UML Diagrams: Sequence Diagrams The Requirements Model, and The Dynamic Analysis Model

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Outline

- Review of previous Lecture
- The Requirements Model and the Analysis model
- Importance of Sequence Diagrams
- Rules of sequence diagrams
- Use Cases and Sequence Diagrams
- The System Sequence Diagrams
- The Sound Recorder Example
- The E-Commerce Example
- Other Examples

Review of Previous lecture

- Review of development phases and UML Development - Overview
- Introduction and importance of Use Case Diagrams
- Use Case Diagram Rules
- Examples of Use Case diagrams
- Requirements Elicitation Process
  1. Identify Actors
  2. Identify Scenarios
  3. Identify Use Cases
  4. Refine Use Cases
  5. Identify Relationships between actors and Use Cases
  6. Identify Initial Analysis Objects
  7. Identify Non-functional requirements

Requirements, Use cases, and Scenarios

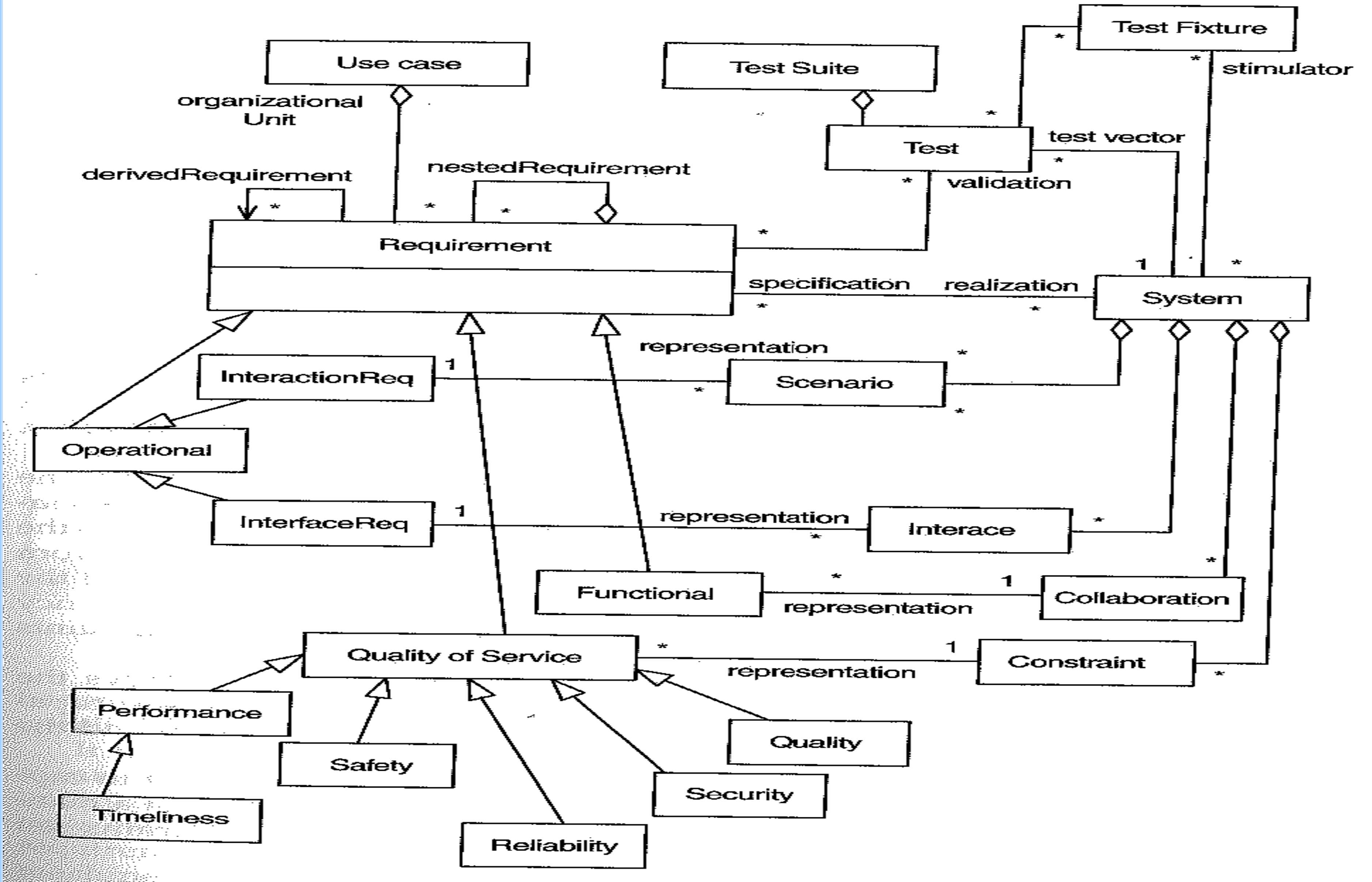
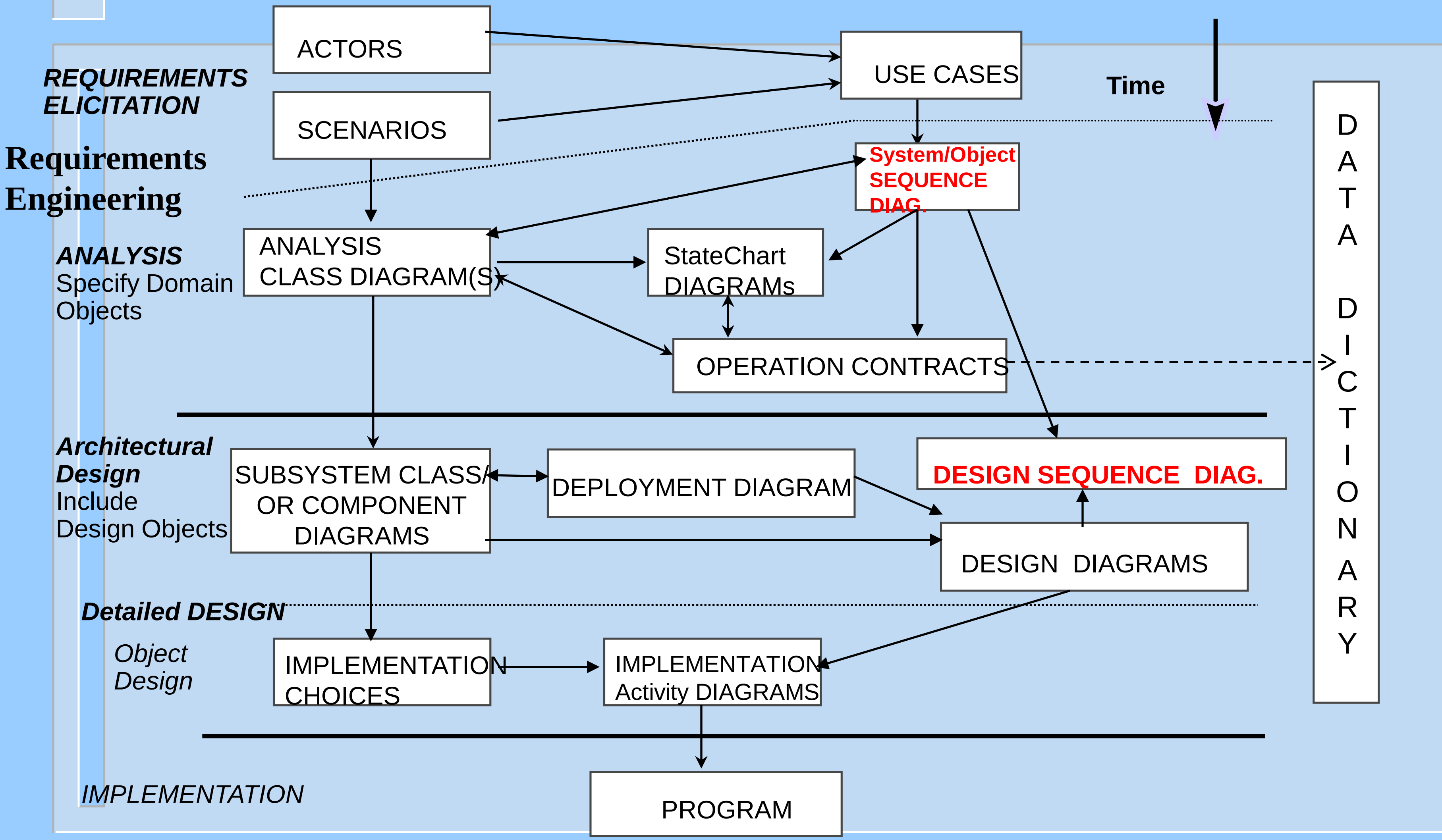


Figure 5-1: *Requirements Taxonomy*

UML Development - Overview



Where are we in the Requirements Engineering ?

- Requirements Engineering focus: elicitation and analysis

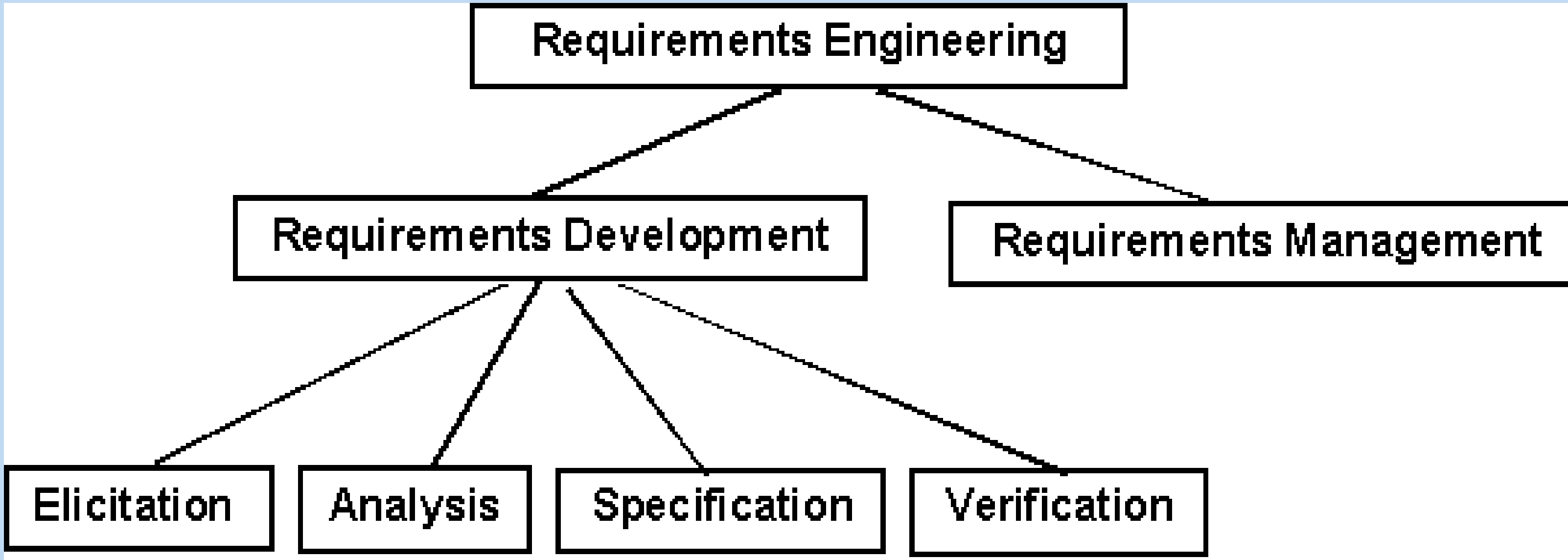
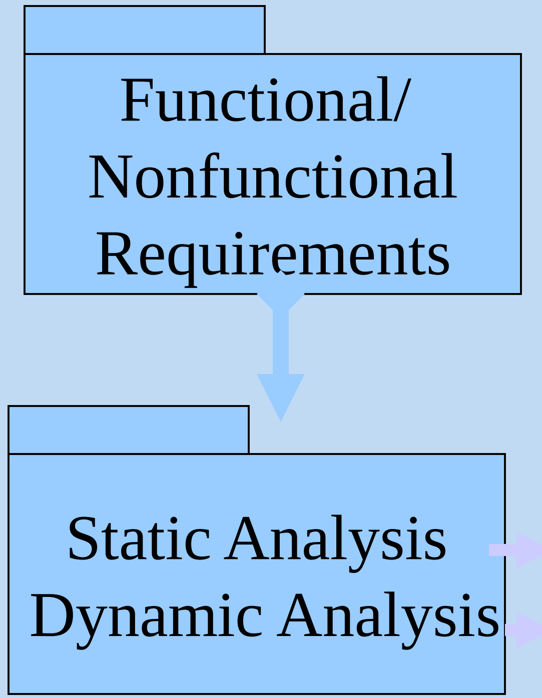


Figure 2. Subdisciplines of requirements engineering.

The Requirements Model and the Analysis Model

The Requirements Elicitation Process



Use Case Diagrams/ Sequence Diagrams (the system level)

The Object-Oriented Analysis Process

- Class Diagrams
- State Diagrams/ Refined Sequence Diagrams (The object level)

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- The Requirements Model and the Analysis model
- Introduction to Requirements Engineering
- **Importance of Sequence Diagrams**
- **Rules of sequence diagrams**
- Use Cases and Sequence Diagrams
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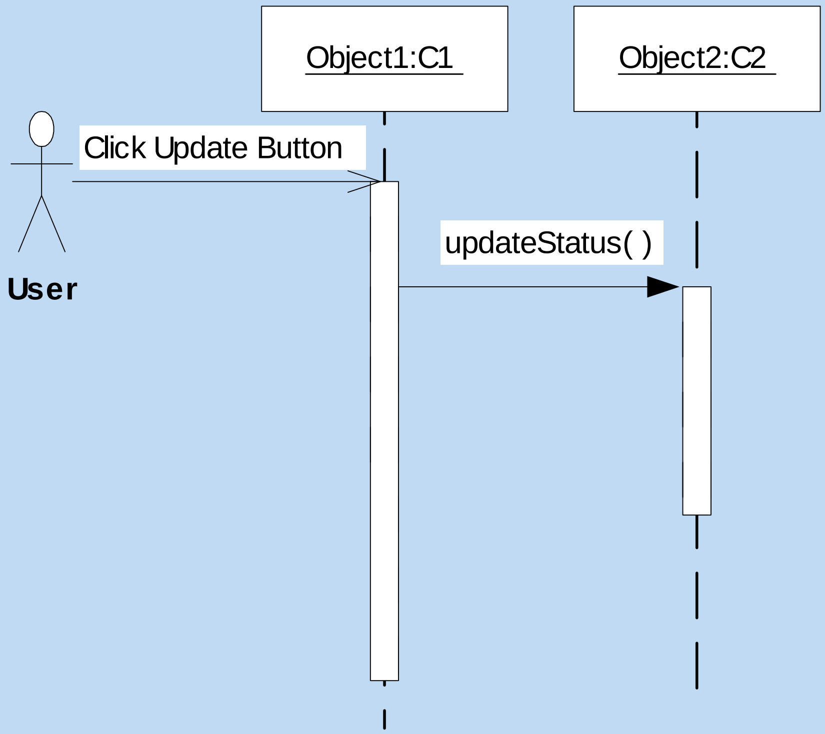
Importance of Sequence Diagrams

- Depict object interactions in a given scenario identified for a given Use Case
- Specify the messages passed between objects using horizontal arrows including messages to/from external actors
- Time increases from Top to bottom

