Designing SOA
Case Study(*)

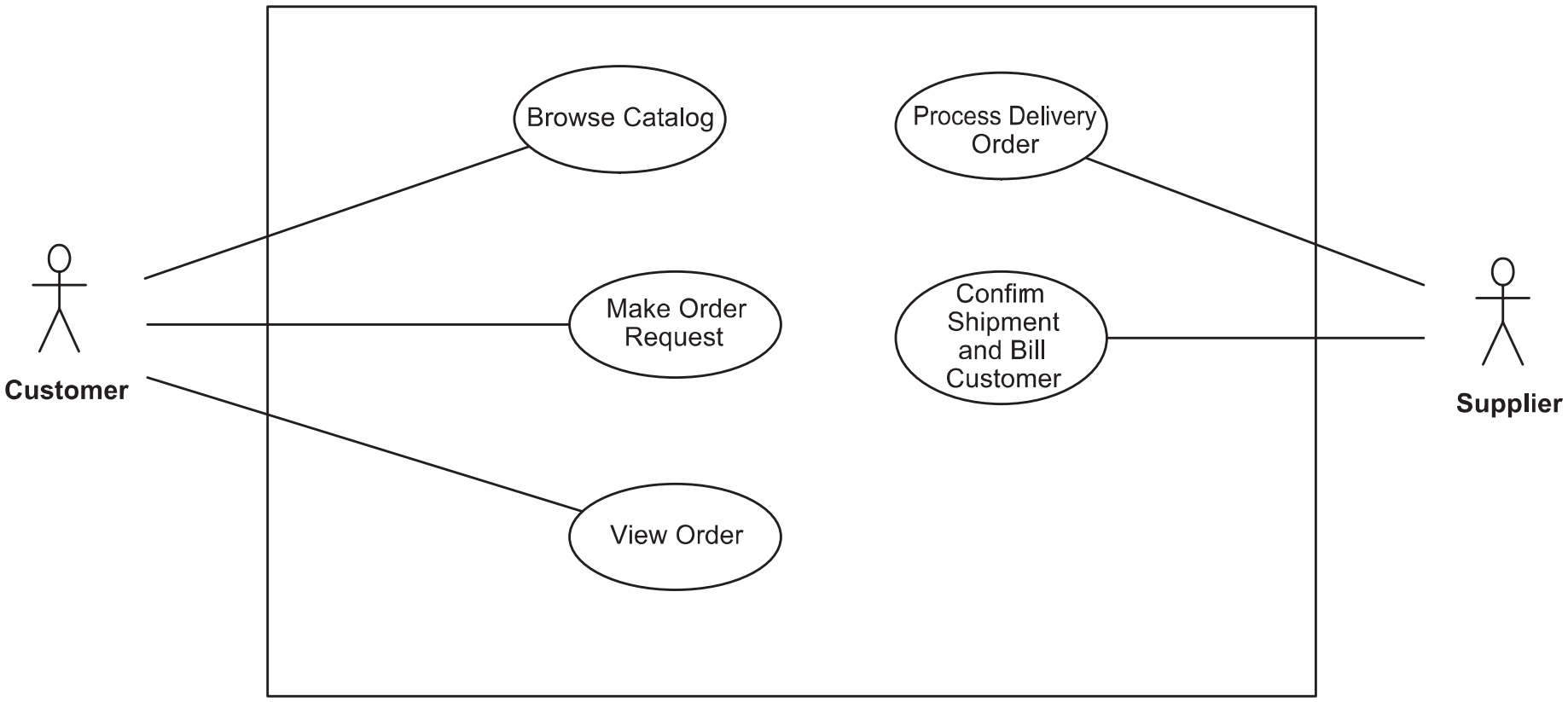
(*) Hassan Gomaa, *Software Modeling and Design: UML, Use Cases, Patterns, and Software Architectures*, Cambridge Press.

Web-based Online Shopping System

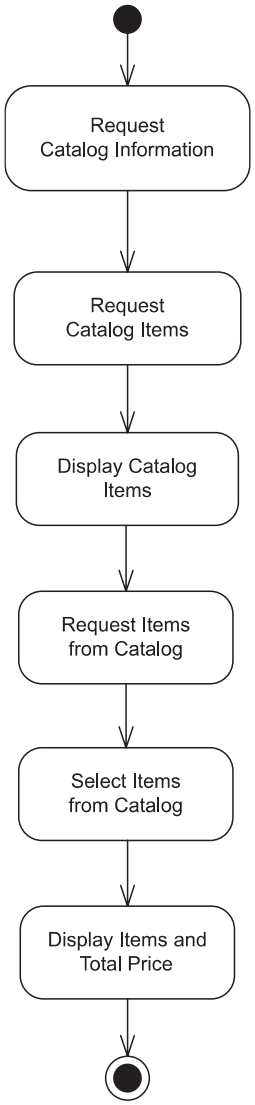
- In the **Web-based Online Shopping System**, customers can request to purchase one or more items from the supplier
- The customer provides personal details, such as address and credit card information
- This information is stored in a customer account
- If the credit card is valid, then a delivery order is created and sent to the supplier
- The supplier checks the available inventory, confirms the order, and enters a planned shipping date
- When the order is shipped, the customer is notified, and the customer's credit card account is charged

Use Case Modeling

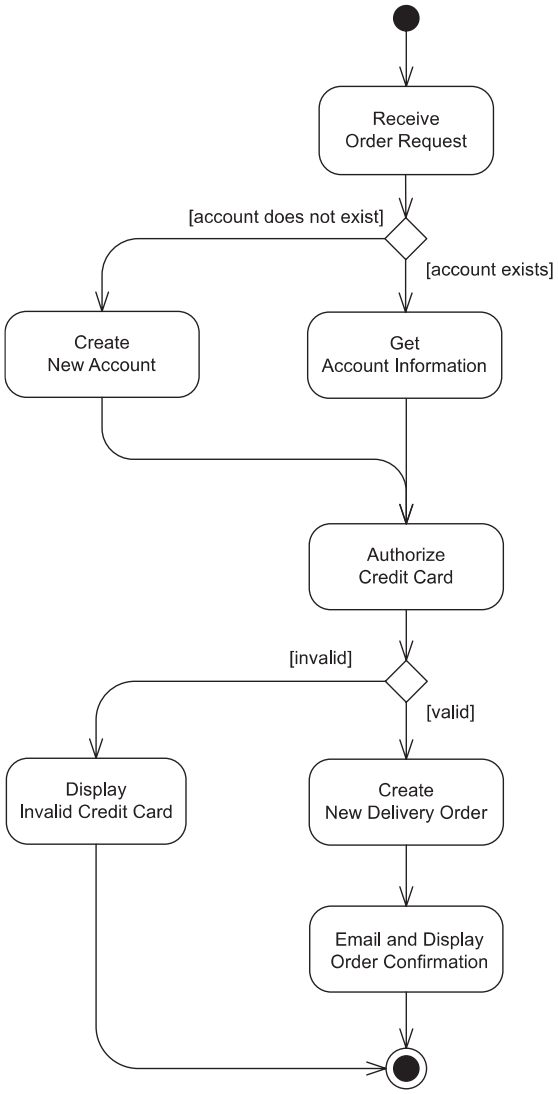
Use Case Diagram



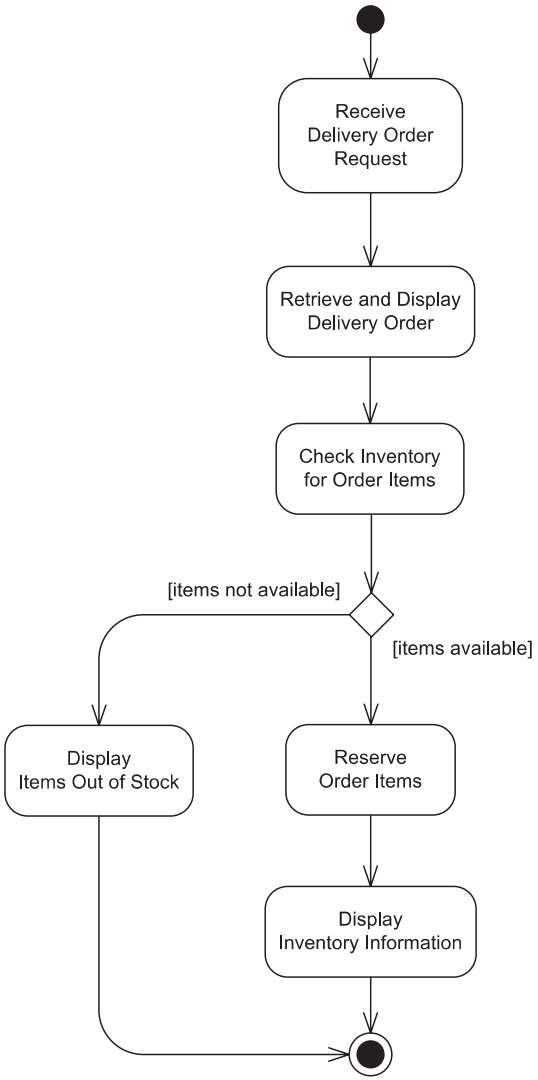
Activity diagram for *Browse Catalog* UC



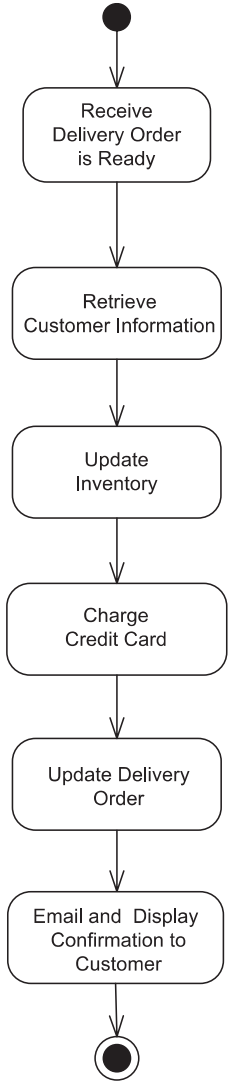
Activity diagram for *Make Order Request* UC



