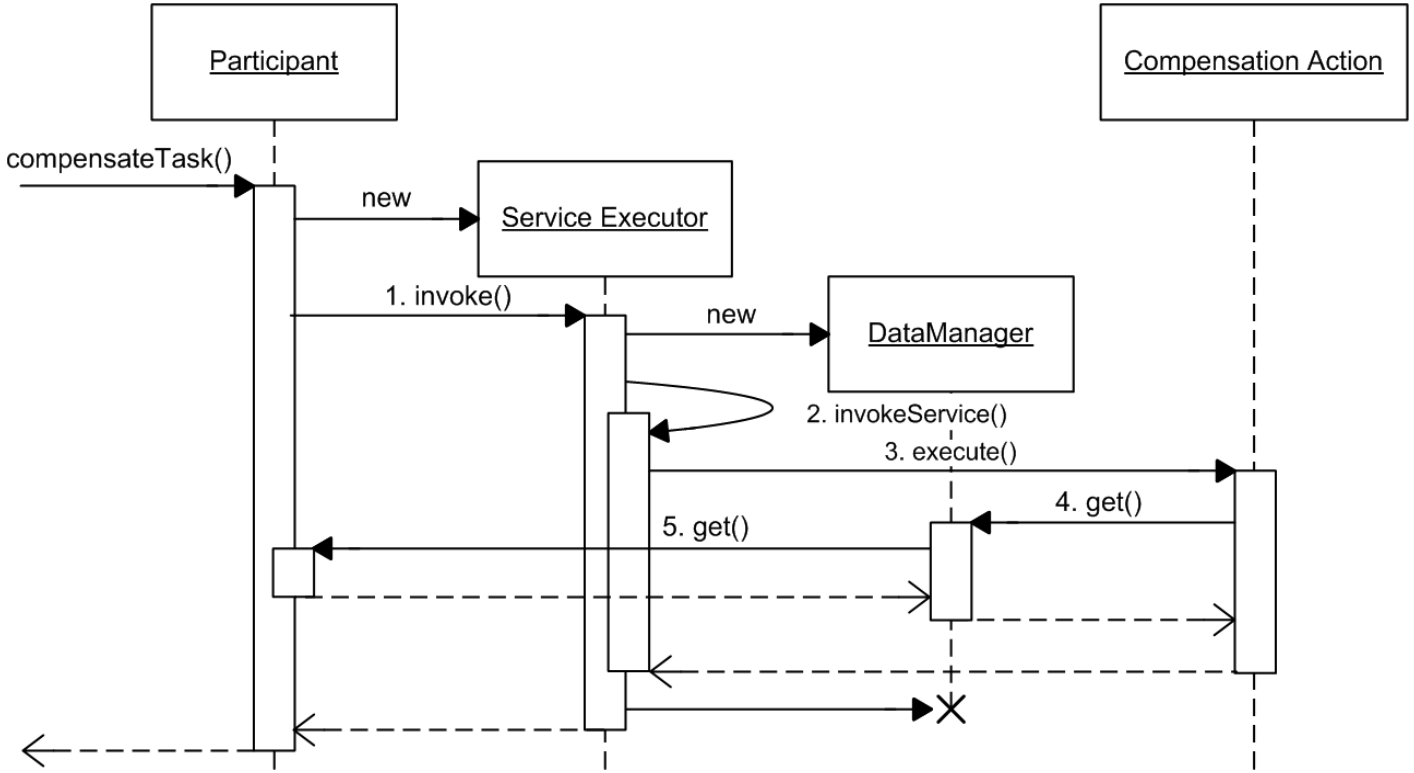
BA Task Management



BA Completion Management



BA Compensation Management



BA Close Management