Rules of Sequence Diagrams

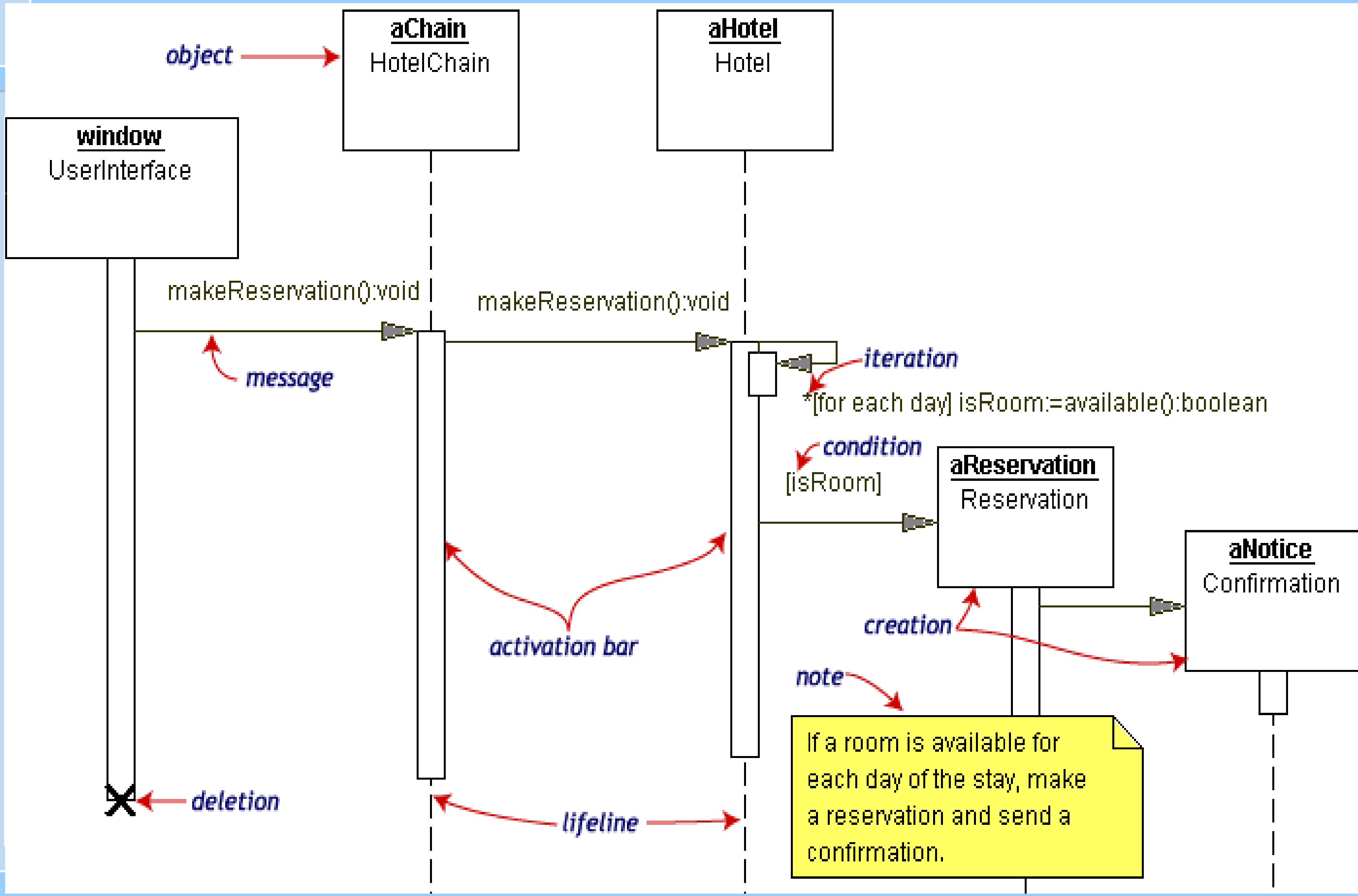
- Sequence Initiation



Rules of Sequence Diagrams

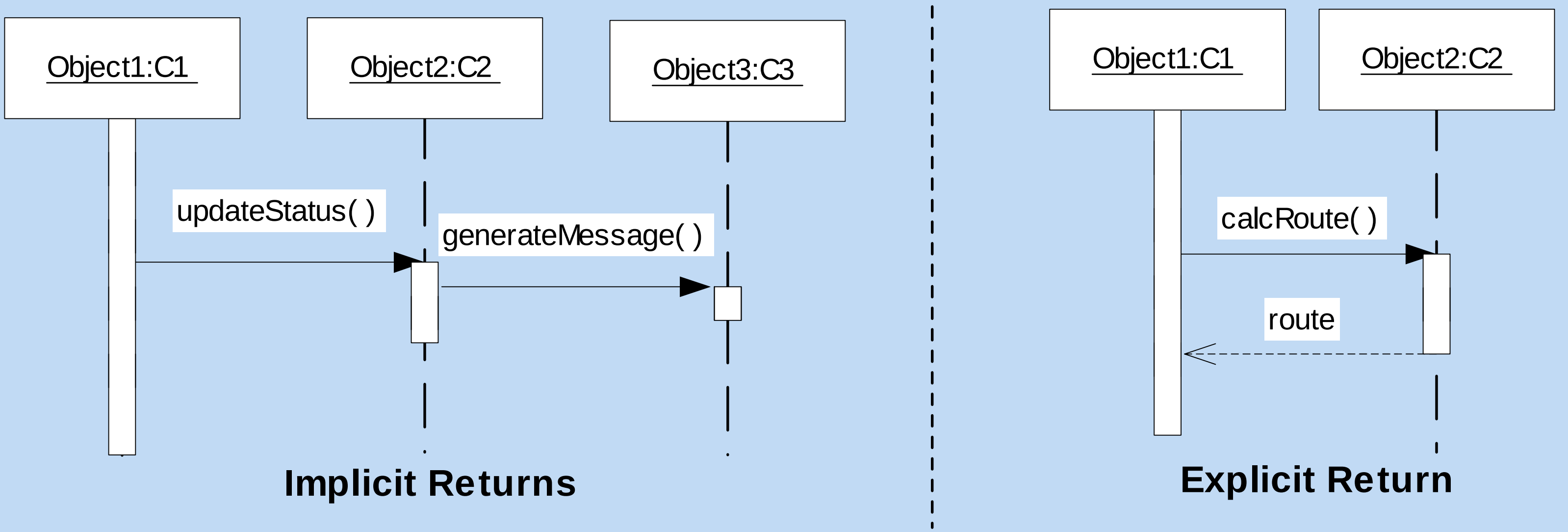
- Identify objects needed to support use cases, determine sequence of internal events following the external initiating event
- Diagrams that are not initiated with an external actor represent only a partial sequence
- Partial sequence diagrams should clearly identify the actor initiated sequence diagrams from which they are launched

Example of Sequence Diagrams Notation



Rules of Sequence Diagrams

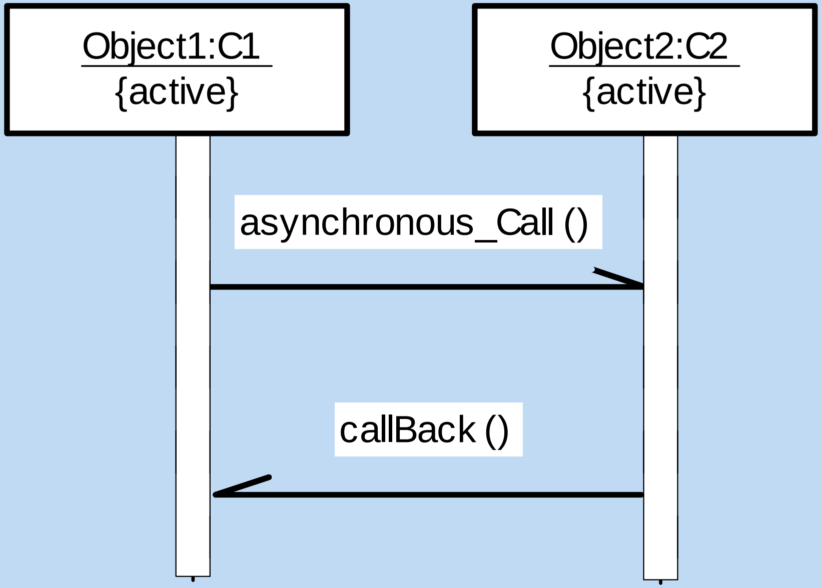
- Messages specified on interactions can be synchronous or asynchronous