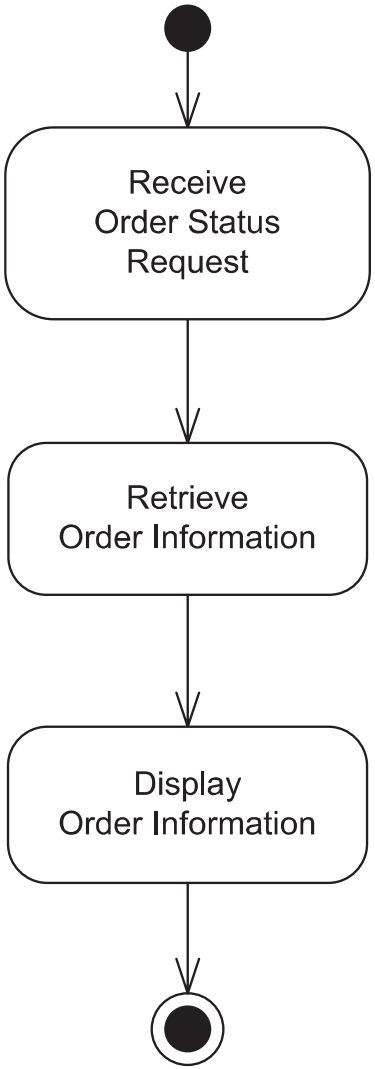
Activity diagram for *Process Delivery Order* UC