Synchronous call

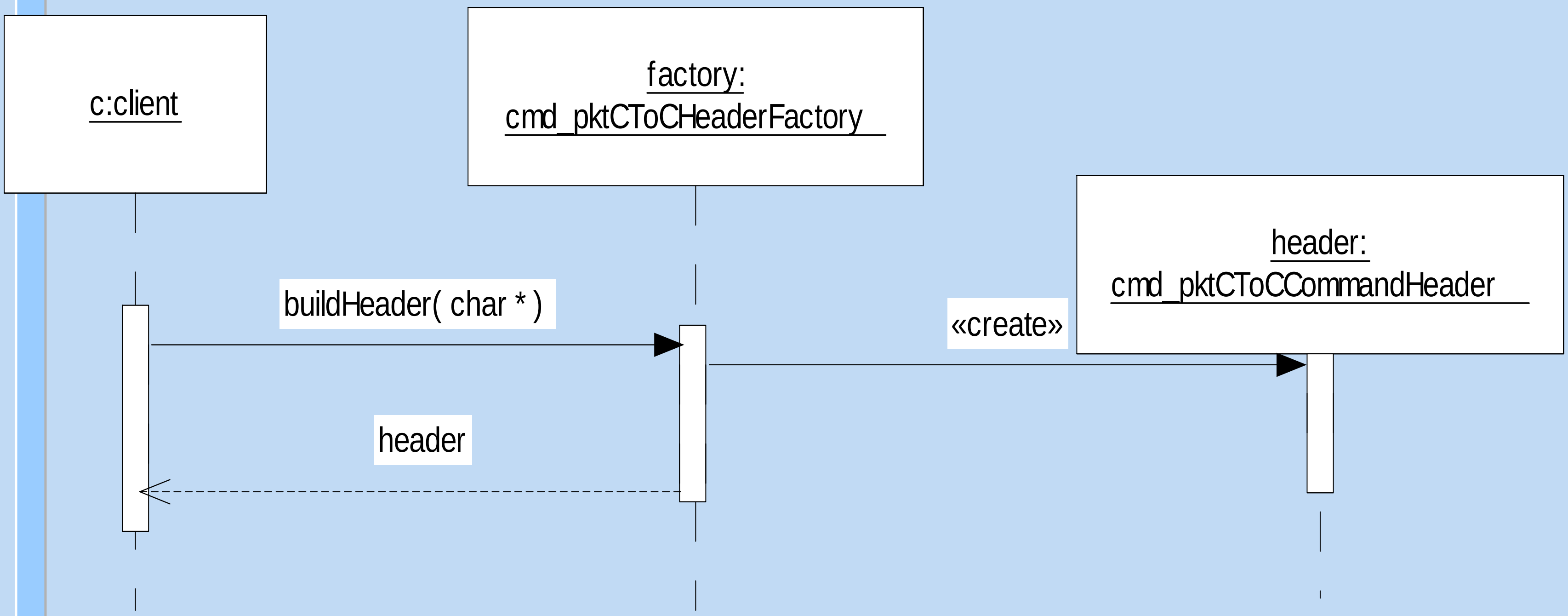
Rules of Sequence Diagrams

Asynchronous call



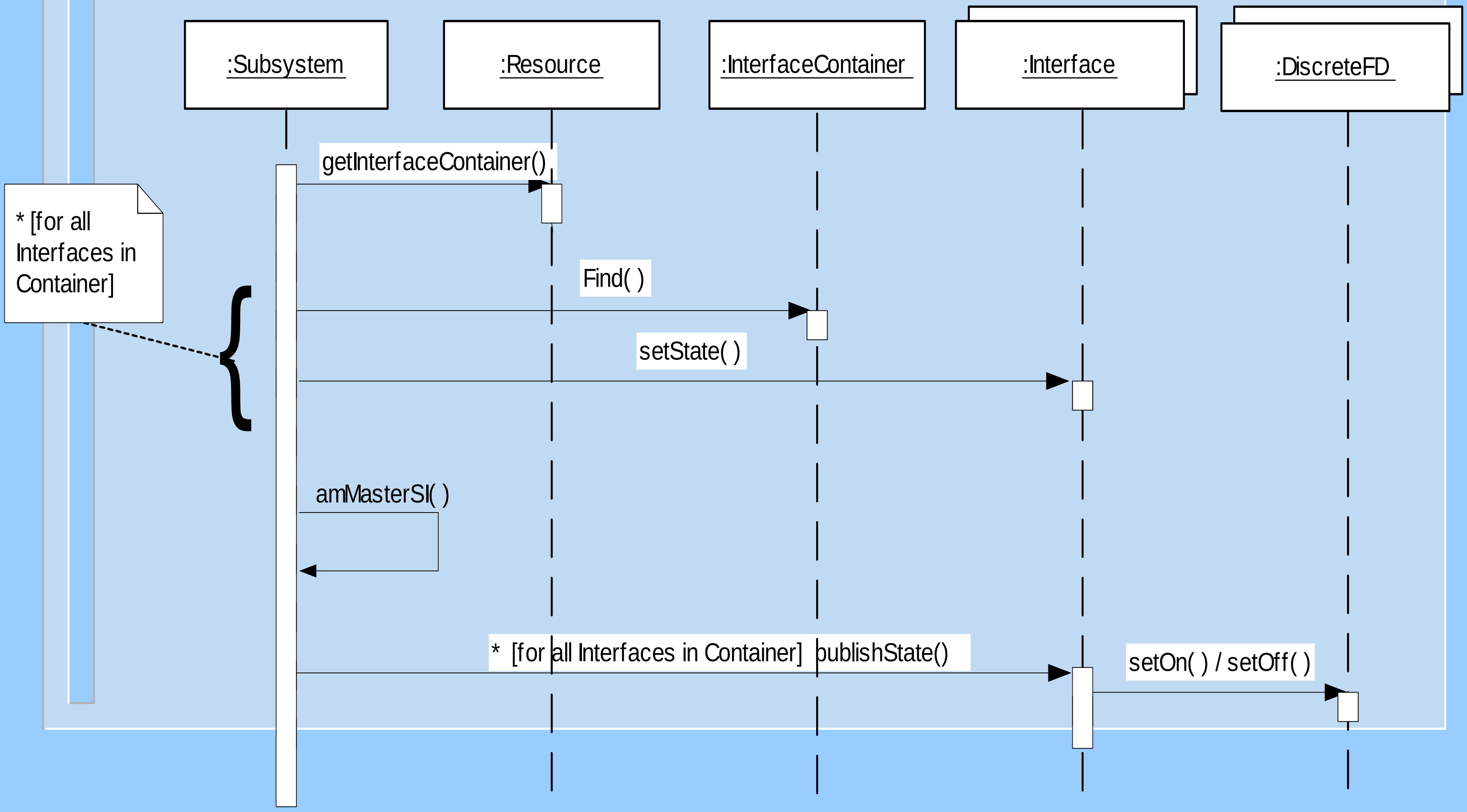
Rules of Sequence Diagrams

- Display operation names on call arrows

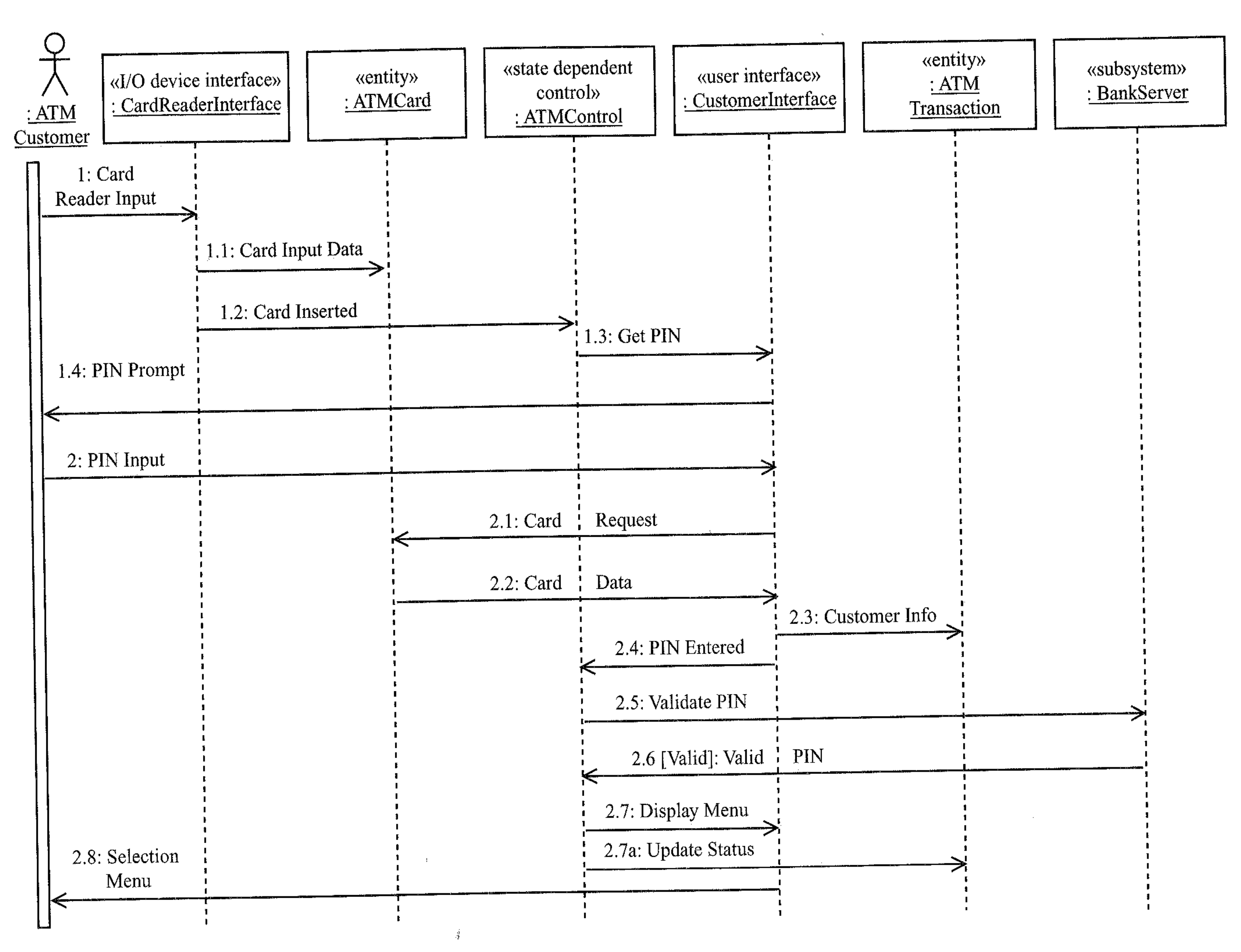


Rules of Sequence Diagrams

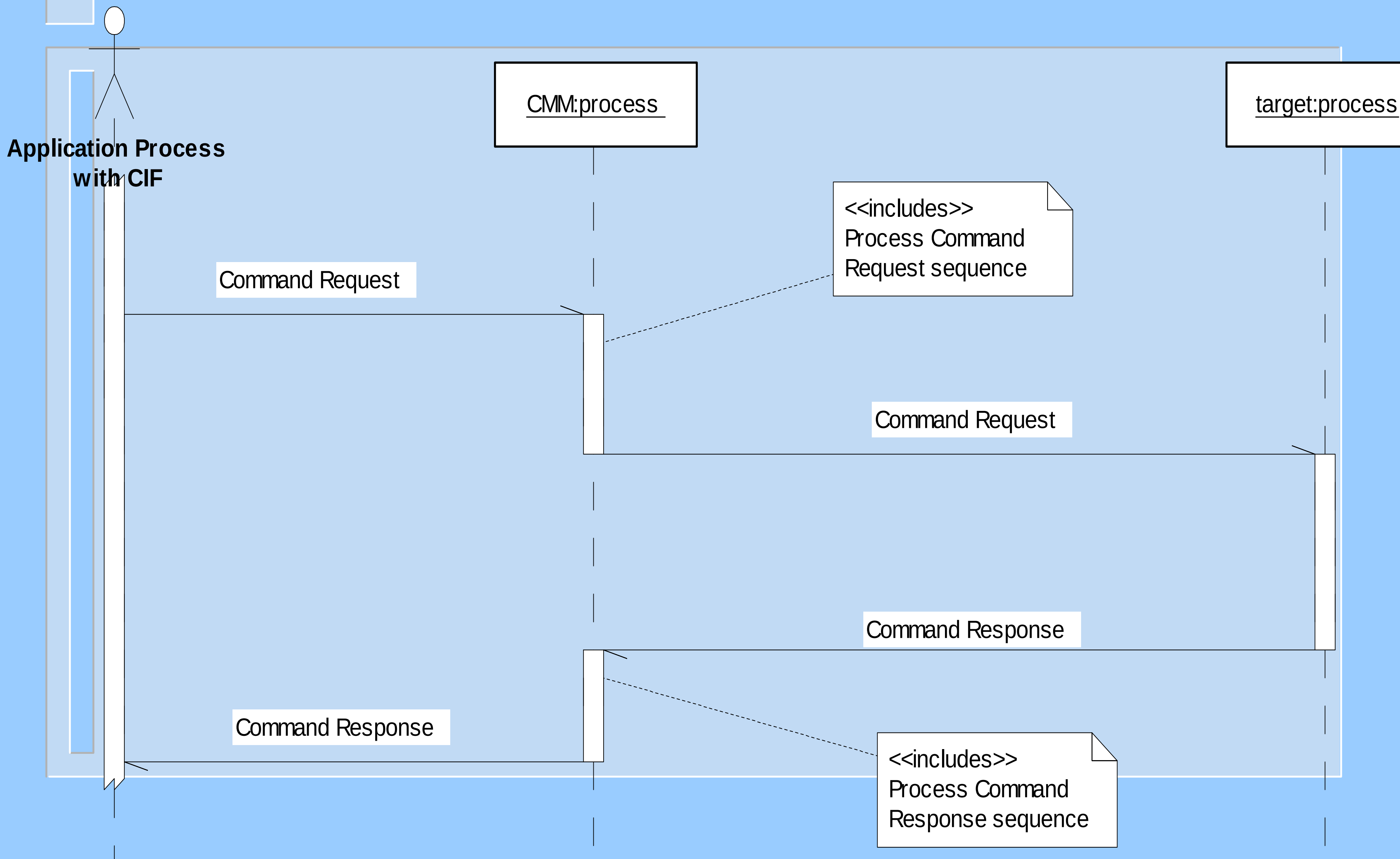
Compound and Simple Iteration



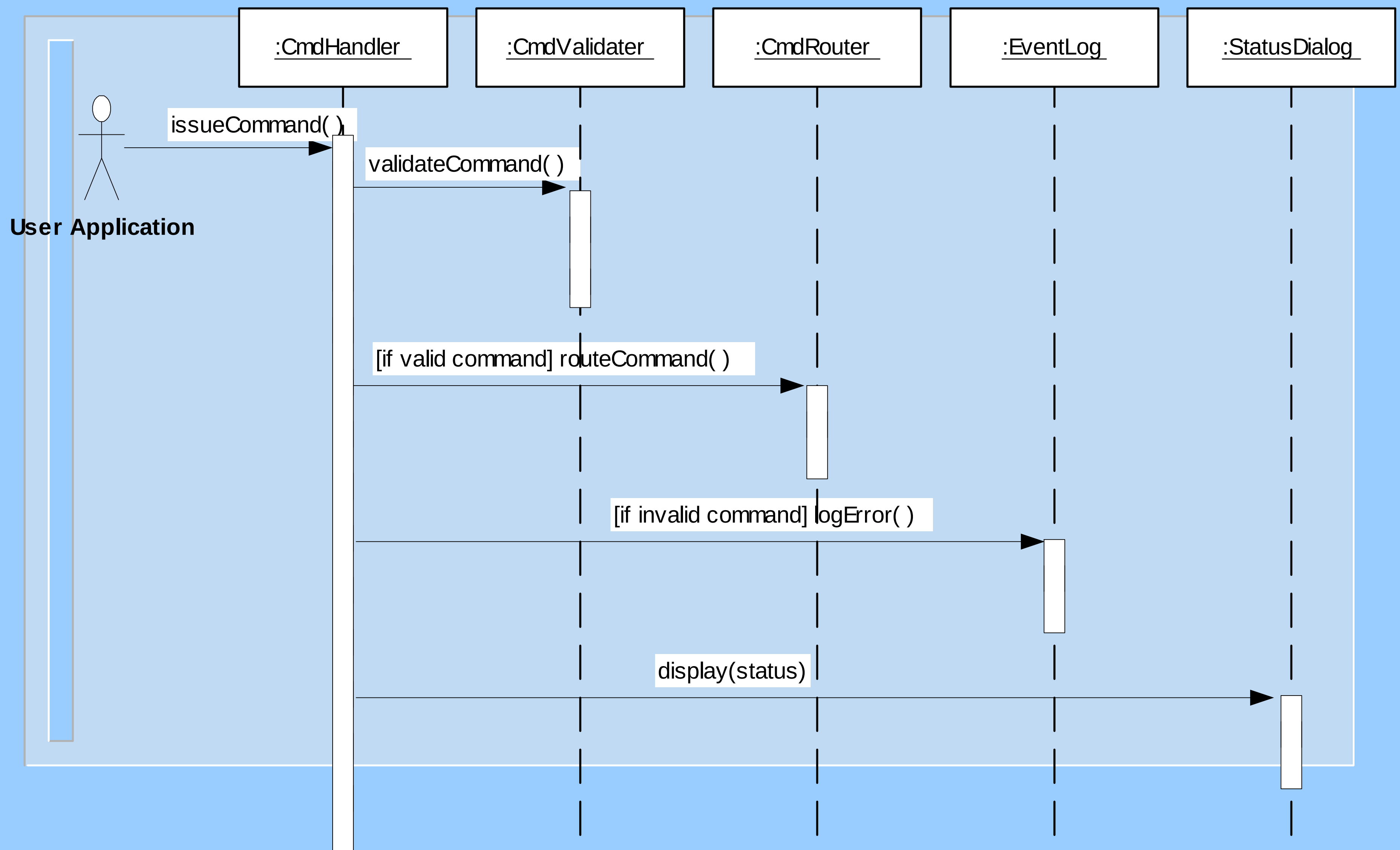
Numbering the Sequence of Interactions



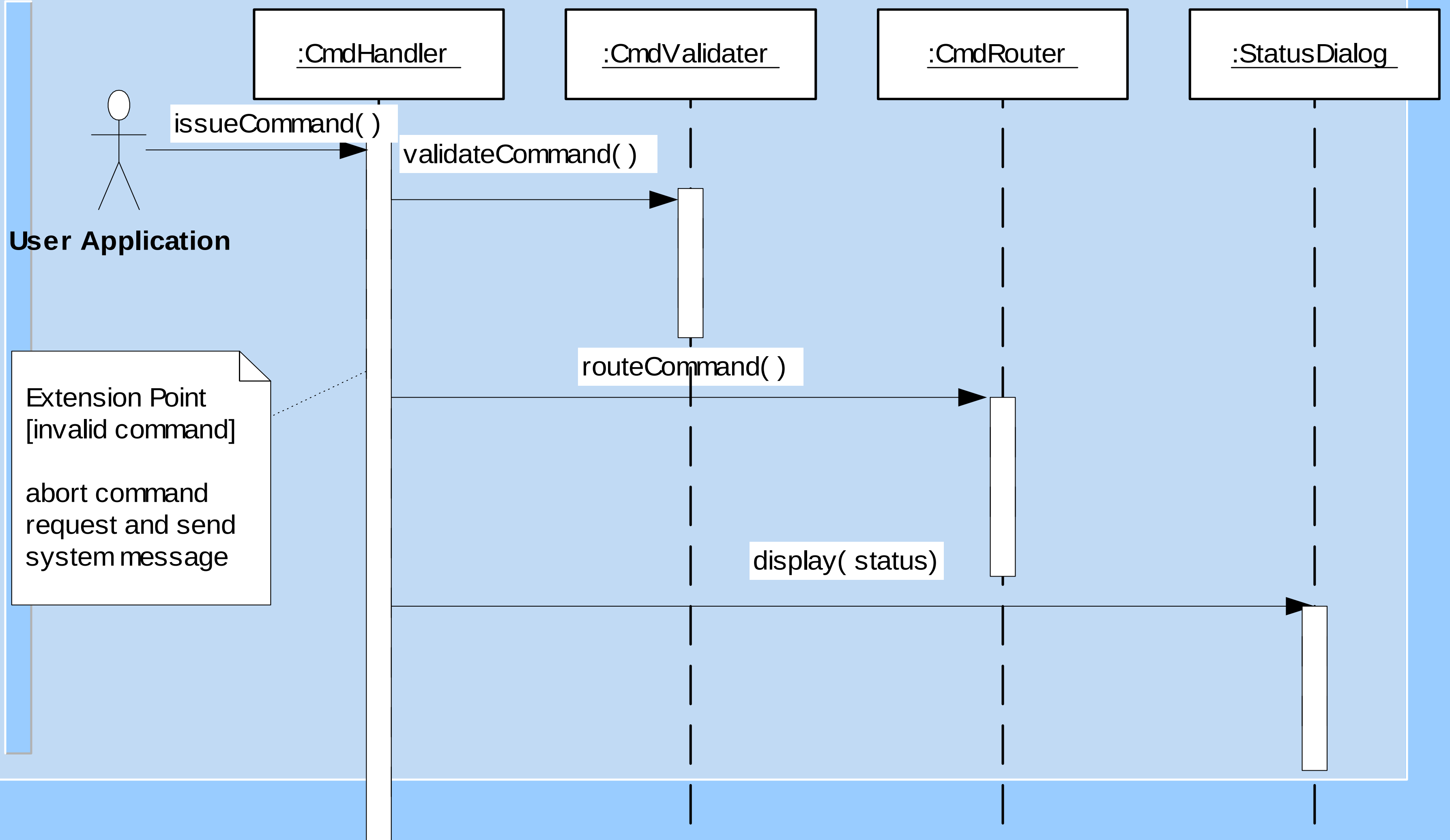
‘included’ sequence diagrams



Showing alternate behavior in a sequence diagram



Showing Extension Point



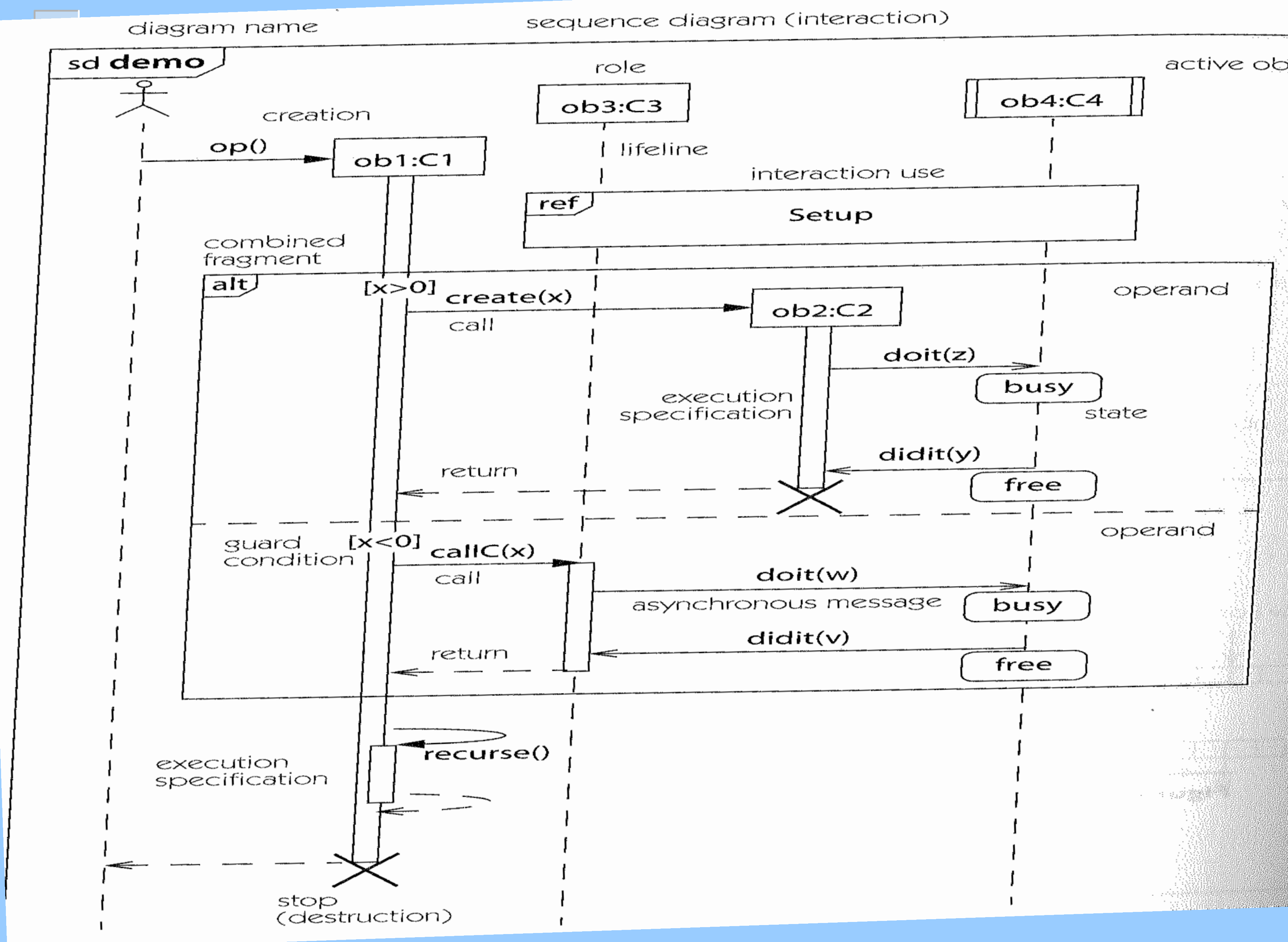
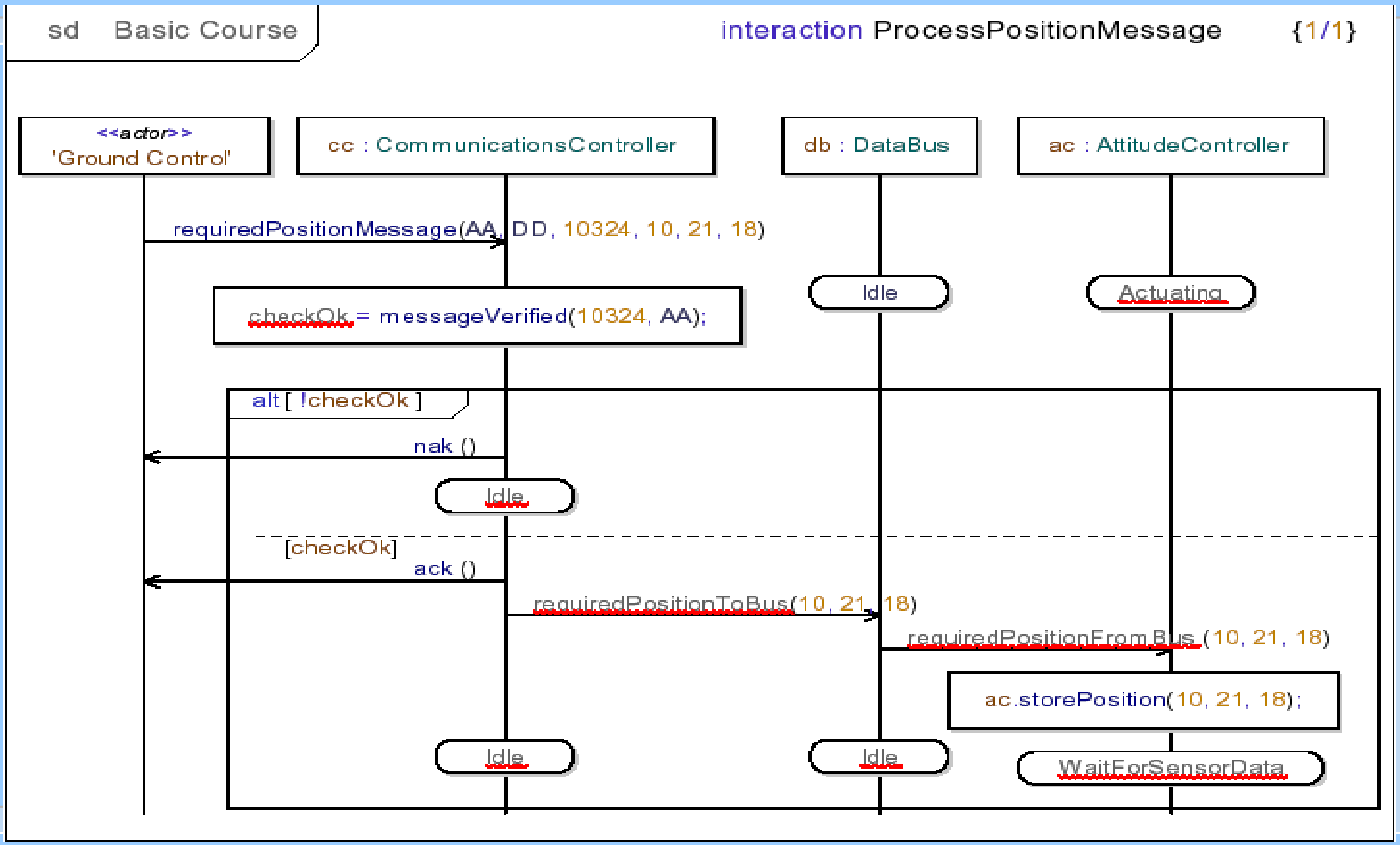


diagram name
sequence diagram (interaction)
sd demo
role
active obj
ob3:C3
ob4:C4
creation
op()
ob1:C1
lifeline
interaction use
ref
Setup
combined fragment
alt
[x>0]
create(x)
ob2:C2
operand
call
doit(z)
busy
execution specification
state
didit(y)
return
free
operand
guard condition
[x<0]
callC(x)
call
doit(w)
asynchronous message
busy
didit(v)
return
free
recurse()
execution specification
stop (destruction)

Rules of Sequence Diagrams

Showing alternate behavior in a sequence diagram



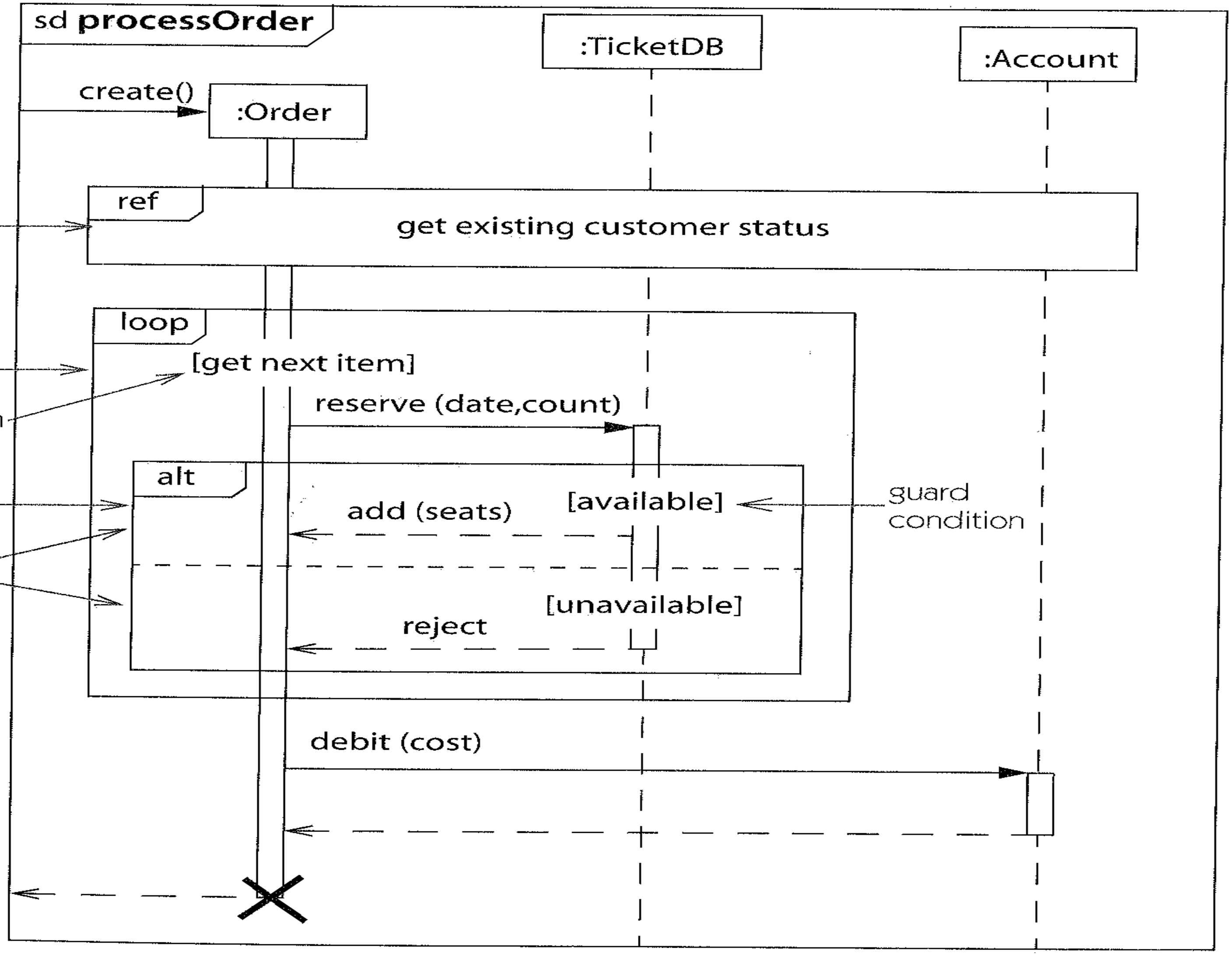


Figure 9-3. *Structured control constructs*

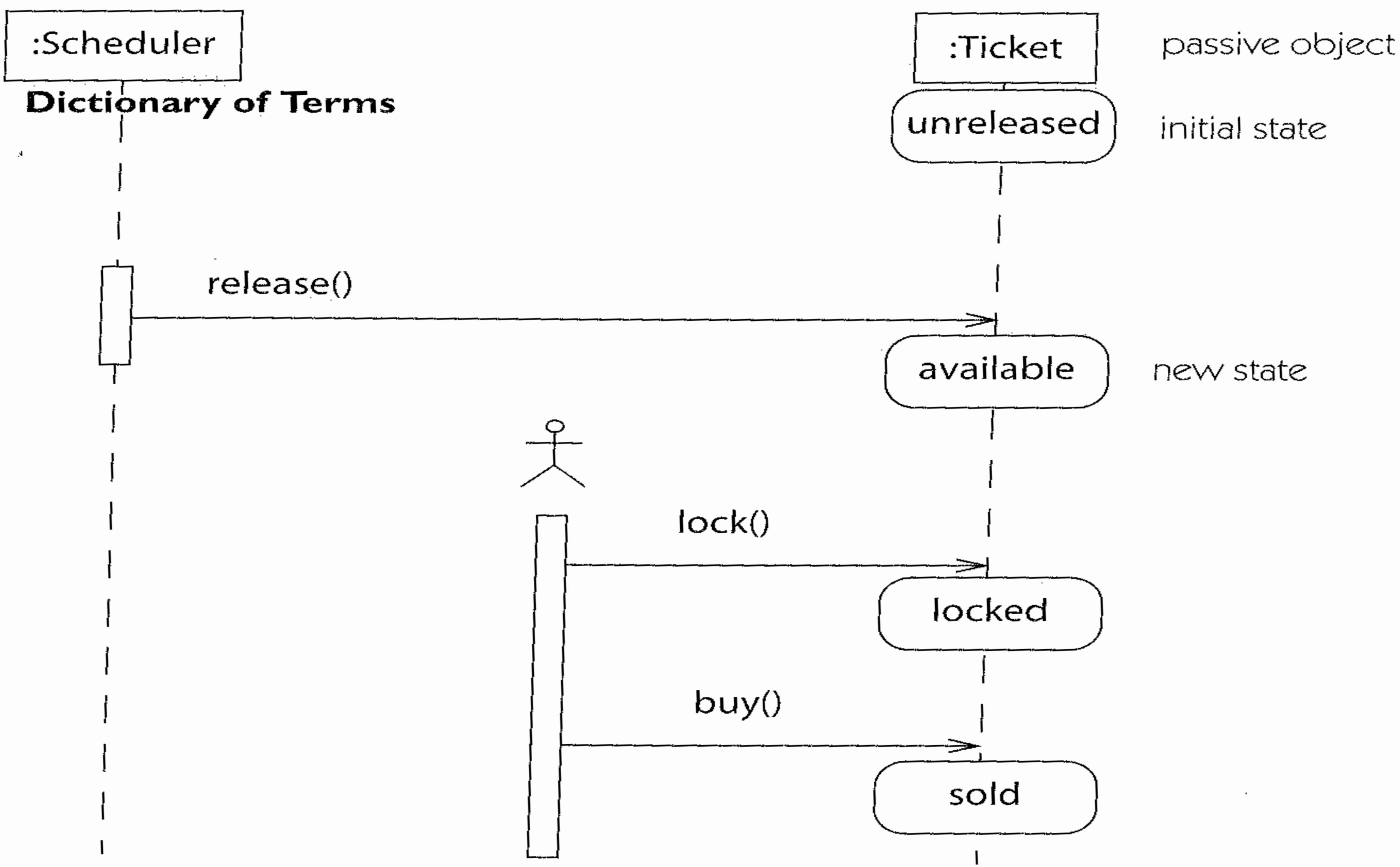


Figure 14-249. *Object states on a sequence diagram*

Communication/Collaboration Diagrams

They Specify similar information of interactions without the time axis

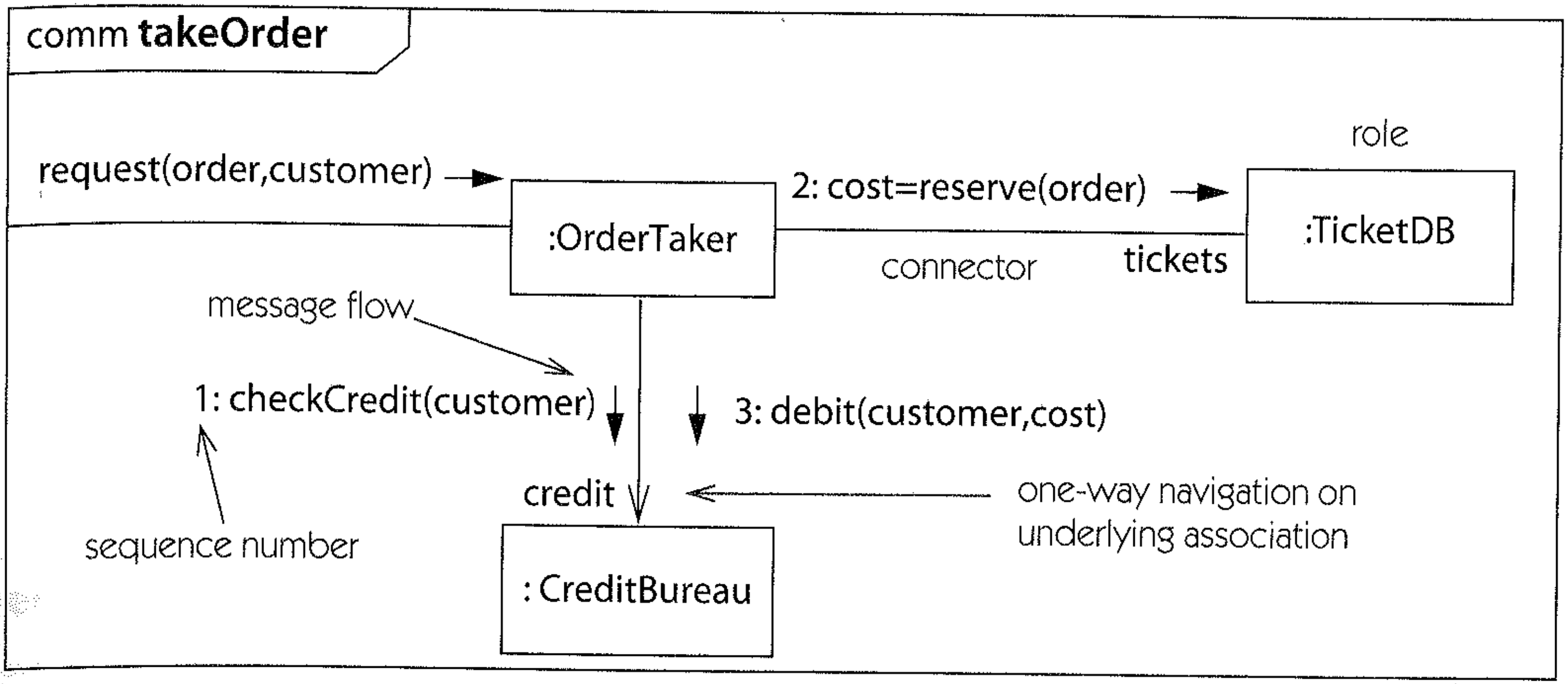
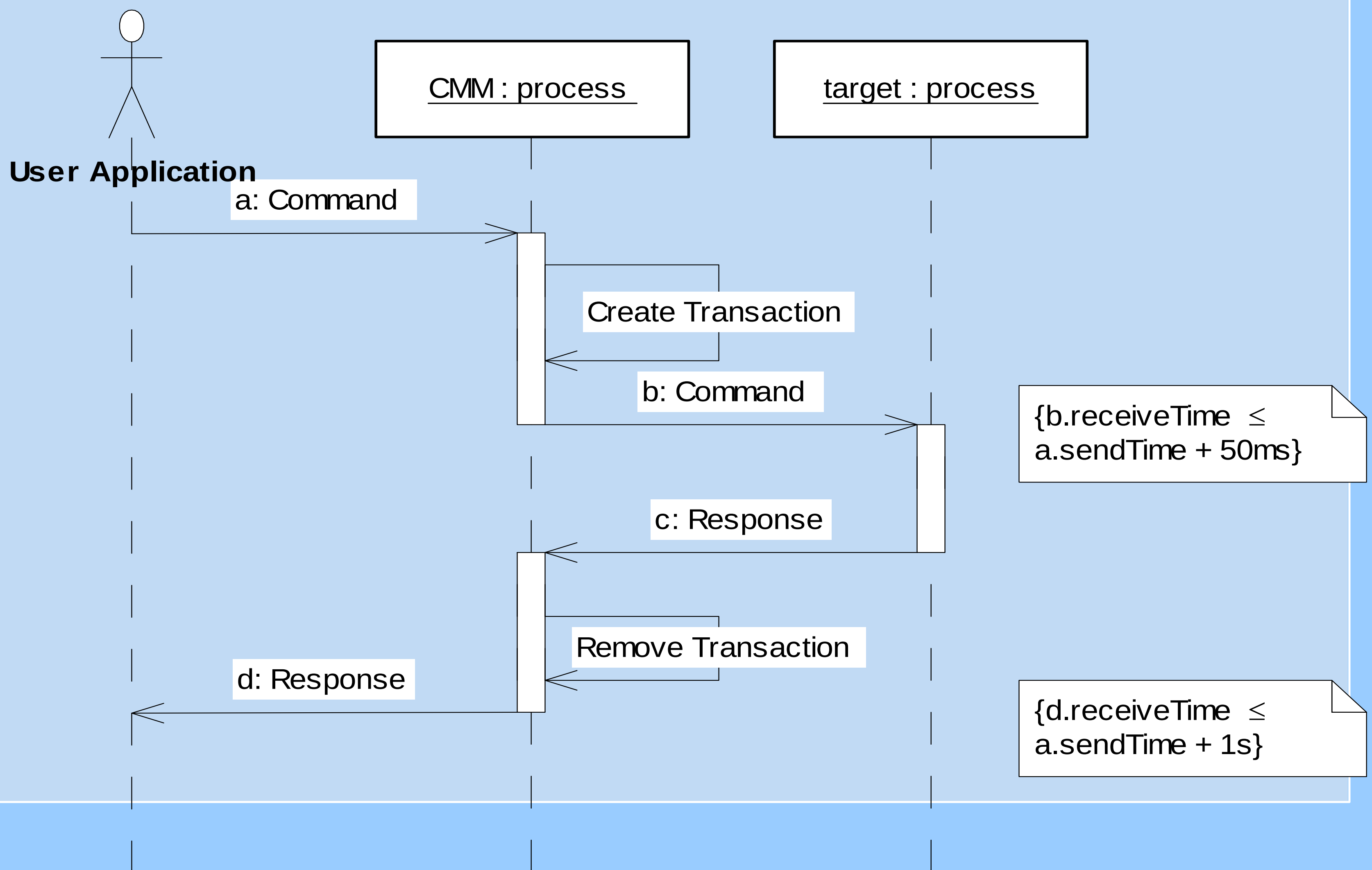
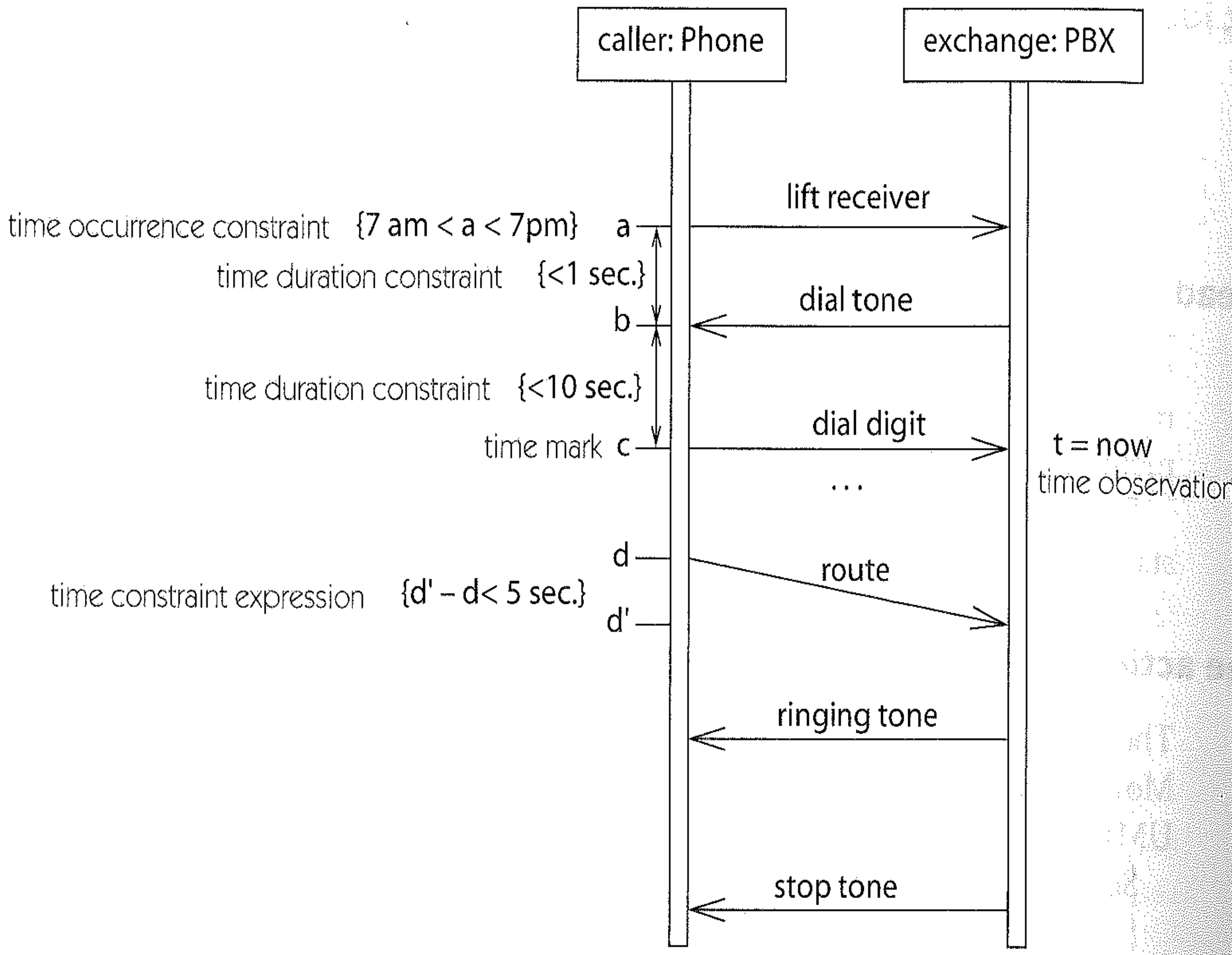