Activity diagram for *Confirm Shipment and Bill Customer* UC

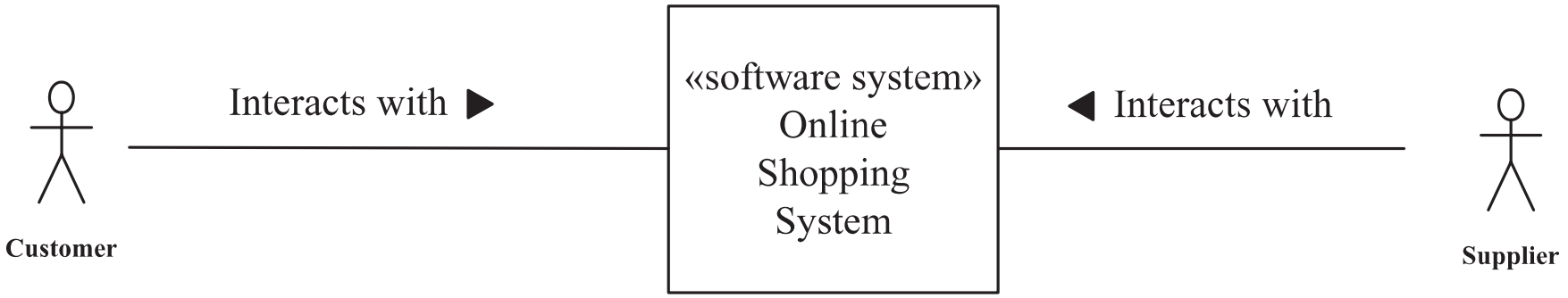


Activity diagram for View Order UC

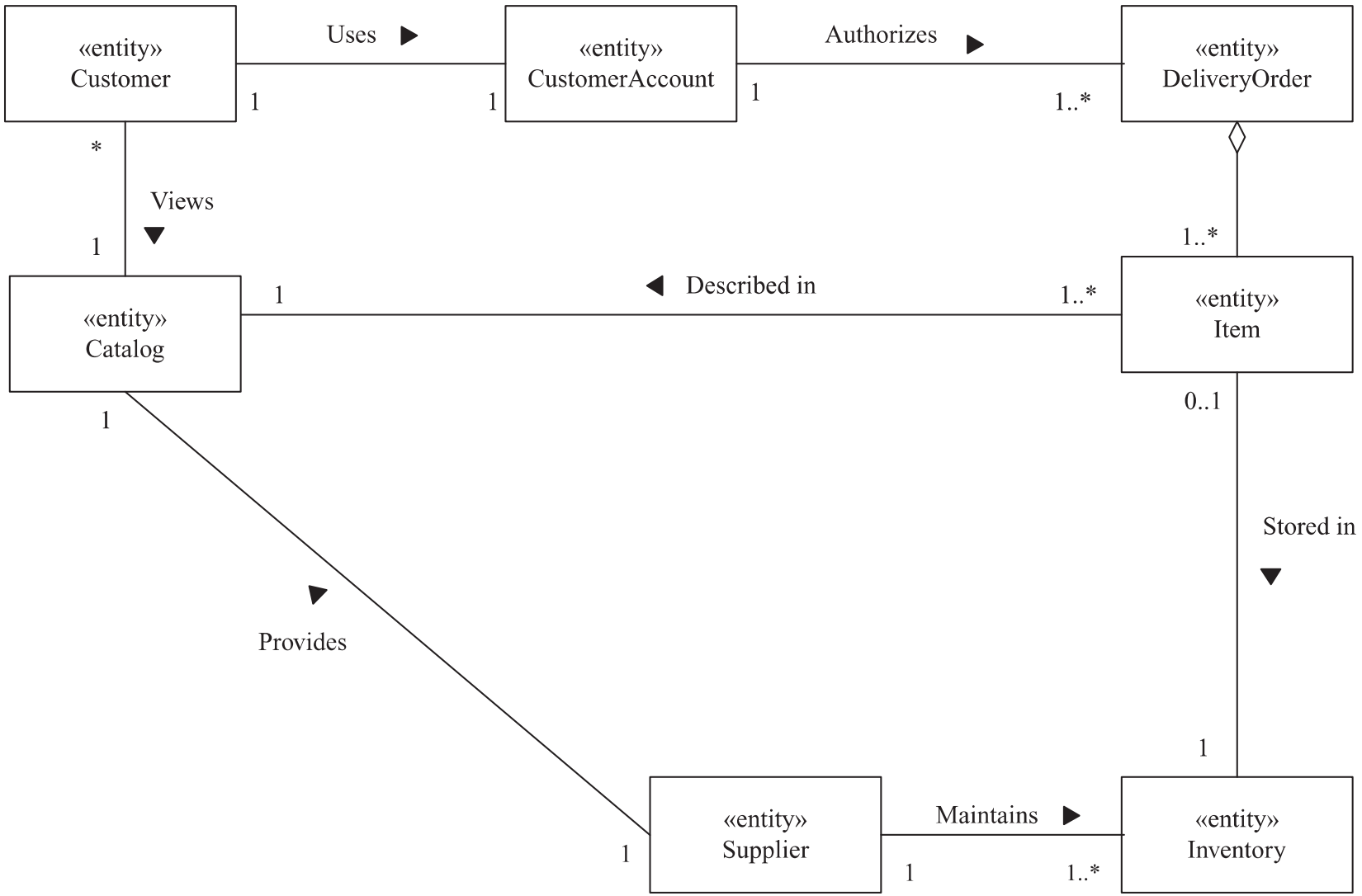


Static Modeling

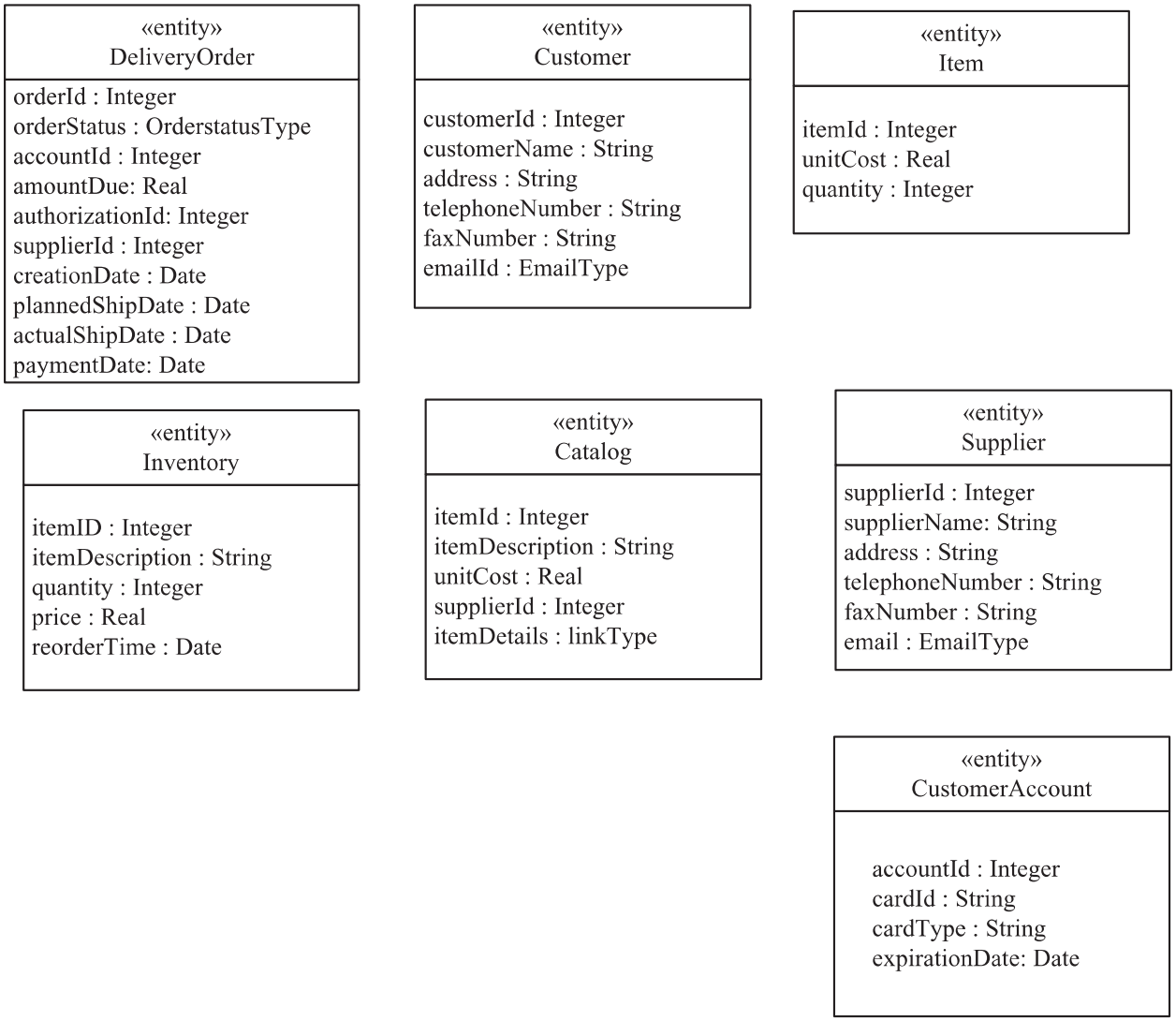
Software System Context Class Diagram



Entity Class Diagram



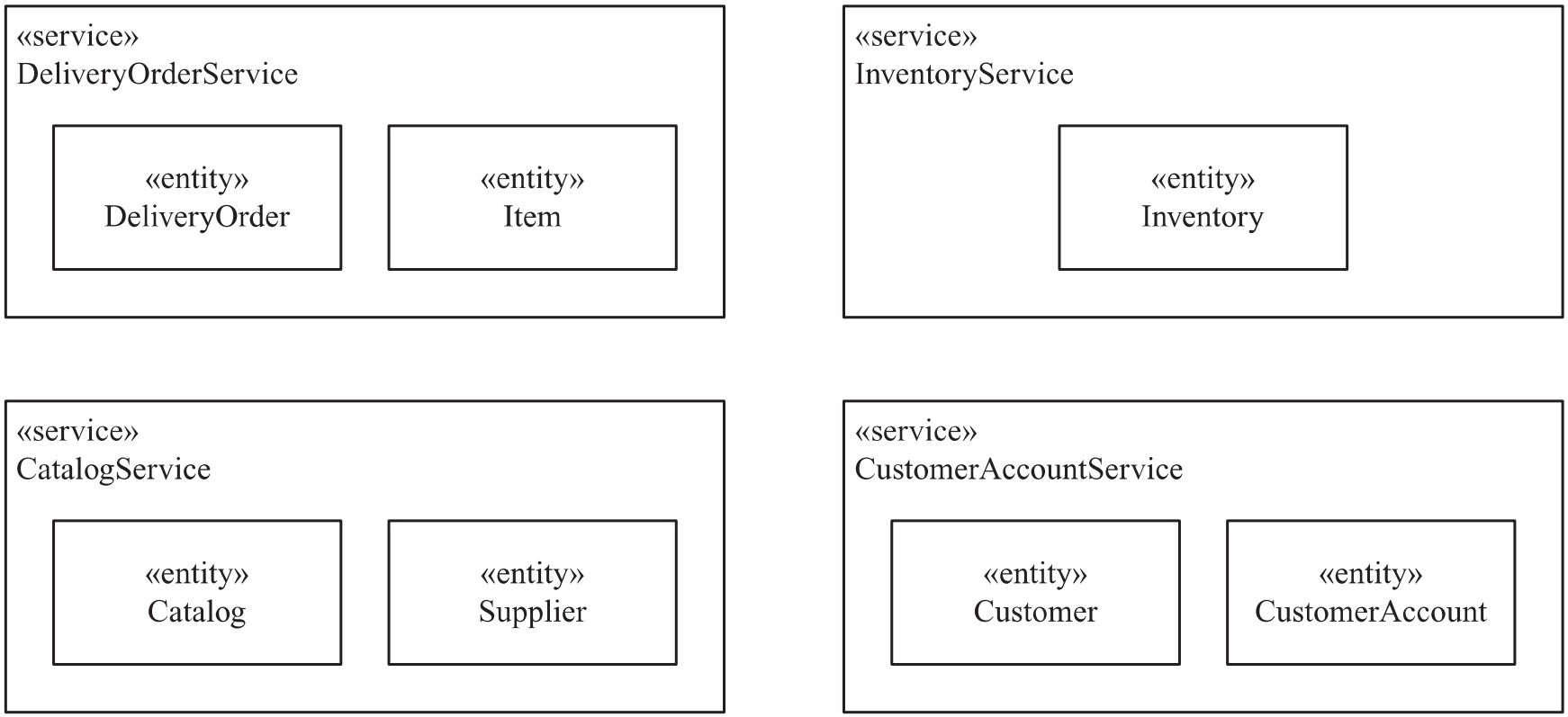
Entity Classes



Class Structuring

- The entity classes determined in the previous section are integrated into a service-oriented architecture by means of service classes
- Catalog Service, Customer Account Service, Delivery Order Service, and Inventory Service are service classes that provide access to the entity classes

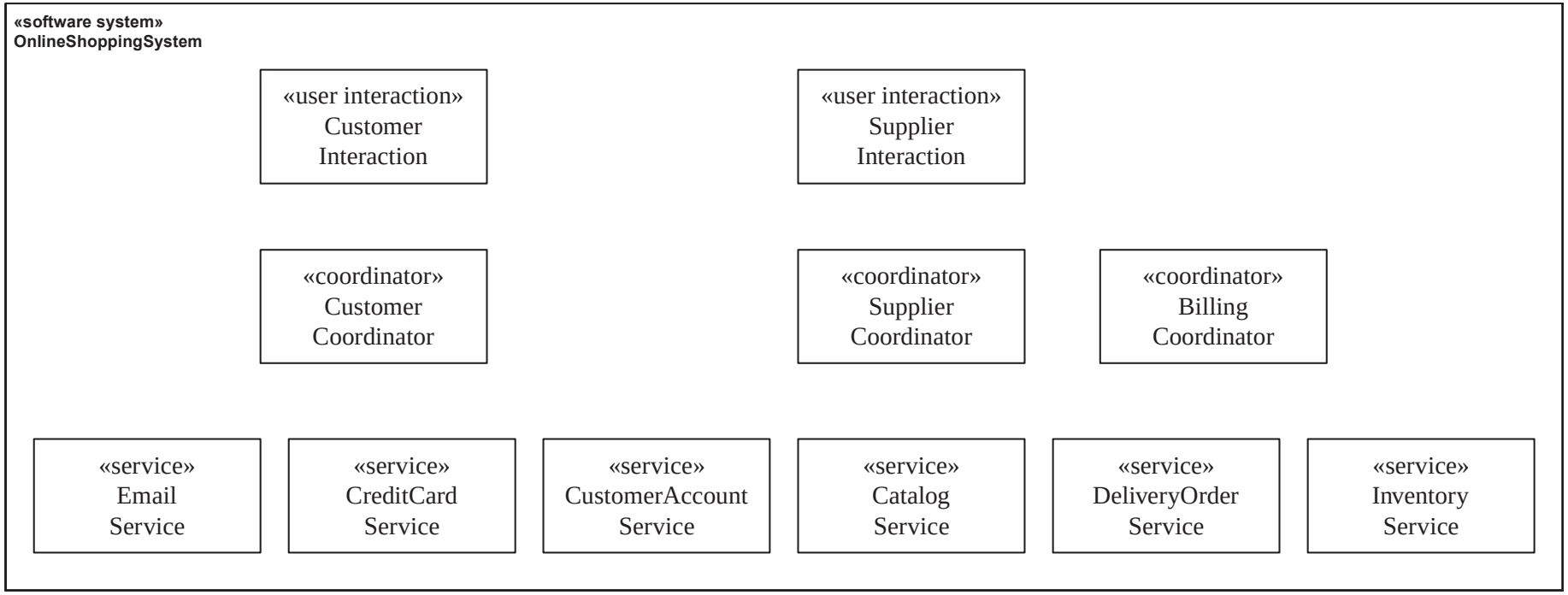
Service and Entity Classes



Other classes