Figure 9-4. *Communication diagram*

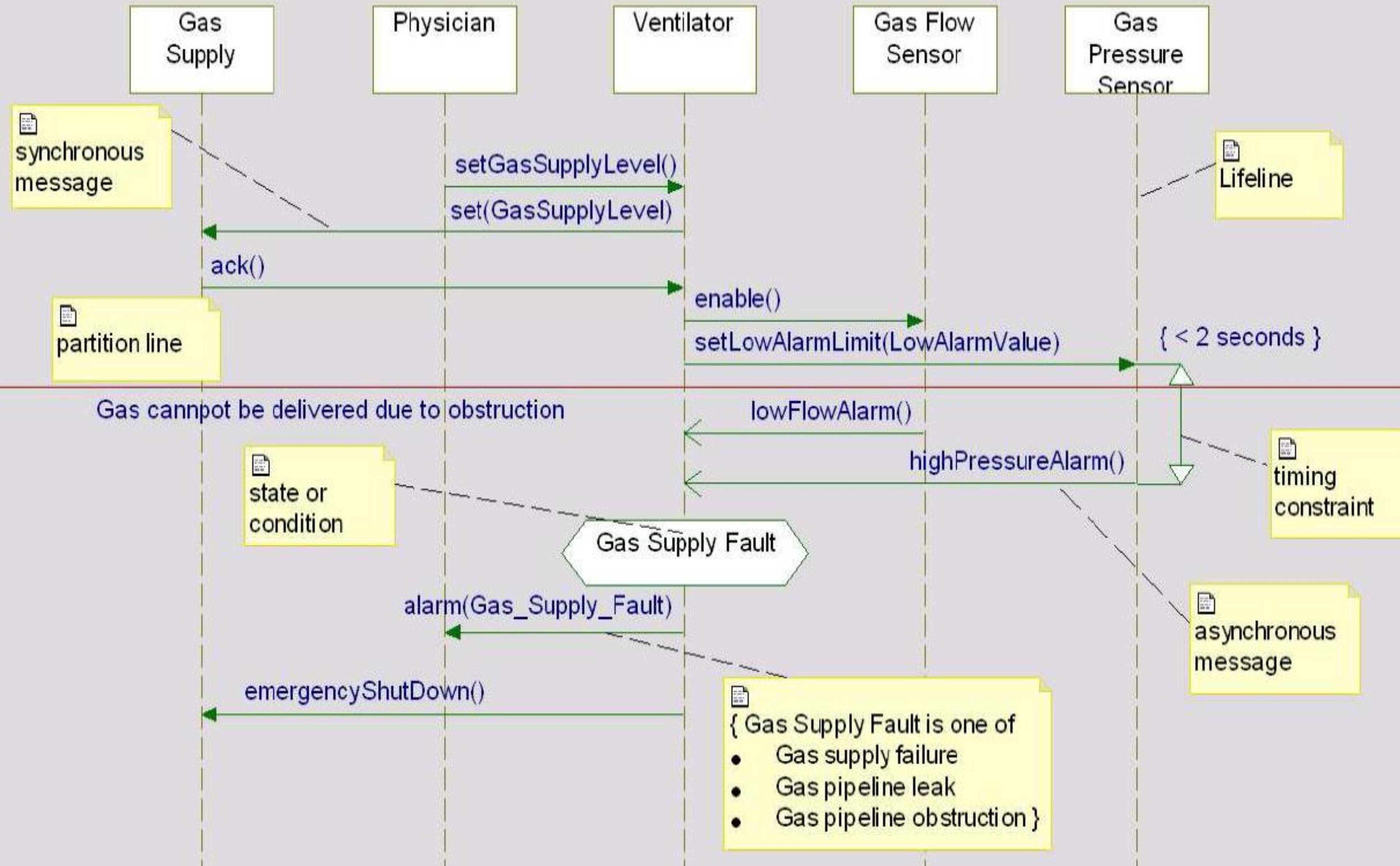
Specifying Timing Requirements



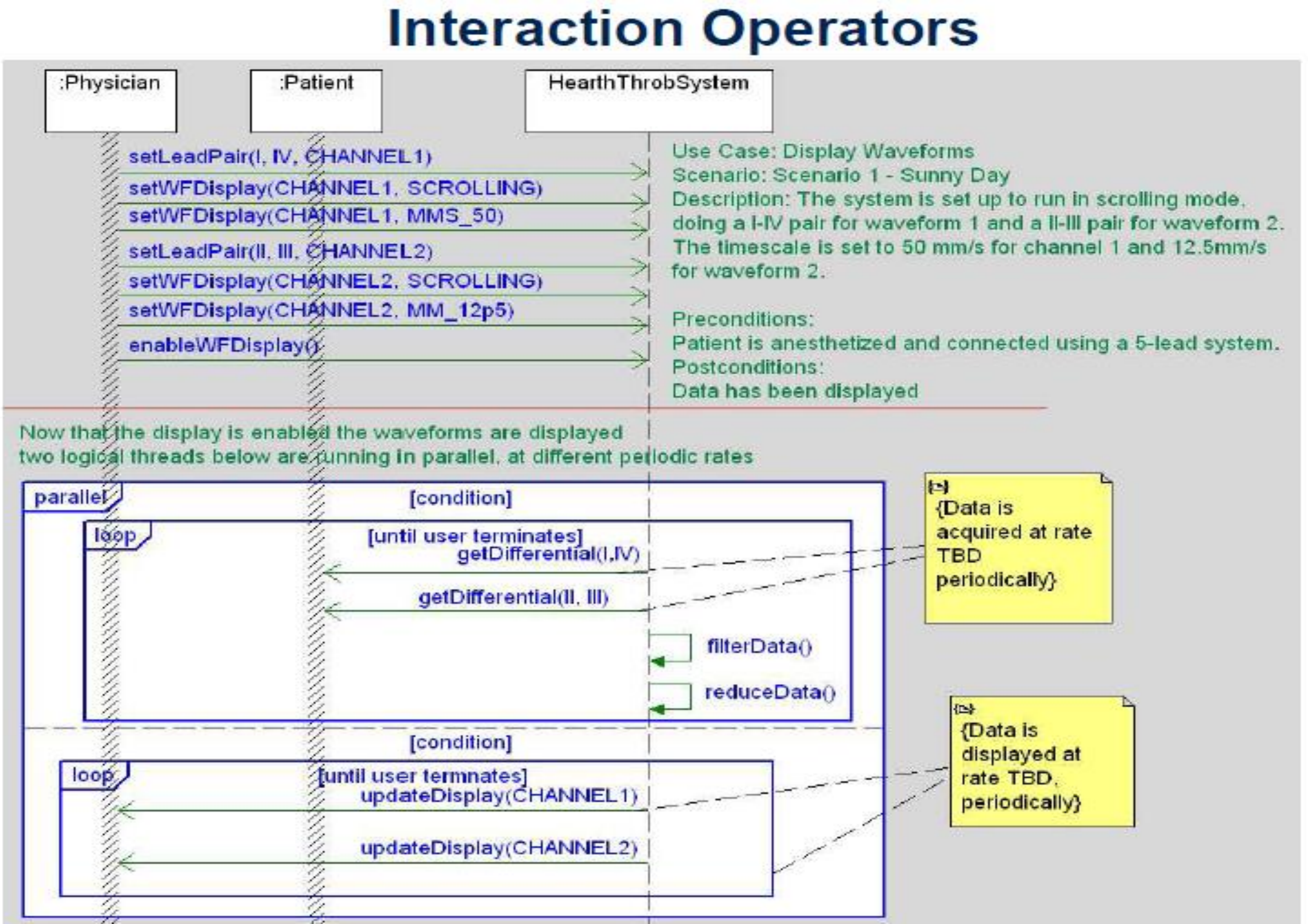


caller: Phone
exchange: PBX
time occurrence constraint
{7 am < a < 7pm}
a
lift receiver
time duration constraint
{<1 sec.}
b
dial tone
time duration constraint
{<10 sec.}
dial digit
time mark
c
t = now
time observation
. . .
d
route
time constraint expression
{d' – d< 5 sec.}
d'
ringing tone
stop tone

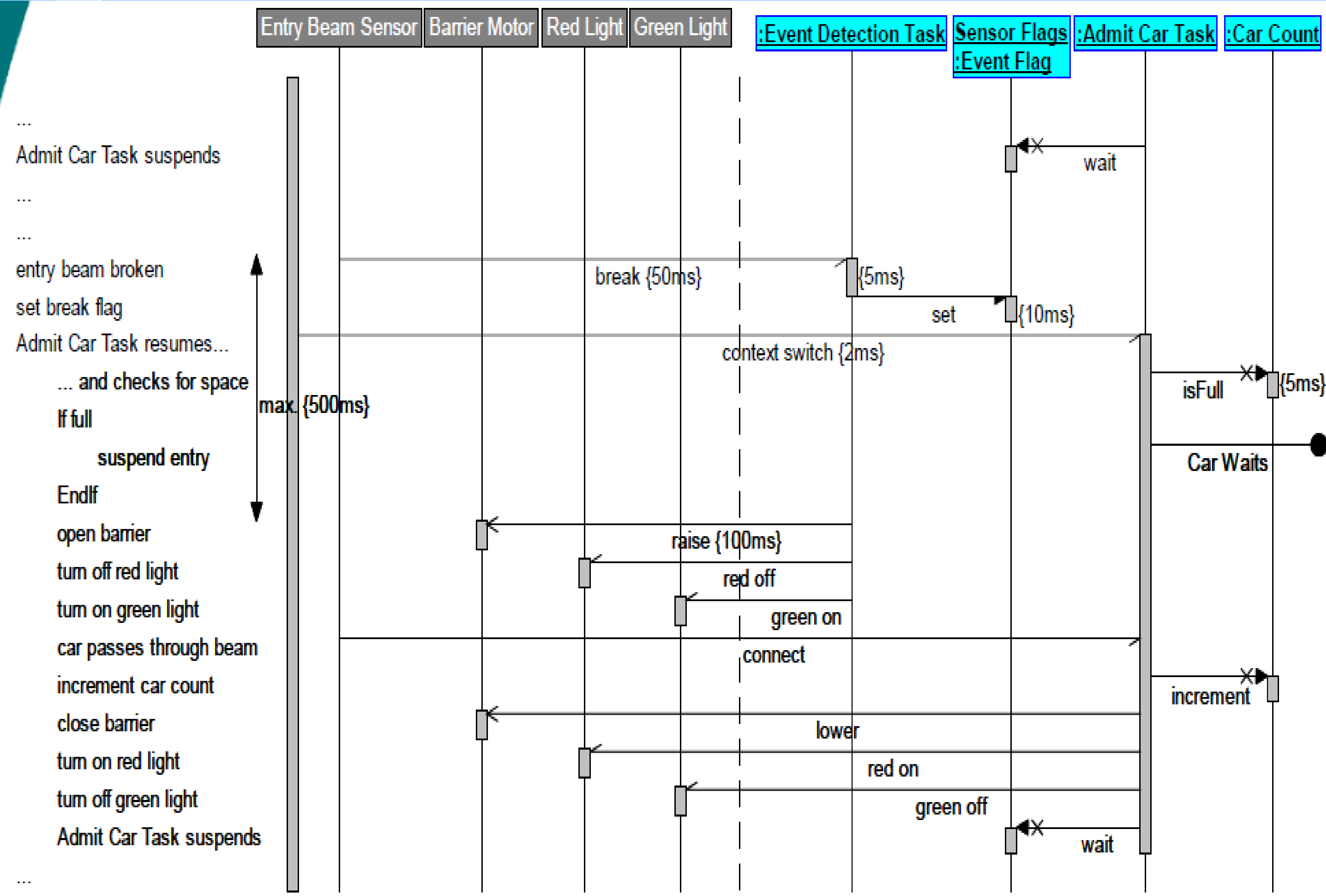
Specifying Timing Requirements



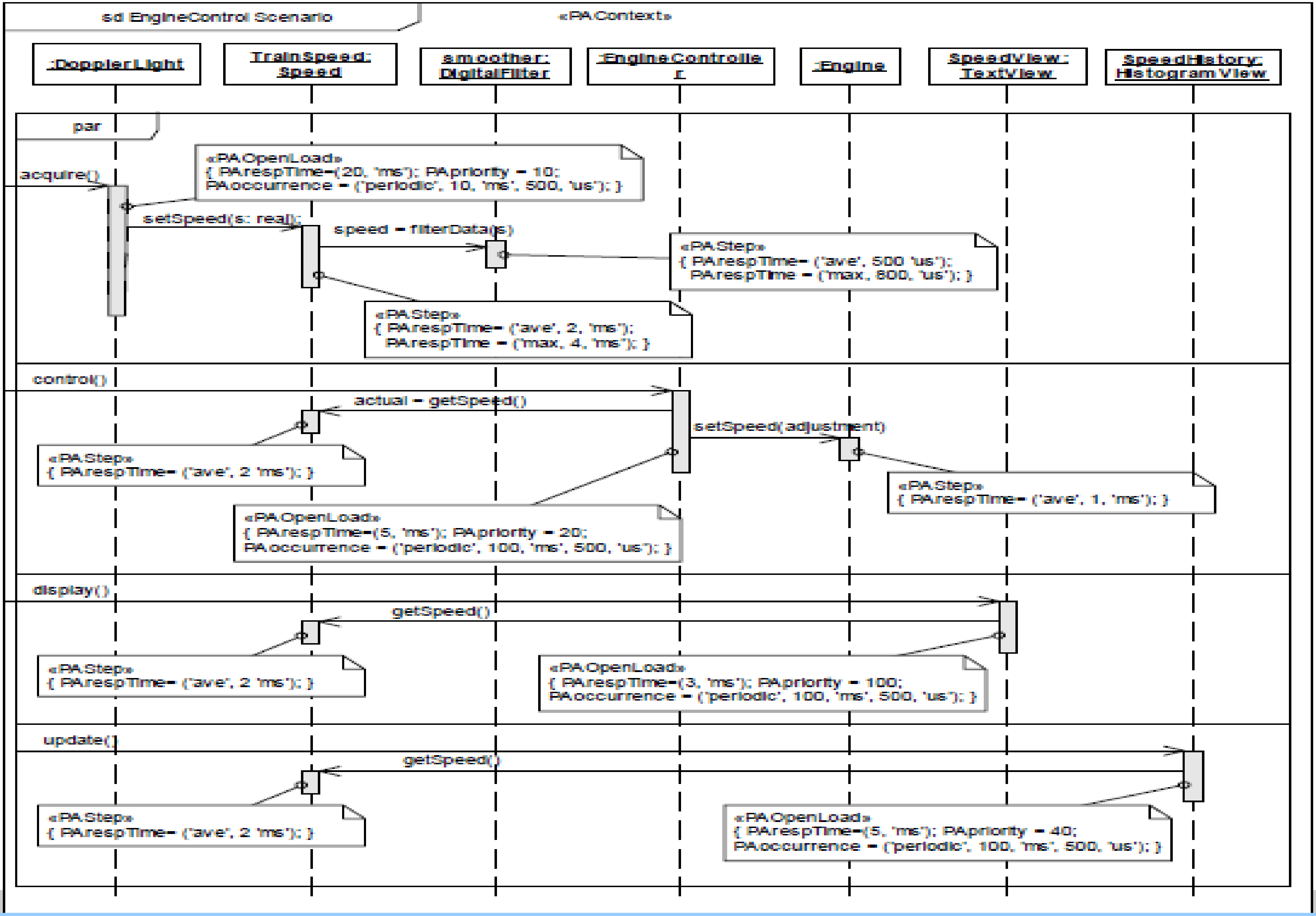
Specifying Timing Requirements (Data rates in notes)



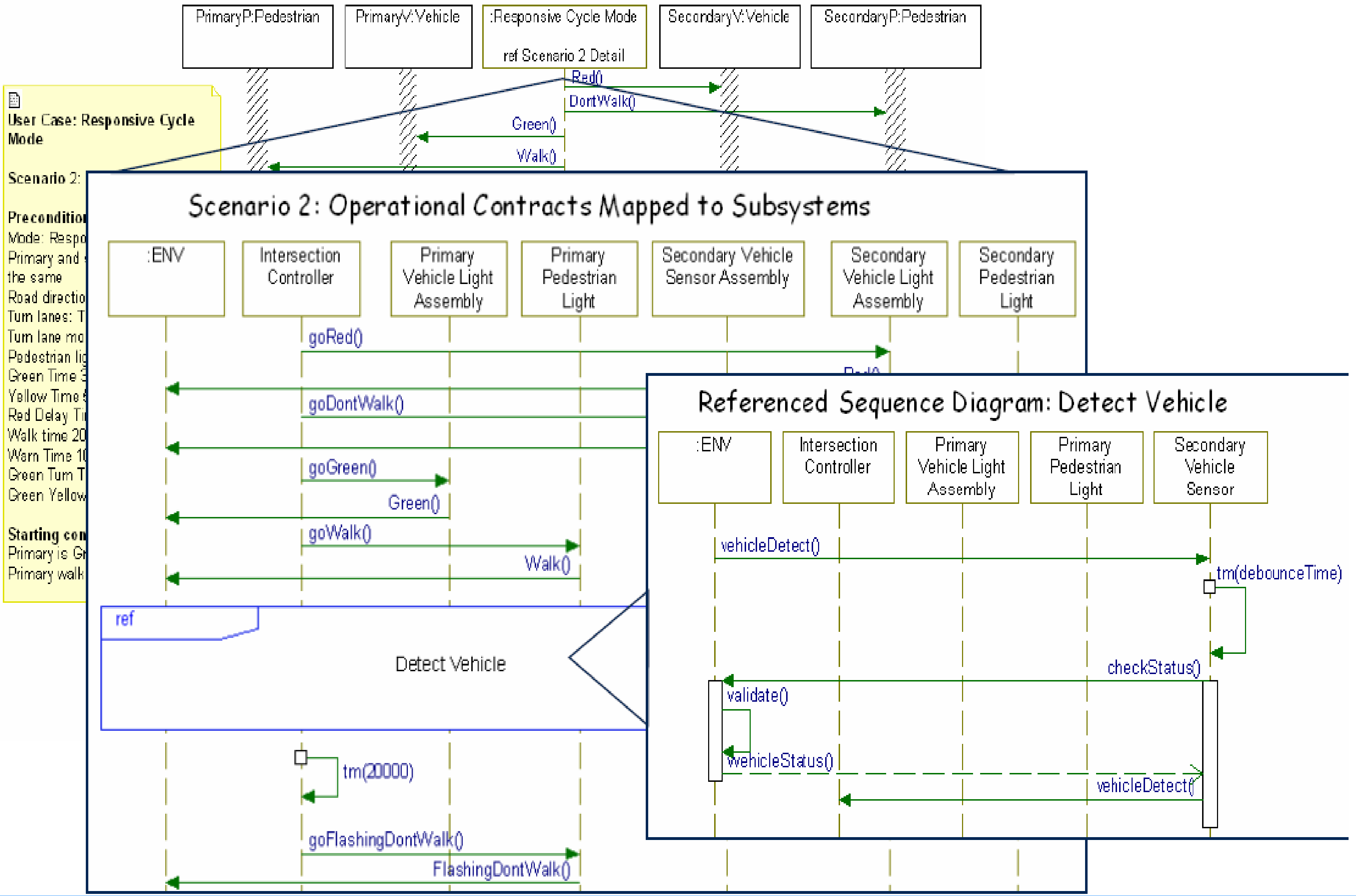
Specifying Timing Requirements: on interactions



Specifying Timing Requirements (ave and max)



Specifying Timing Requirements: (Timeout events)



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Recall Requirements Elicitation Process

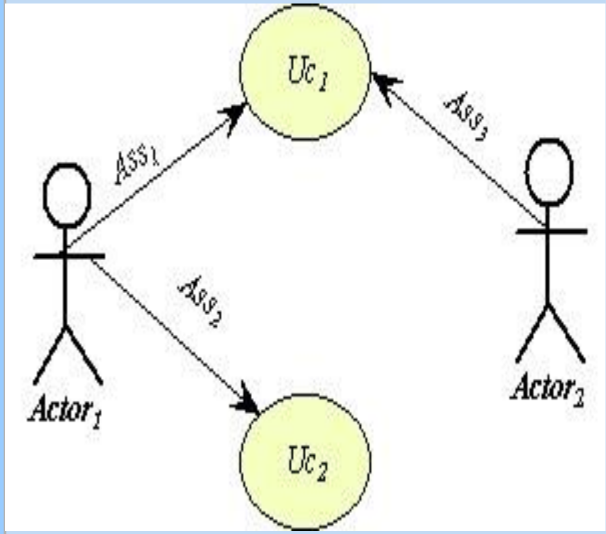
- The process of requirements elicitation consists of the following steps
  1. Identify Actors
  2. Identify Scenarios
  3. Identify Use Cases
  4. **Refine Use Cases**
  5. Identify Relationships between actors and Use Cases
  6. Identify Initial Analysis Objects
  7. Identify Non-functional requirements

Requirements Elicitation Process Step 4. Refining Use Cases

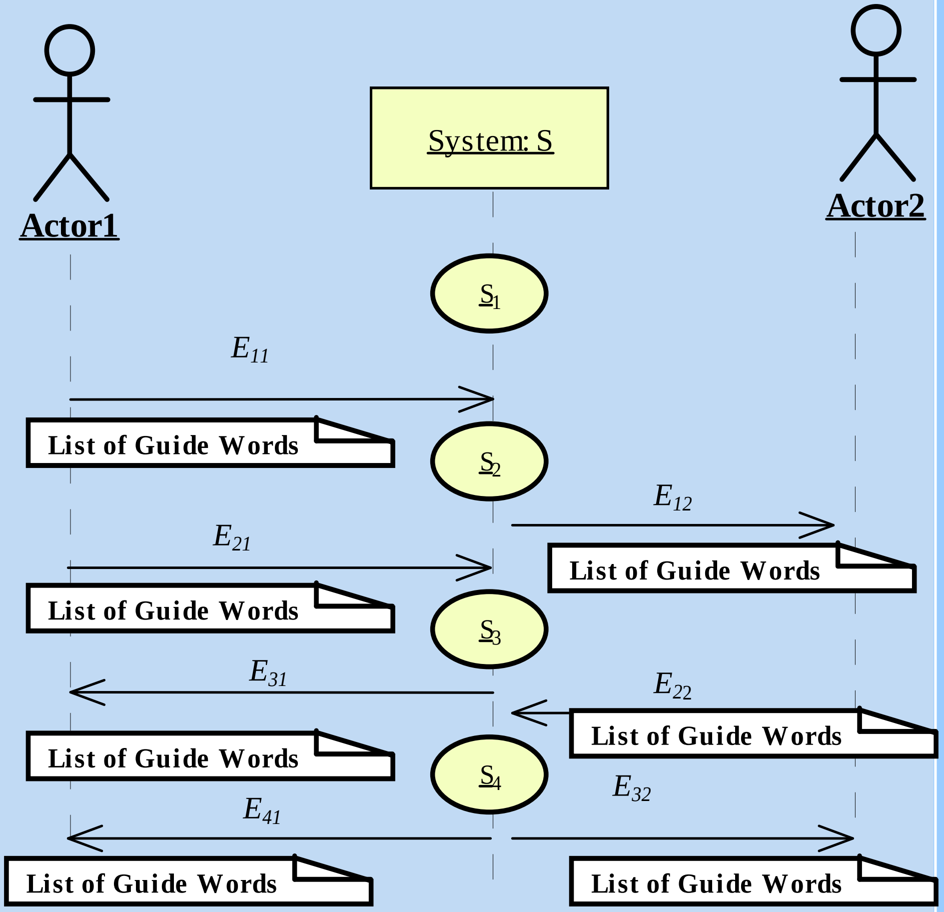
System Sequence Diagrams

- System sequence diagrams establish the dynamic behavior in terms of key scenarios of the system for each use case
- The system sequence diagram models a scenario of the system interactions with the environment for a given use case
- Input/output events are clearly identified in each sequence diagram,
- The State of the system before and after each event are also depicted
- Different diagrams model scenarios with the normal flow of events and the abnormal flow of events

Sequence Diagrams and Use Cases System Sequence Diagram



The use case diagram Of system S



The sequence diagram of use case UC1 for system S

UML Use Case Diagrams: The Requirements Model

Case Study

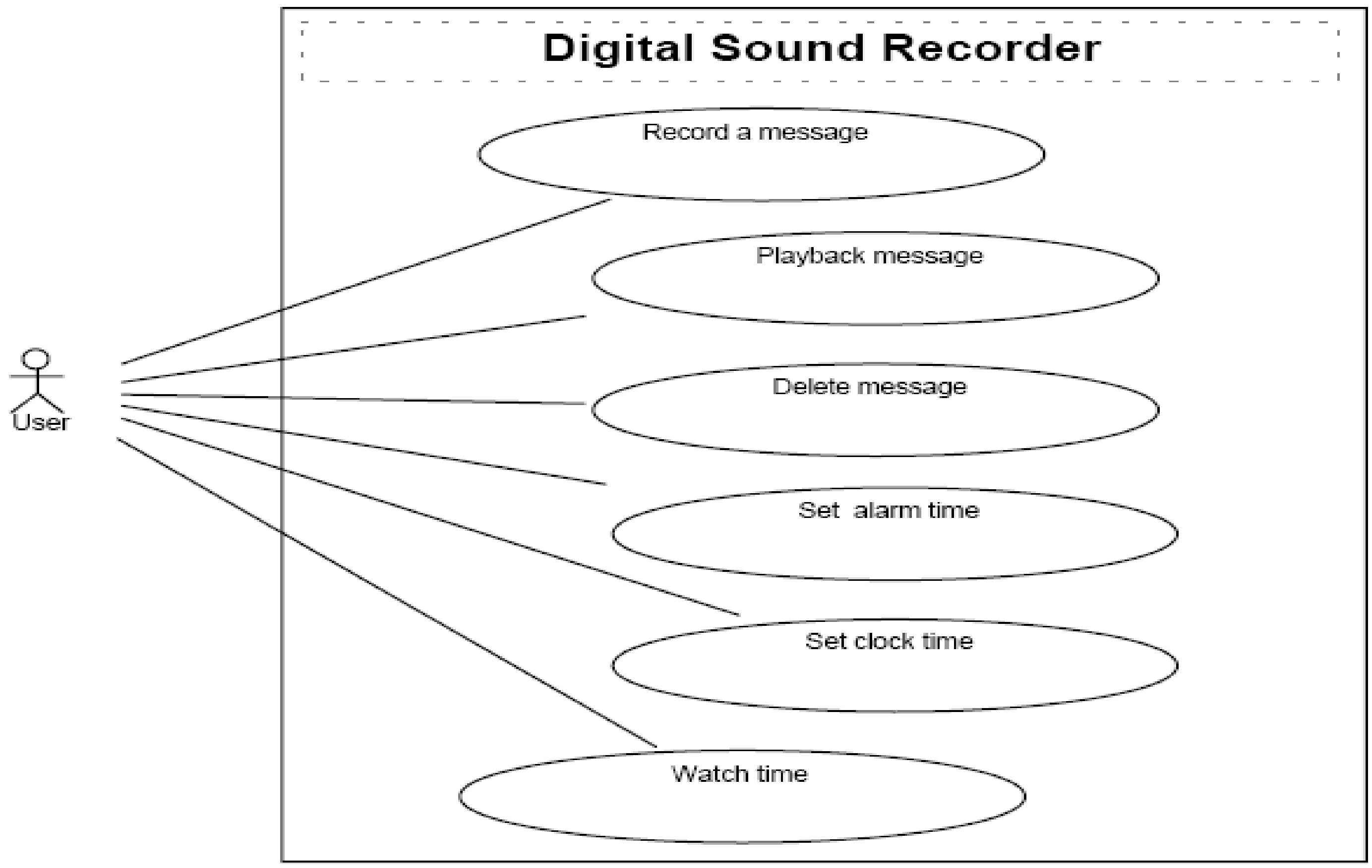


Figure 2.3: Use Case diagram

UML Use Case Diagrams:
The Requirements Model- System Seq. Diags.