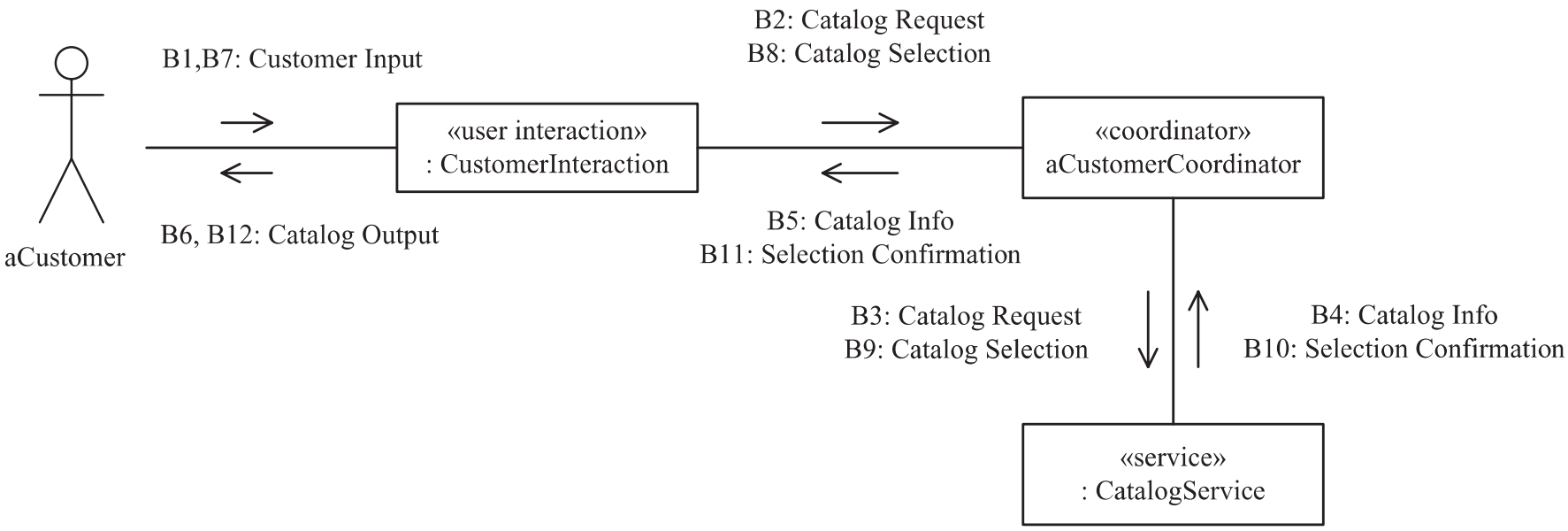
- There is also a *service class*, Credit Card Service, which deals with credit card authorization and charging
- Another *service class* is Email Service, which enables the Online Shopping System to send email messages to customers.
- *User interaction classes* are needed to interact with the external users – in particular, Customer Interaction and Supplier Interaction, which correspond to the actors in the use cases
- In addition, to coordinate and sequence the customer and supplier access to the online shopping services, two *coordinator classes*, Customer Coordinator and Supplier Coordinator, are provided,. A third autonomous coordinator, Billing Coordinator, is needed to deal with billing customers.