Digital Sound Recorder Case Study

- A sequence diagram displays object interactions arranged in a time sequence capturing a specific *scenario* of interactions in a *use case* supported by the system

System Sequence Diagram for Play Massage Scenario: Normal Flow

Time

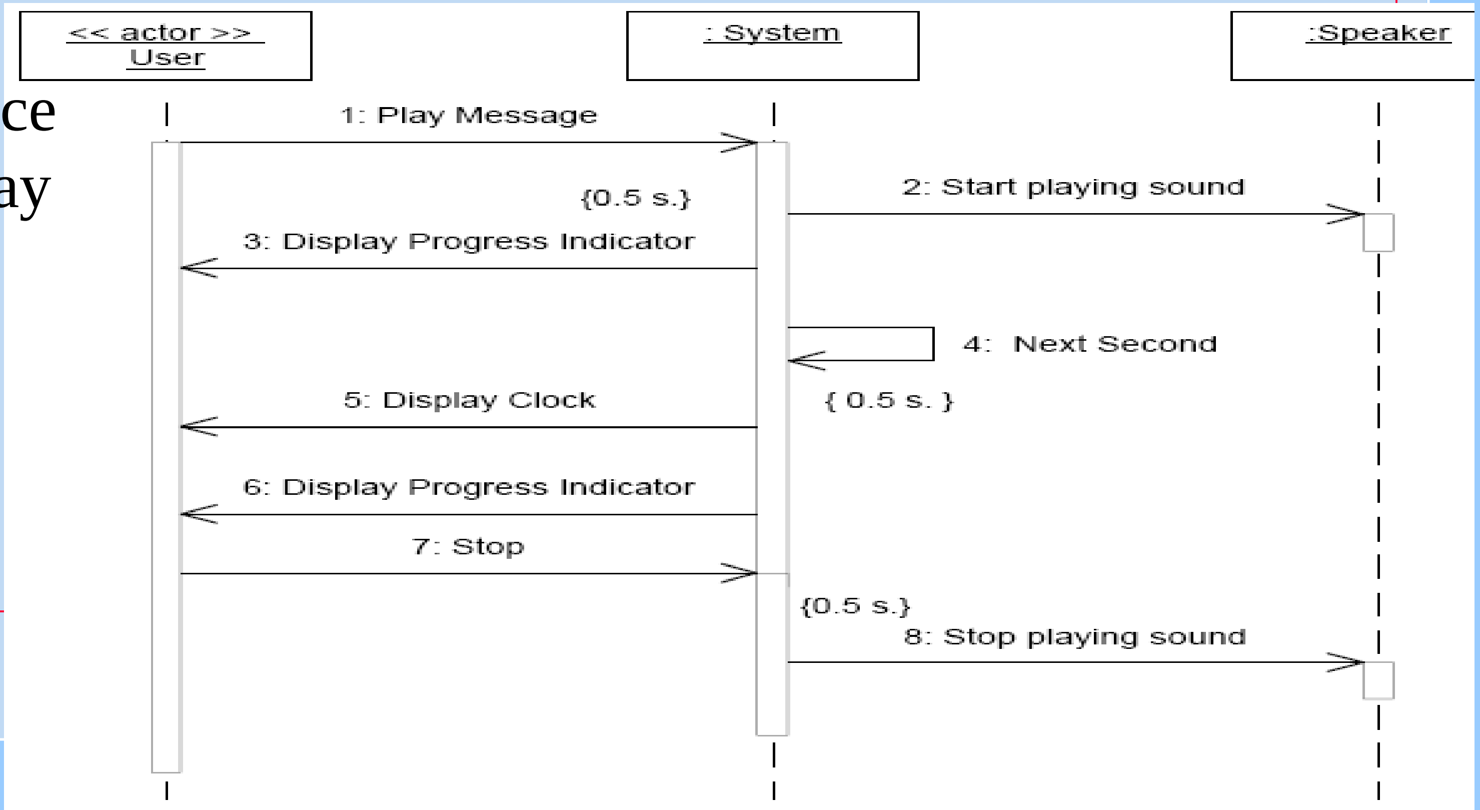


Figure 2.4: Playing message scenario

Sys. Seq. Diagram for Alarm sounding while playing Massage Scenario

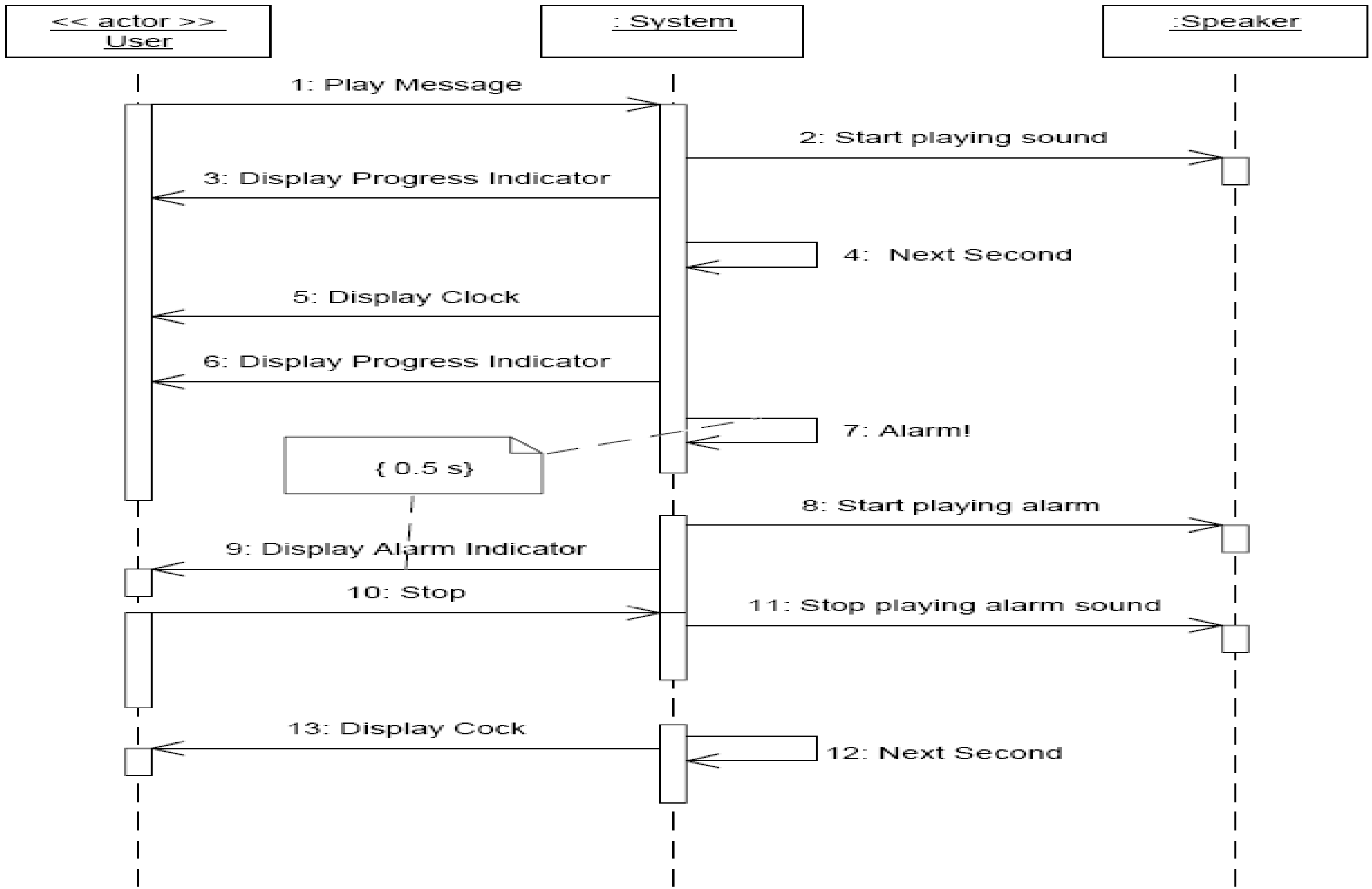


Figure 2.5: Alarm while playing scenario

Sys. Seq. Diag. for Alarm while stand-by followed by No-power event.