Class Structuring

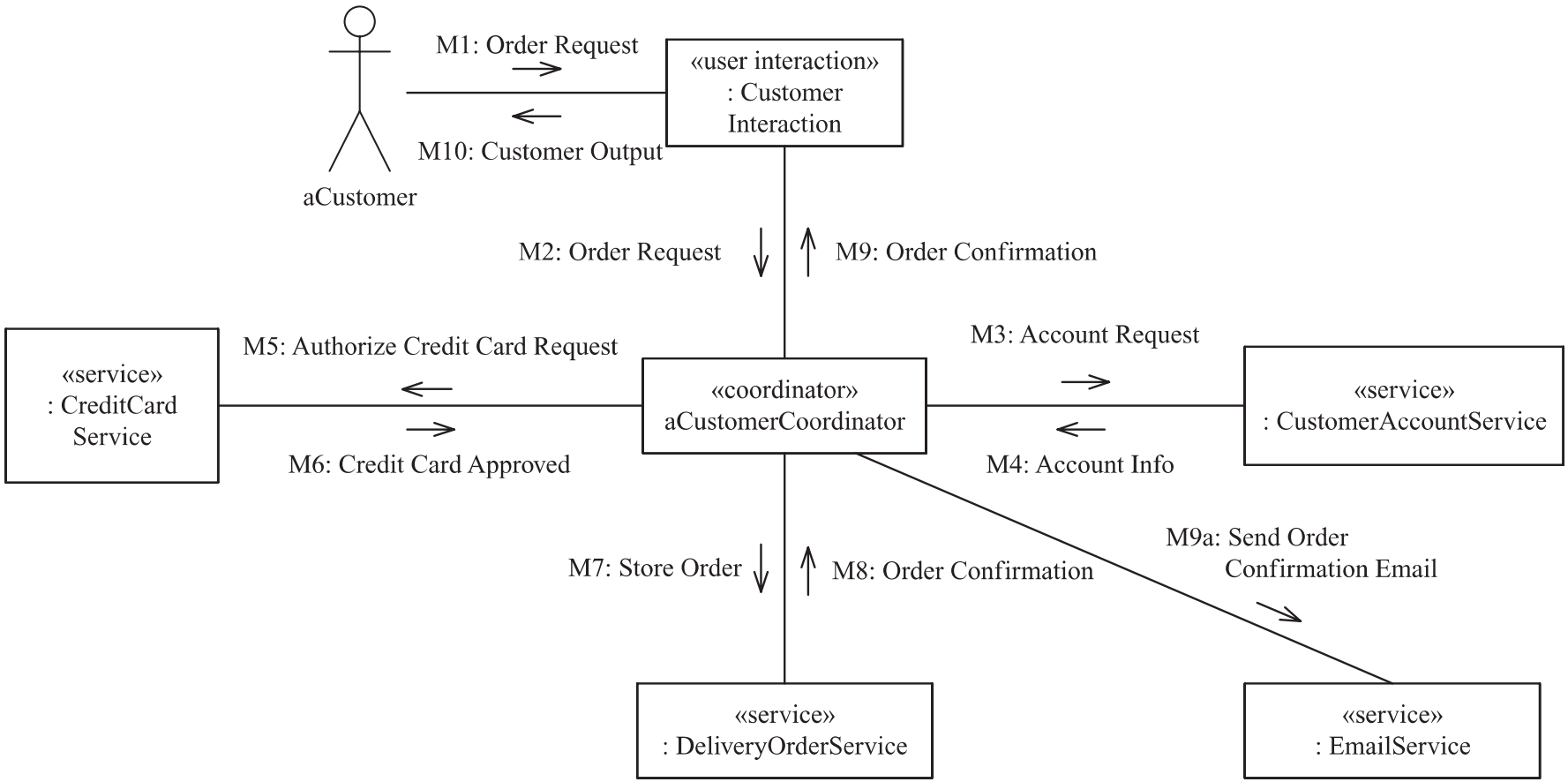


Dynamic Modeling

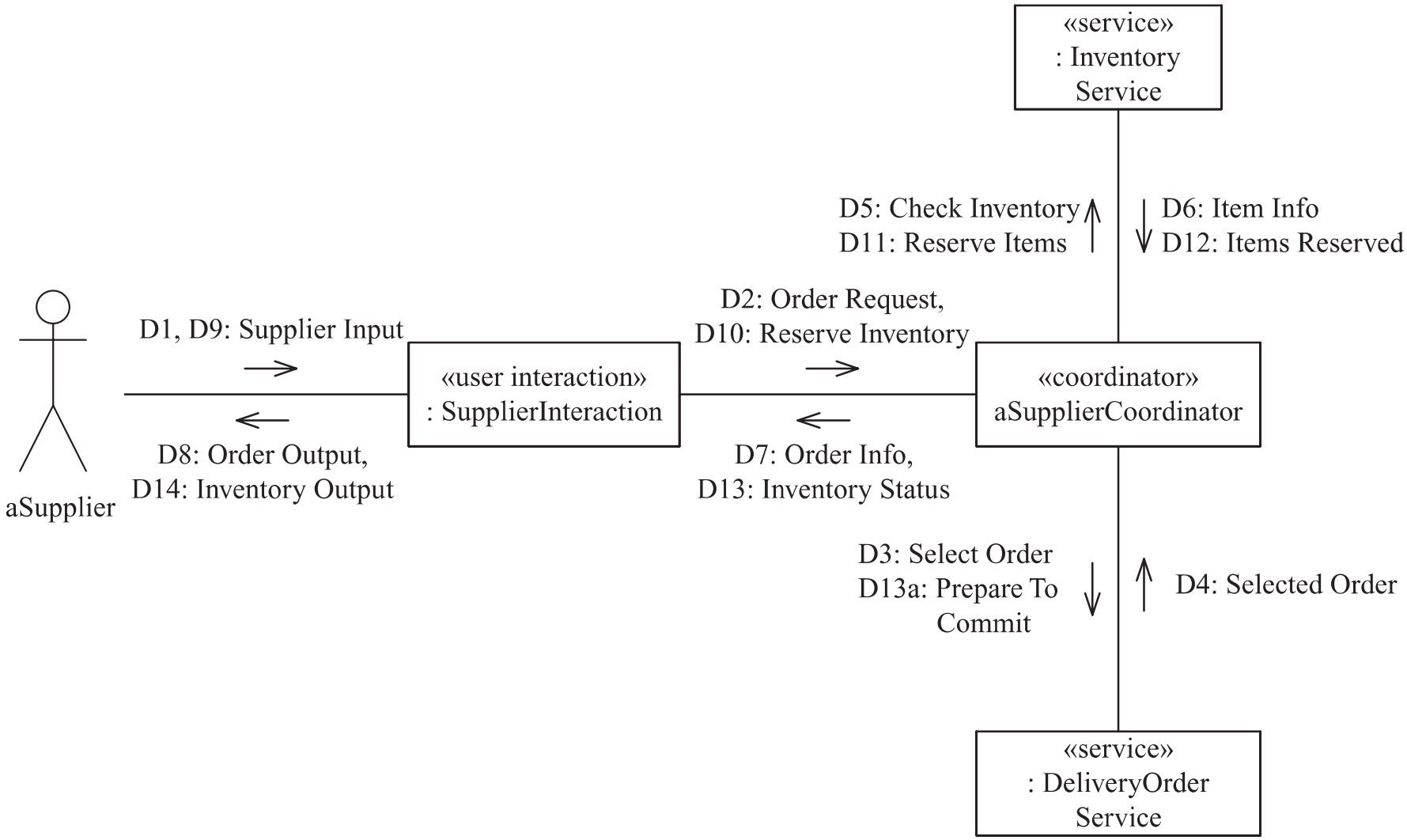
Communication diagram for the *Browse Catalog* UC



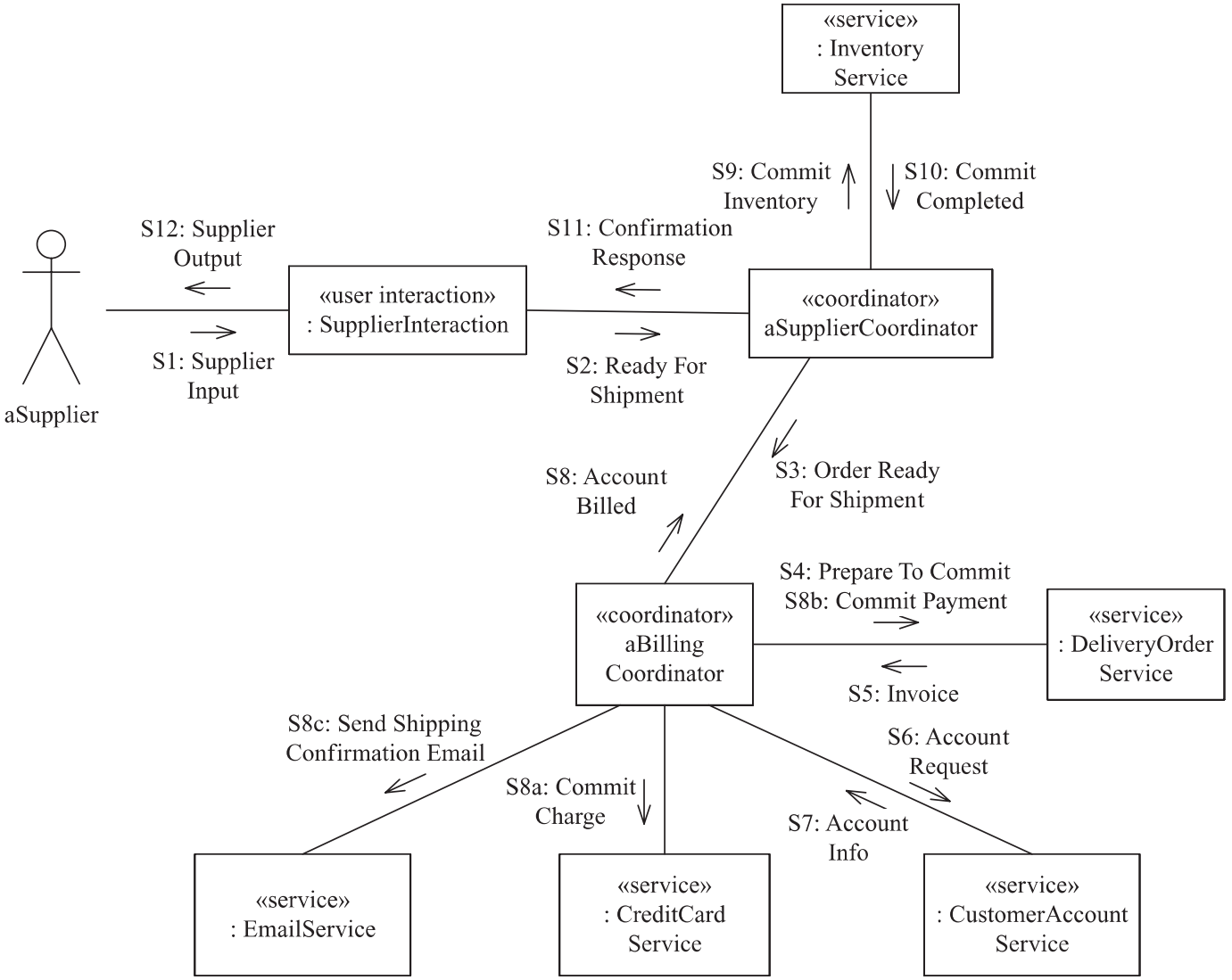
Communication diagram for the *Make Order Request* UC



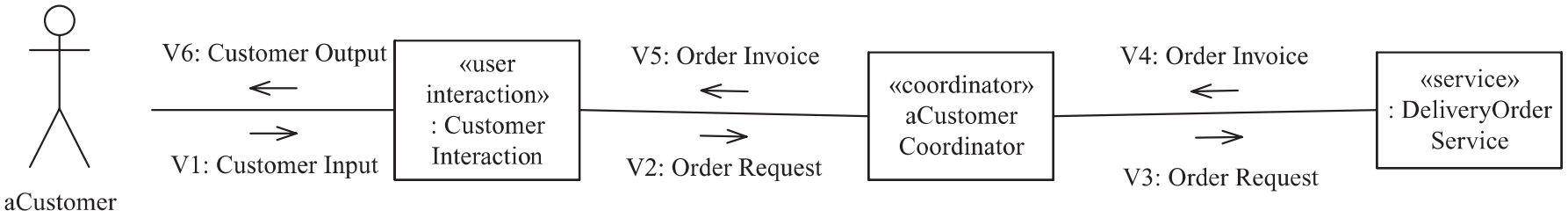
Communication diagram for the *Process Delivery Order* UC



Communication diagram for the *Confirm Shipment and Bill Customer* UC



Communication diagram for the *View Order* UC

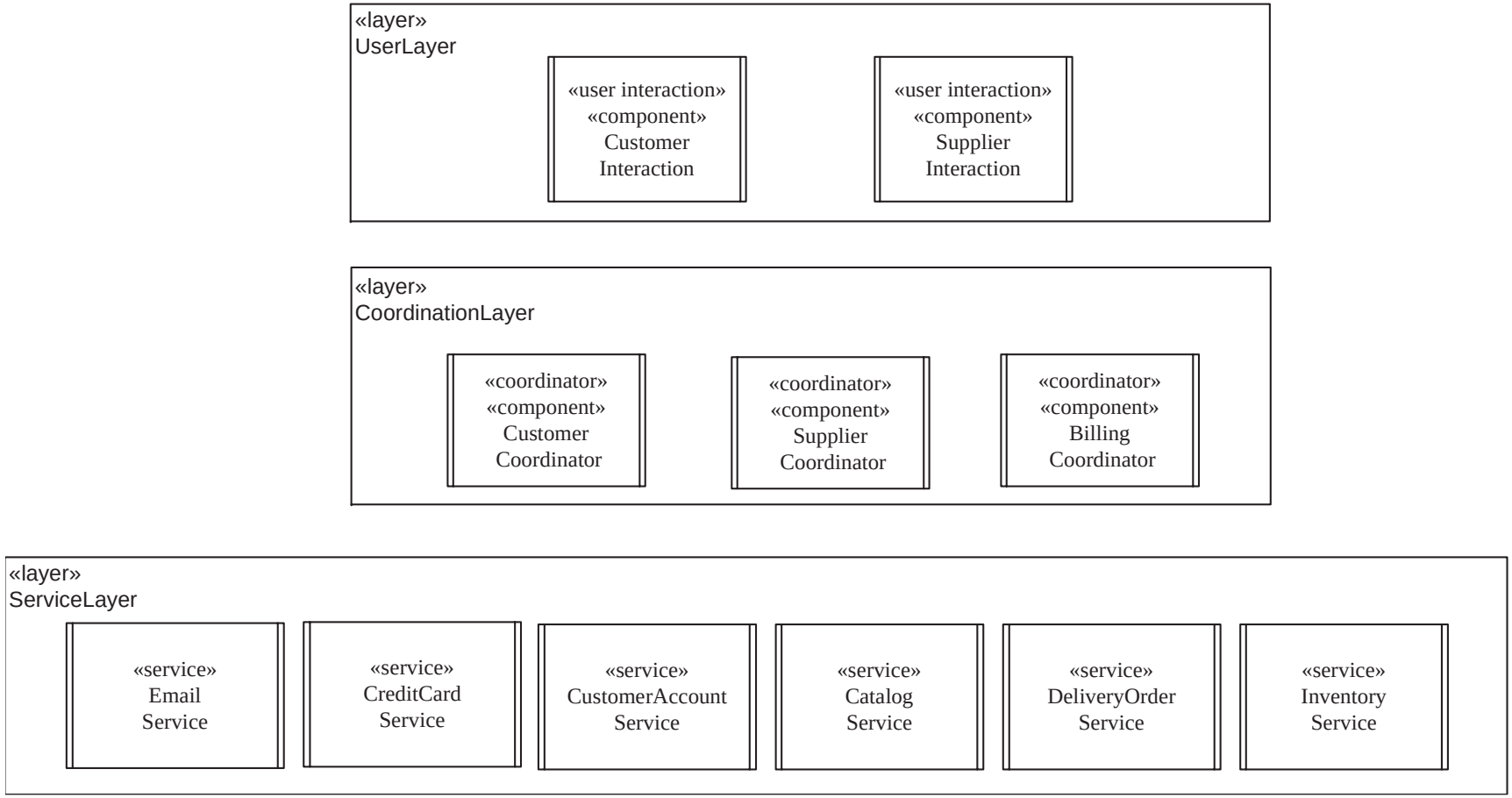


Design Modeling

Design Modeling Overview

- The Online Shopping System is designed as a layered architecture based on the Layers of Abstraction architecture pattern
- The software architecture consists of three layers – a (data) service layer, a coordinator layer, and a user interaction layer
- Furthermore, because this system needs to be highly flexible and distributed, the decision is made to *design a service-oriented architecture*, in which distributed components can discover services and communicate with them
- Each component is depicted with the component stereotype (what kind of component it is, as specified by the component structuring criteria)
- The design of the component and service interfaces are determined by analysis of the communication diagrams for each use case

Layered Architecture



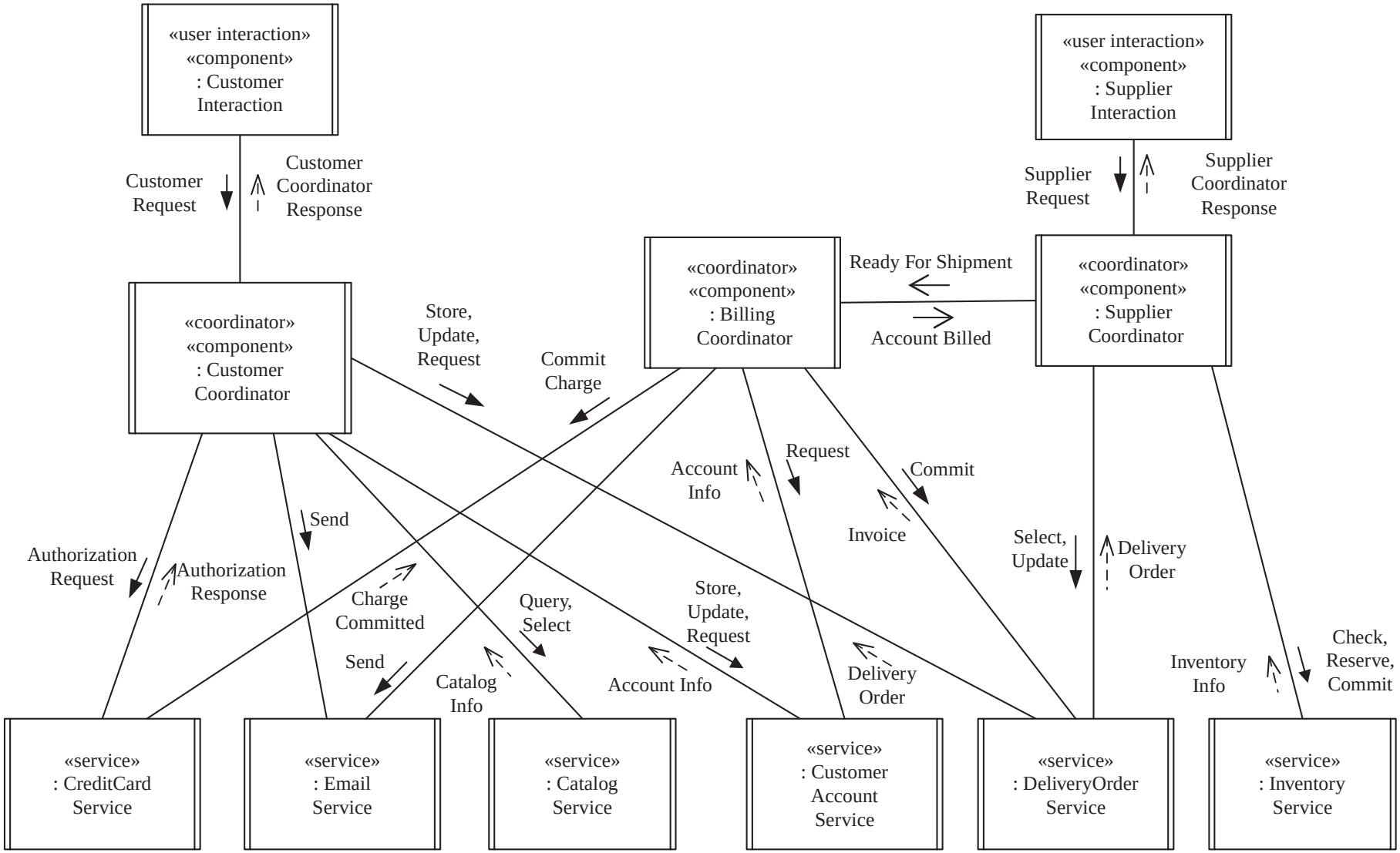
Architectural Communication Patterns

- Synchronous Message Communication with Reply
- Broker Handle
- Service Discovery
- Bidirectional Asynchronous Message Communication
- Two-Phase Commit

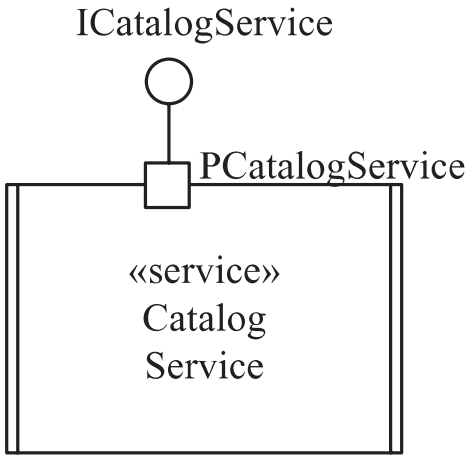
Concurrent Software Design

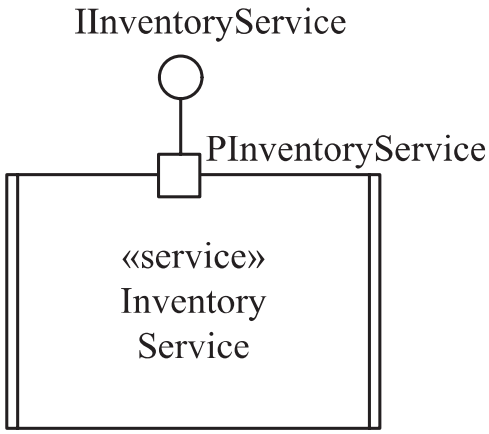
- To keep the design simple, the Synchronous Message Communication with Reply pattern has been widely used in this case study
- This approach has the disadvantage of suspending the client while it awaits a response from the service
- An alternative design to avoid suspending the client is to use the Asynchronous Message Communication with Callback pattern
- The Bidirectional Asynchronous Communication pattern is used for Supplier Coordinator and Billing Coordinator to communicate with each other in both directions

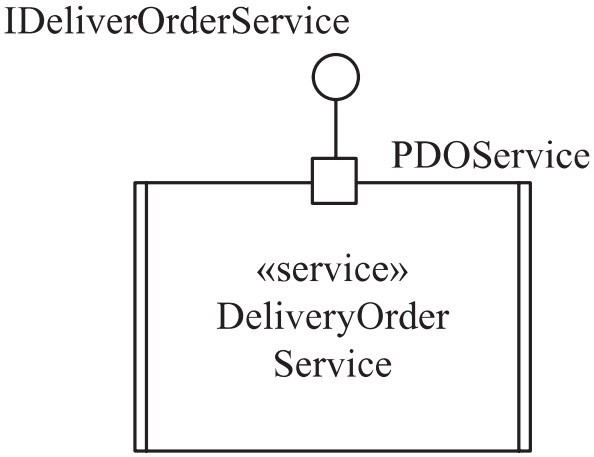
Concurrent Communication Diagram

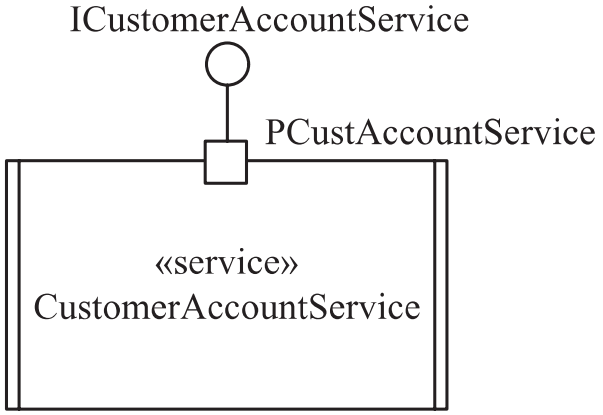


Component Ports and Interfaces for Services

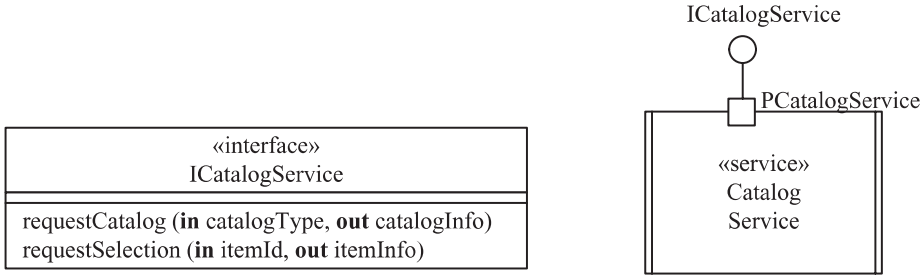


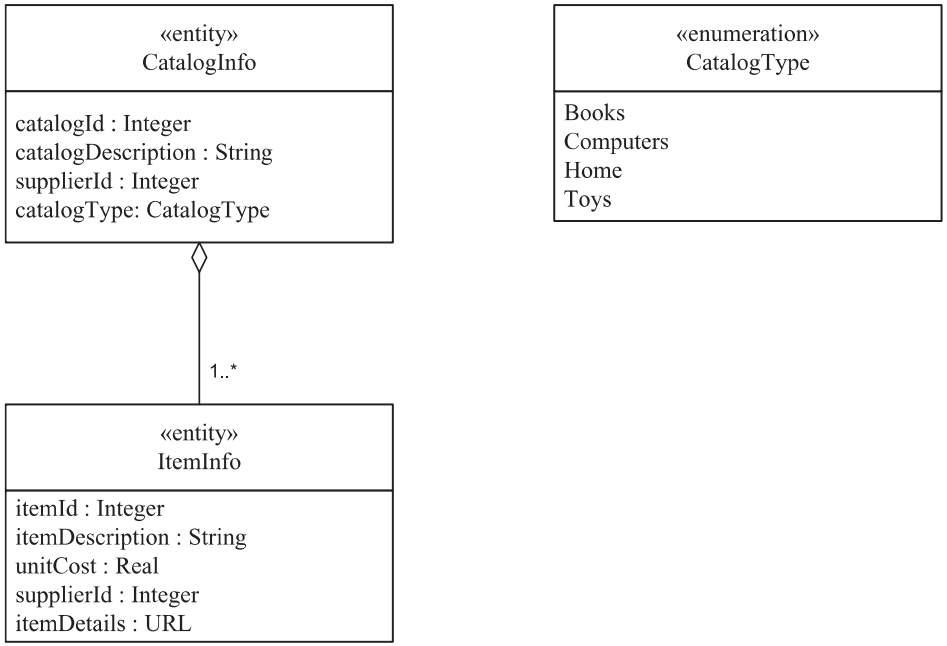




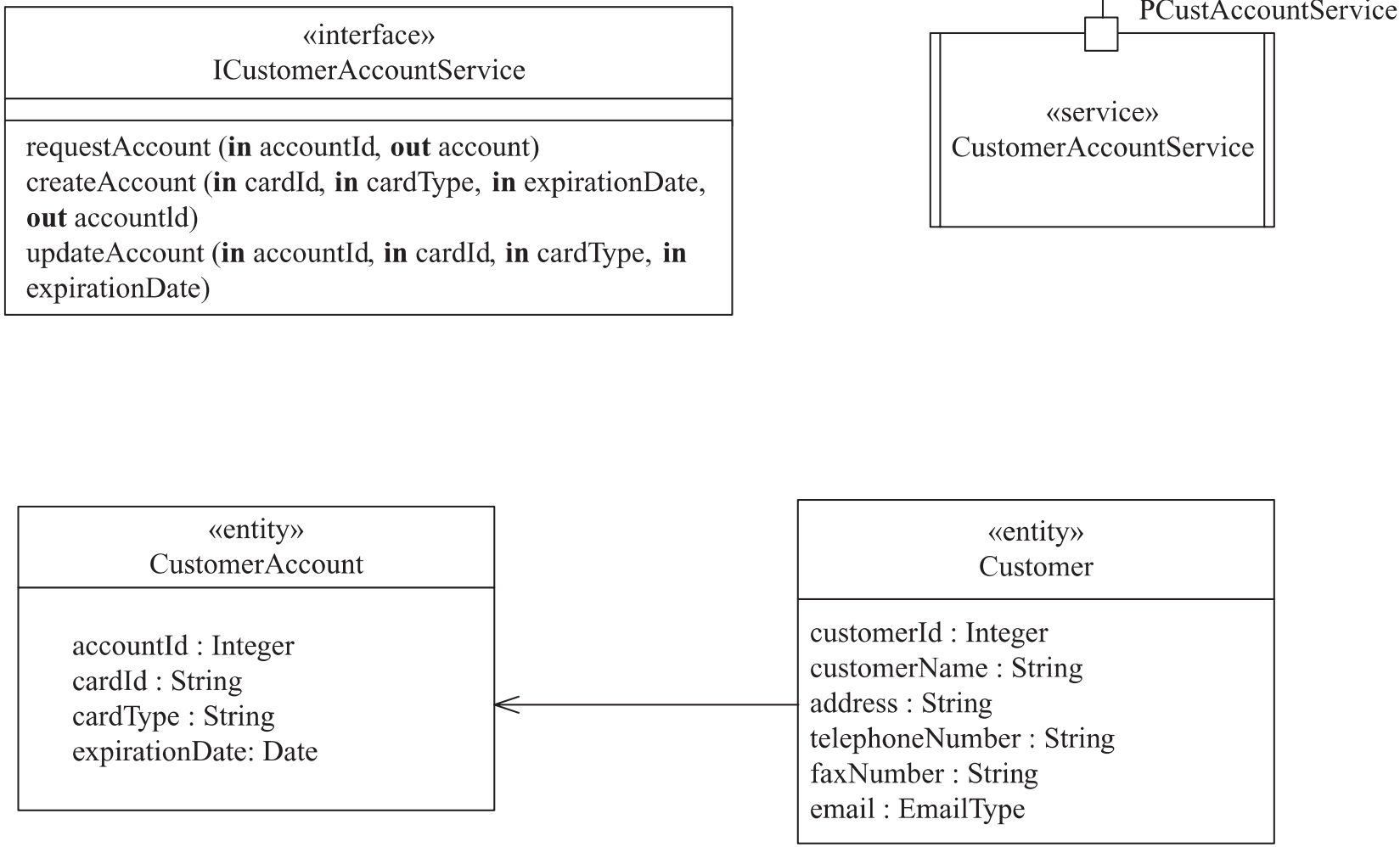


Service Interface for *Catalog* Service

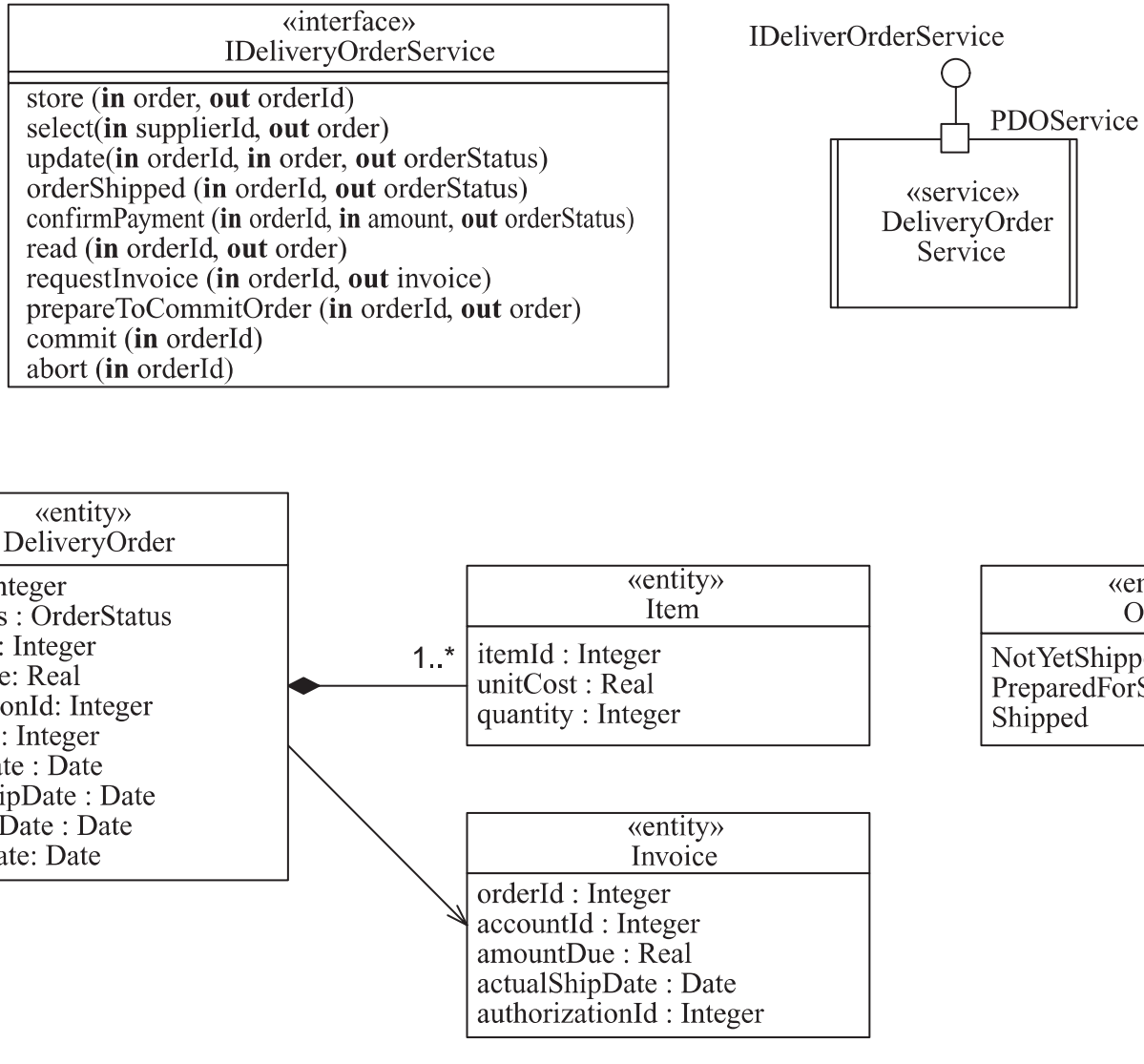




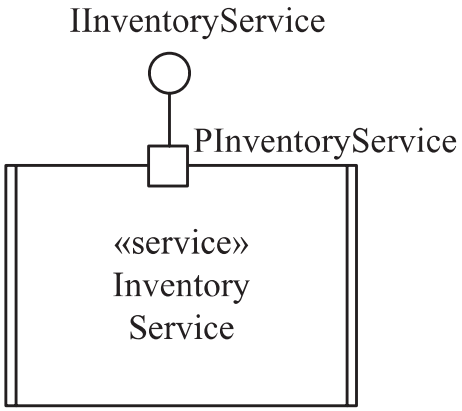
Service Interface for *Customer Account* Service



Service Interface for *Delivery Order* Service



Service Interface for *Inventory* Service



«interface»
IInventoryService

checkInventory (**in** itemId, **out** inventoryStatus)
update (**in** itemId, **in** amount)
reserveInventory (**in** itemId, **in** amount)
commitInventory (**in** itemId, **in** amount)
abortInventory (**in** itemId, **in** amount)

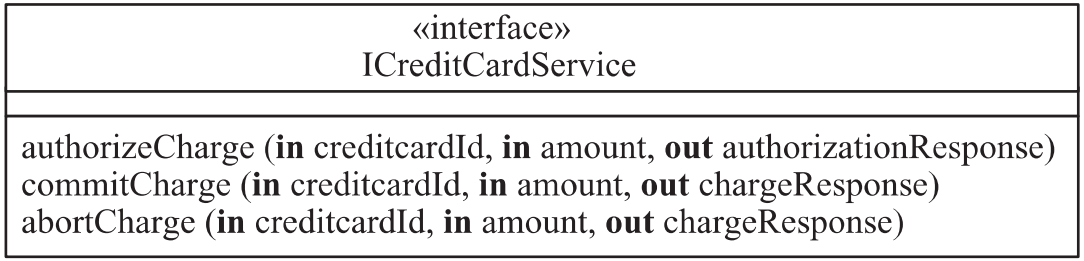
«entity»
Inventory

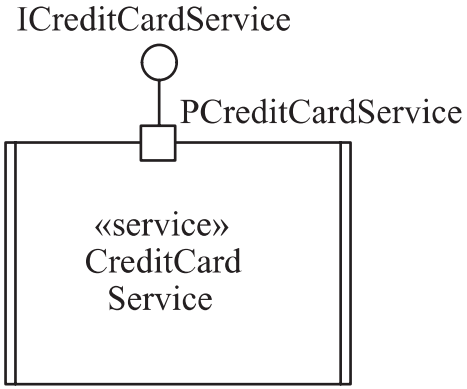
itemID : Integer
itemDescription : String
quantity : Integer
quantityReserved: Integer
price : Real
reorderTime : Date

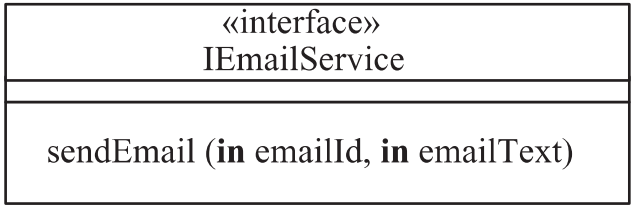
«entity»
InventoryStatus

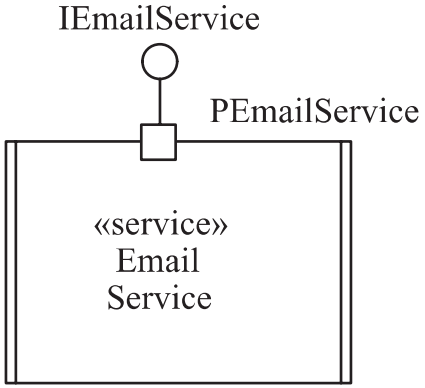
itemID : Integer
currentAmount: Integer
quantityAfterShipped: Integer
reorderTime : Date

Service Interface for *Credit Card* and *Email* services

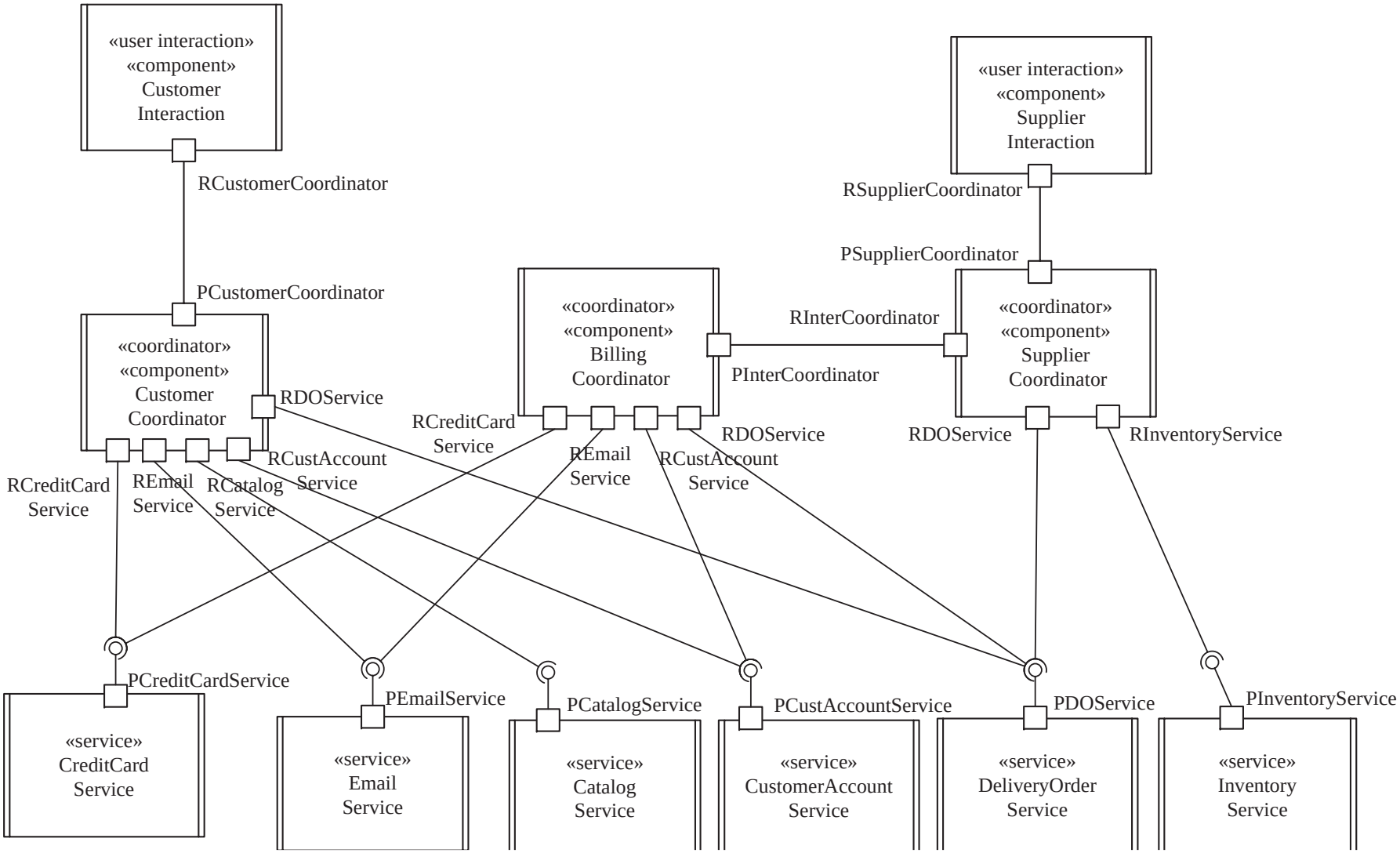




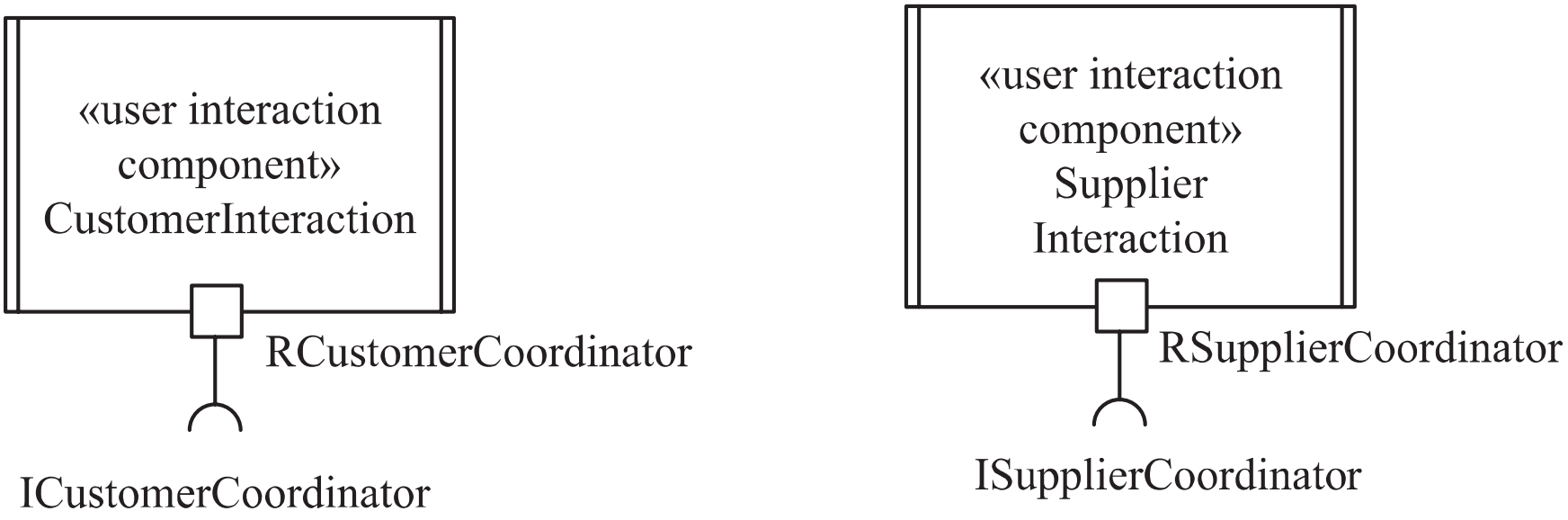




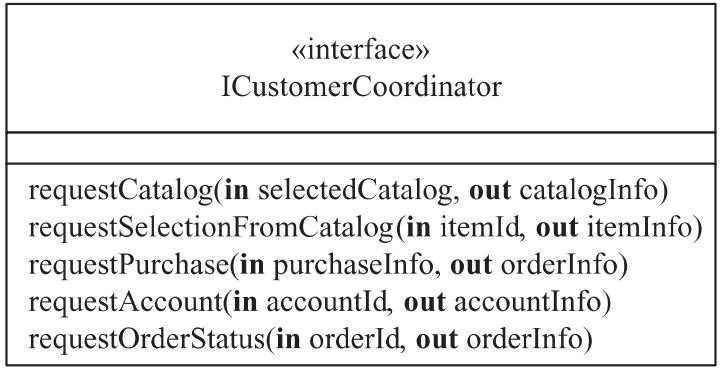
Service-Oriented Software Architecture

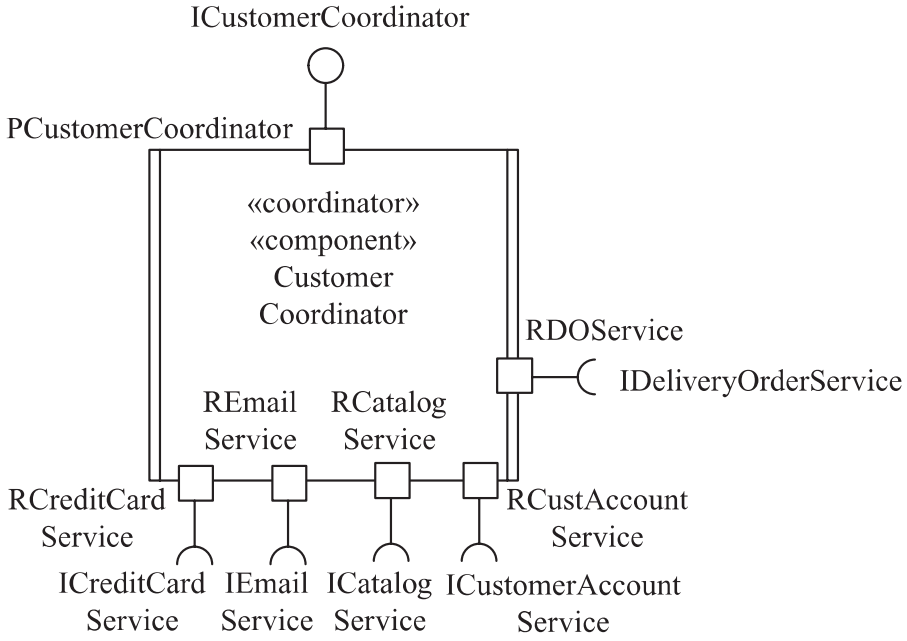


Component ports and interfaces for *Customer Interaction* and *Supplier Interaction*

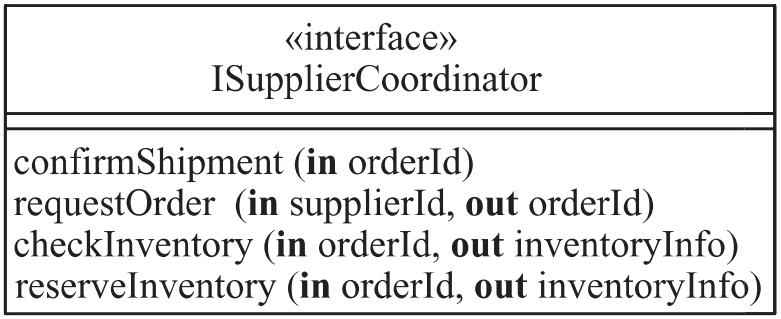


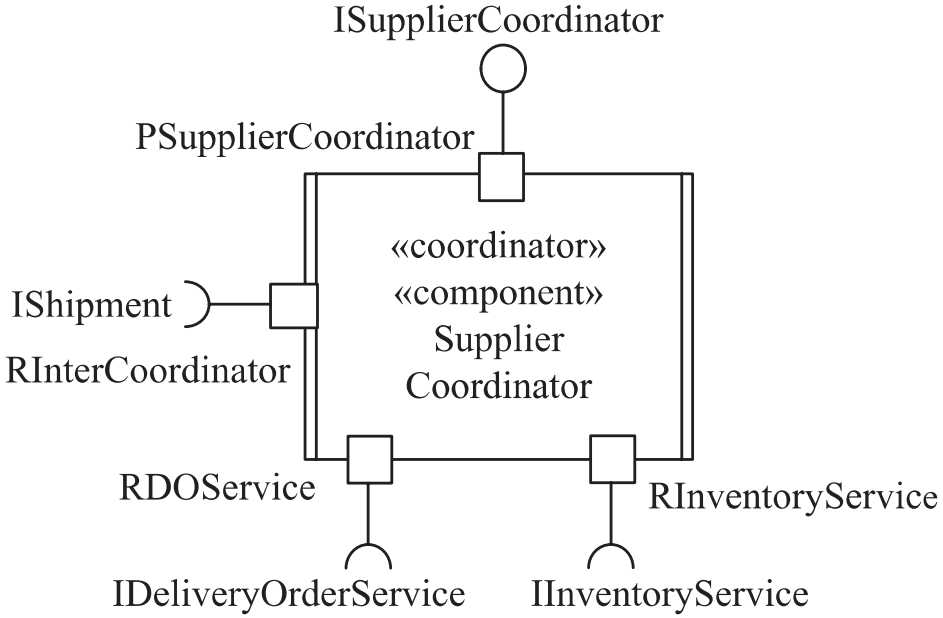
Component ports and interfaces for *Customer* Coordinator



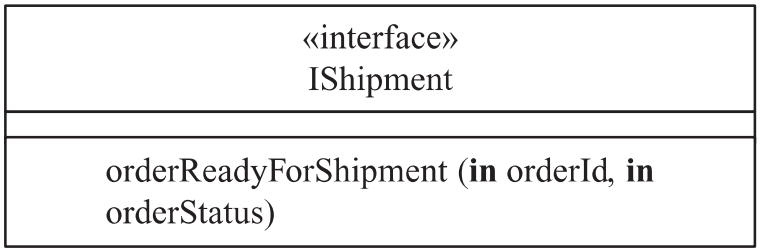


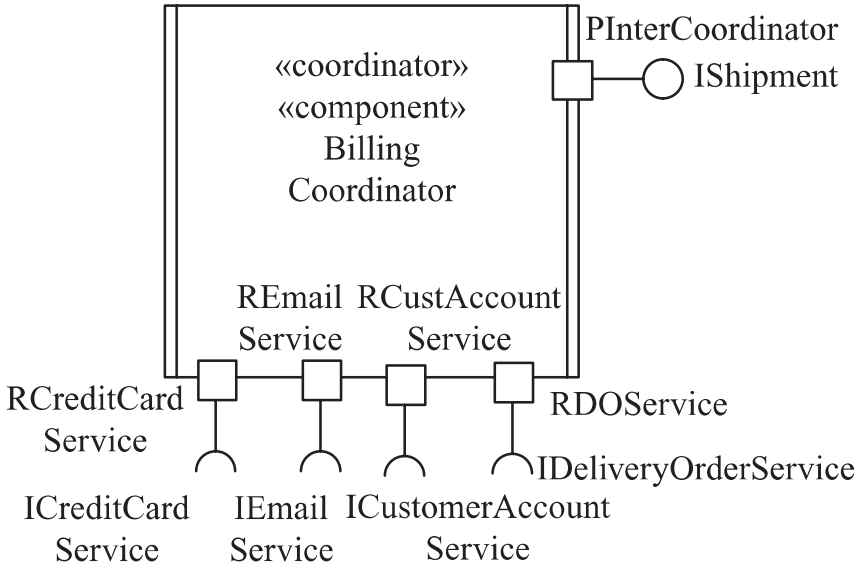
Component ports and interfaces for *Supplier* Coordinator





Component ports and interfaces for *Billing* Coordinator





Service Reuse

- With the SOA paradigm, once the services have been designed and their interfaces specified, the service interface information can be registered with a service broker
- Services can be composed into new applications
- This case study has described an Online Shopping System
- However, other electronic commerce systems could be designed that would reuse the services provided by the Online Shopping System, such as Catalog Service, Delivery Order Service, and Inventory Service