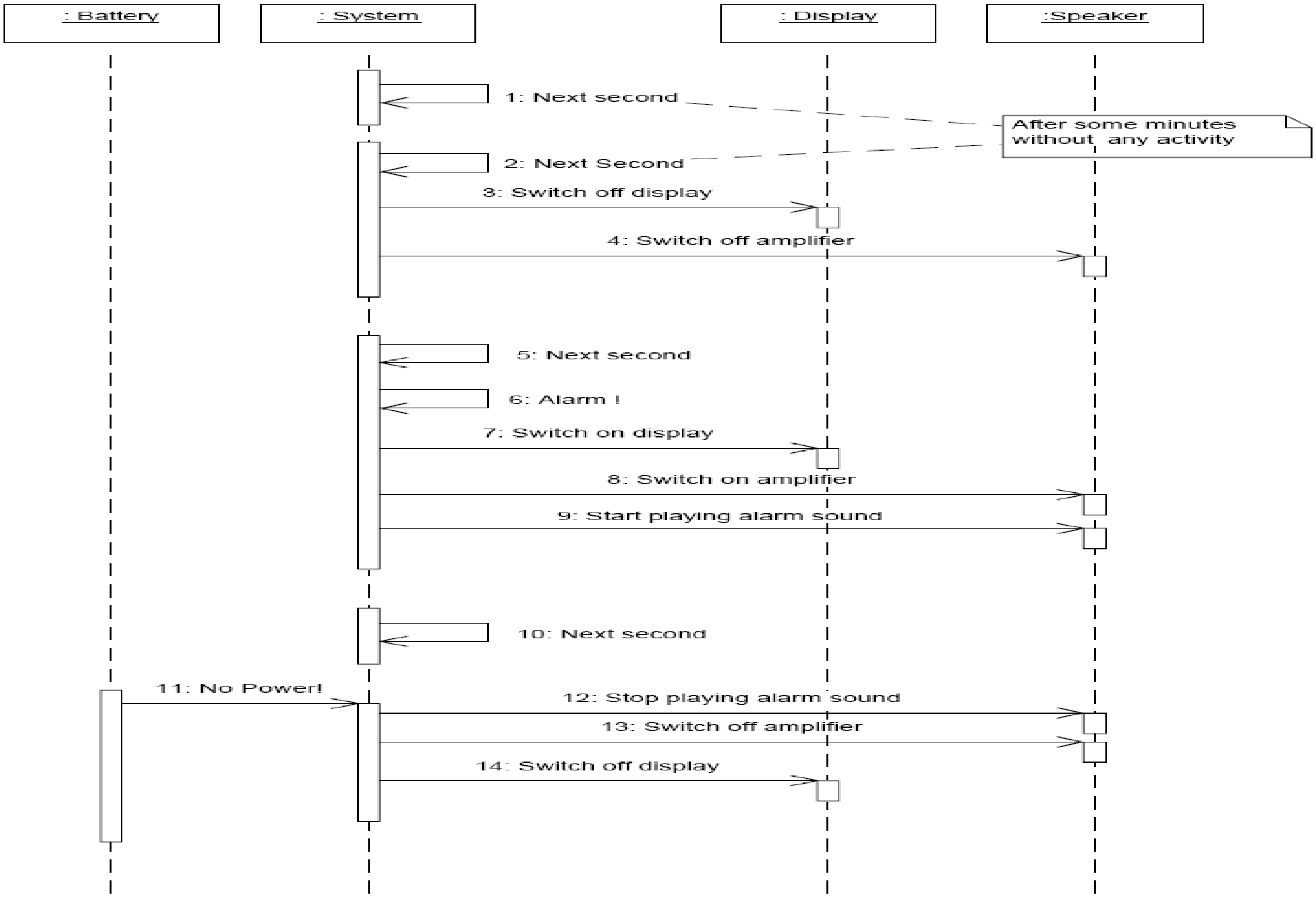


Figure 2.6: Entering and exiting stand-by mode scenario

The ATM Example

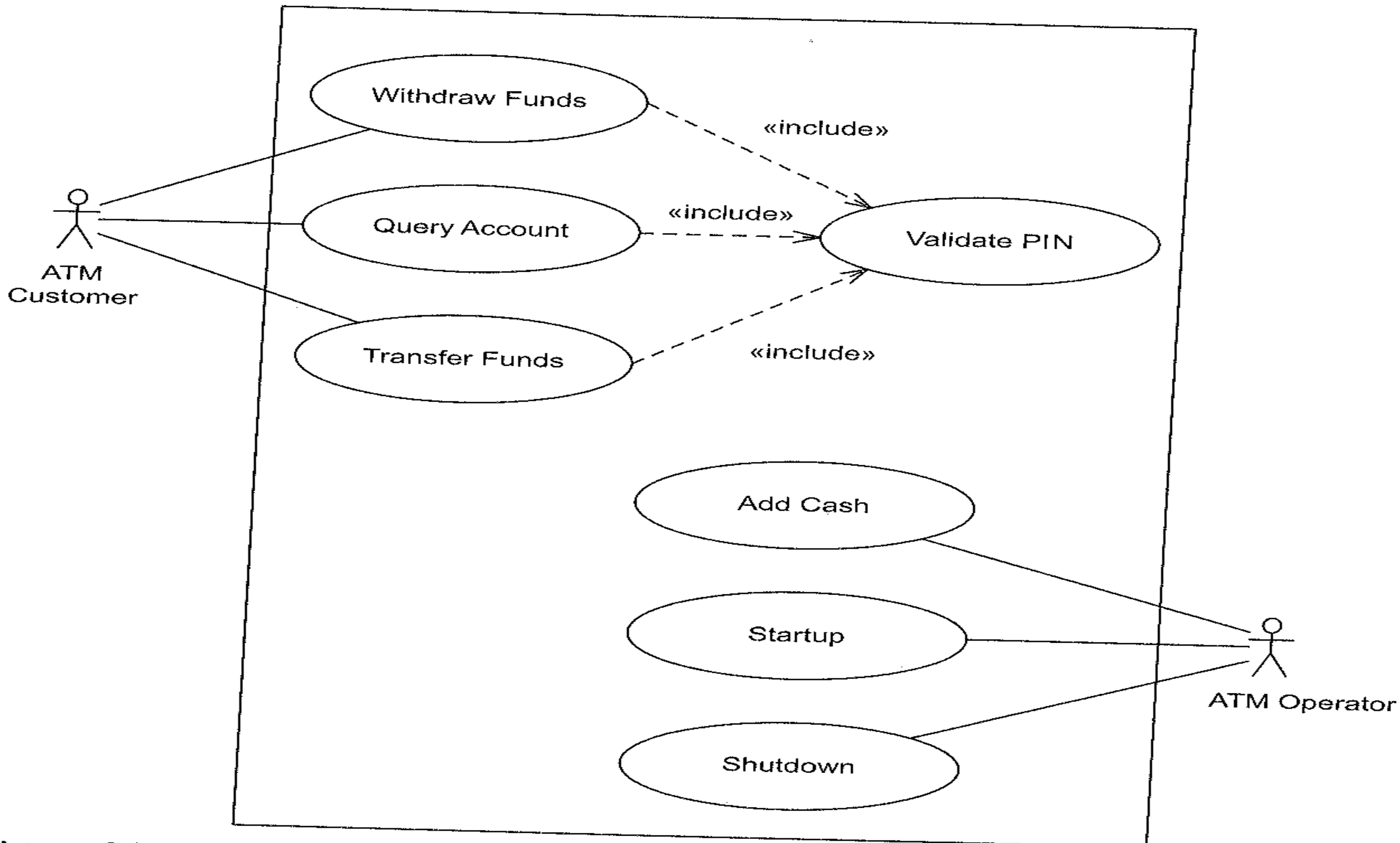


Figure 21.1. Banking System use case model

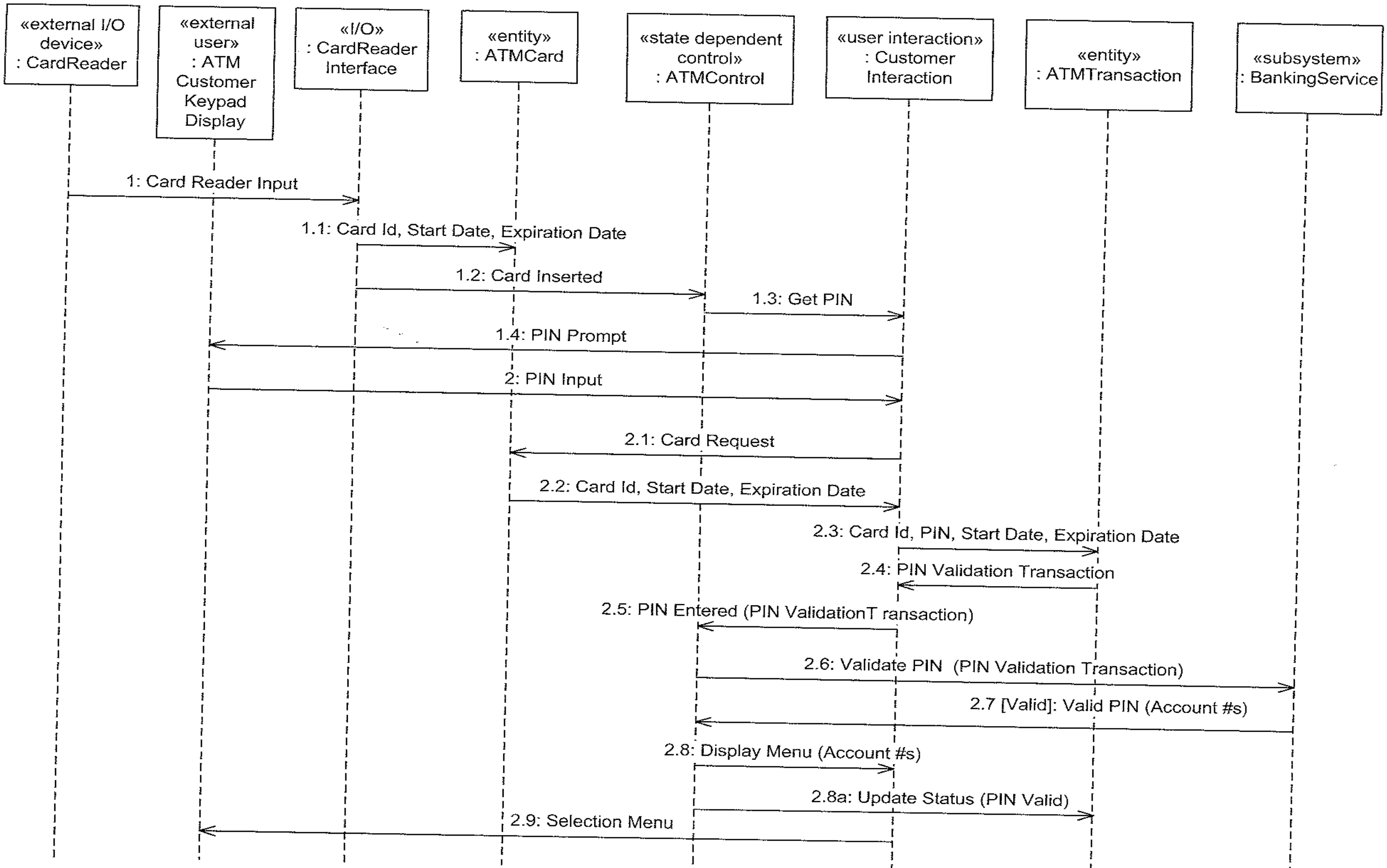


Figure 21.12. Sequence diagram: ATM client Validate PIN use case

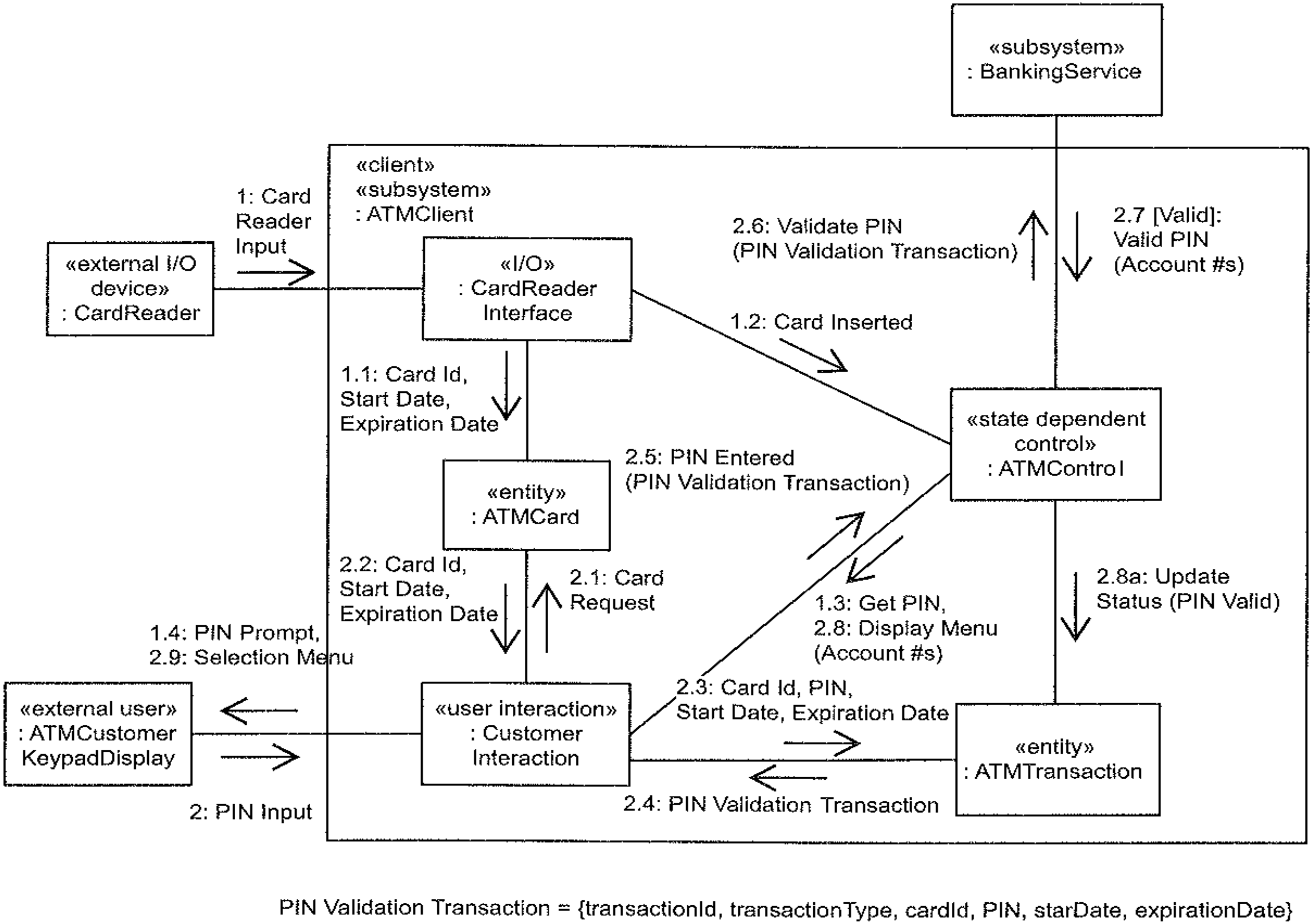


Figure 21.11. Communication diagram: ATM client Validate PIN use case

This is for the Banking Service Subsystem

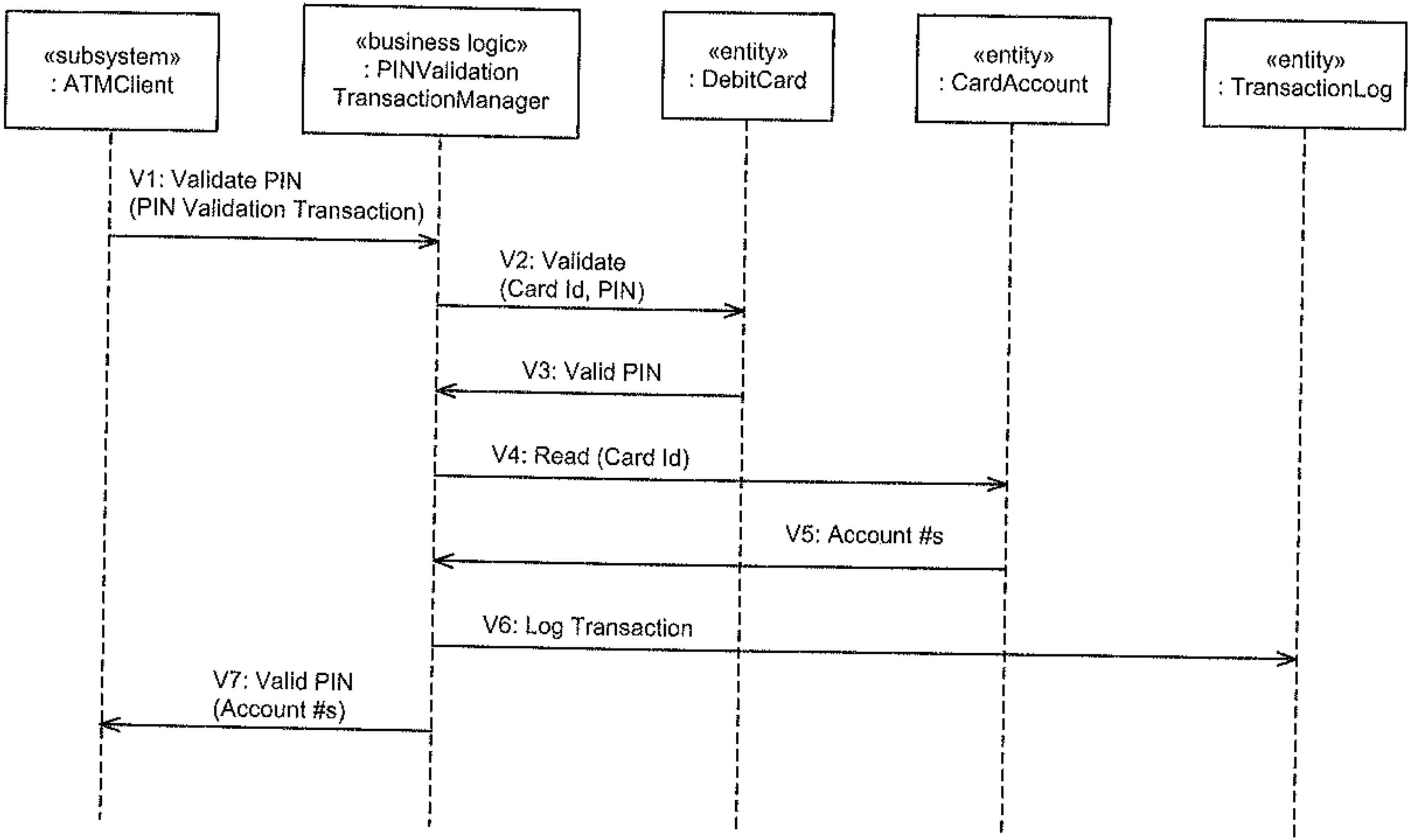


Figure 21.15. Sequence diagram: Banking Service Validate PIN use case

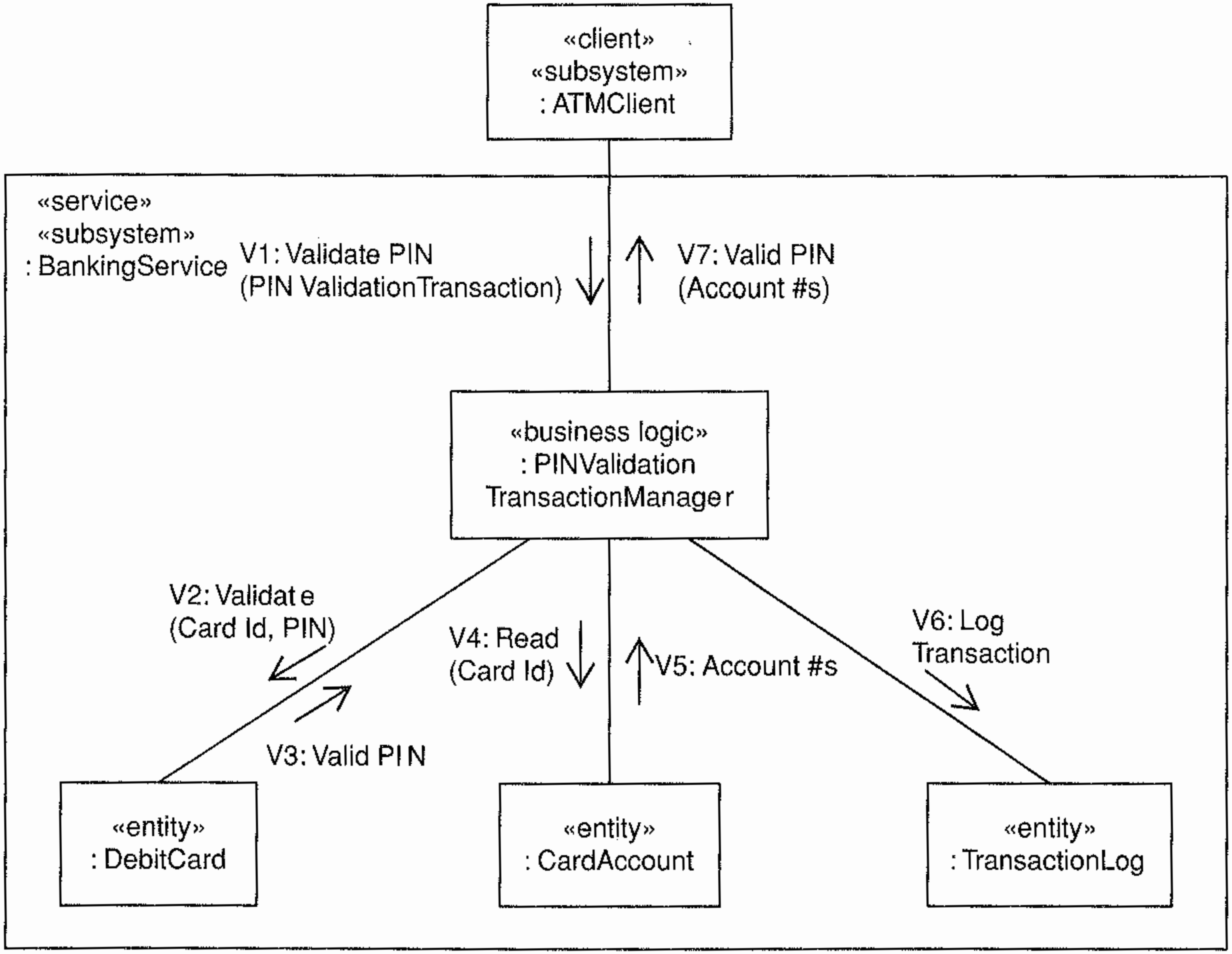


Figure 21.14. Communication diagram: Banking Service Validate PIN use case

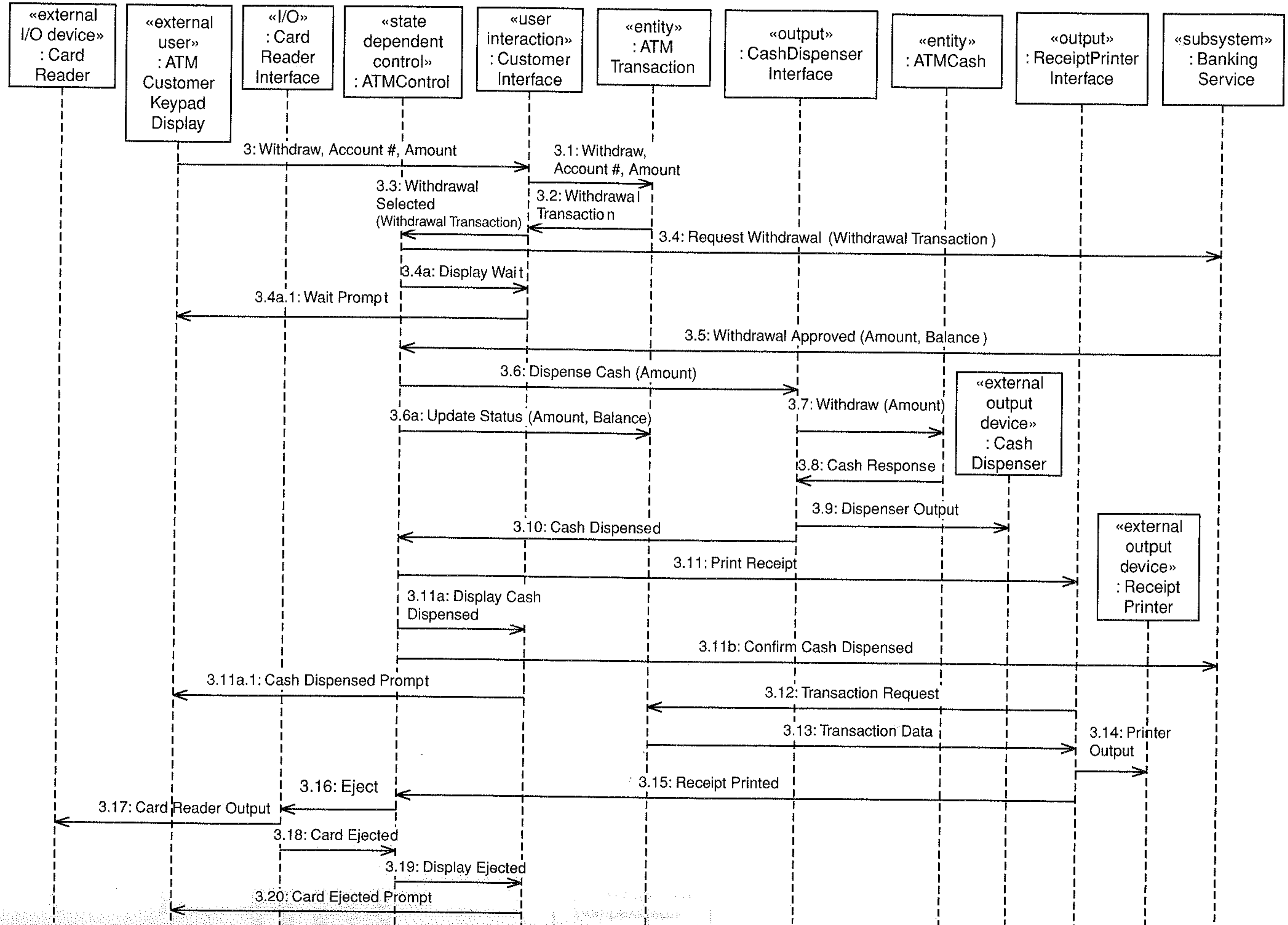
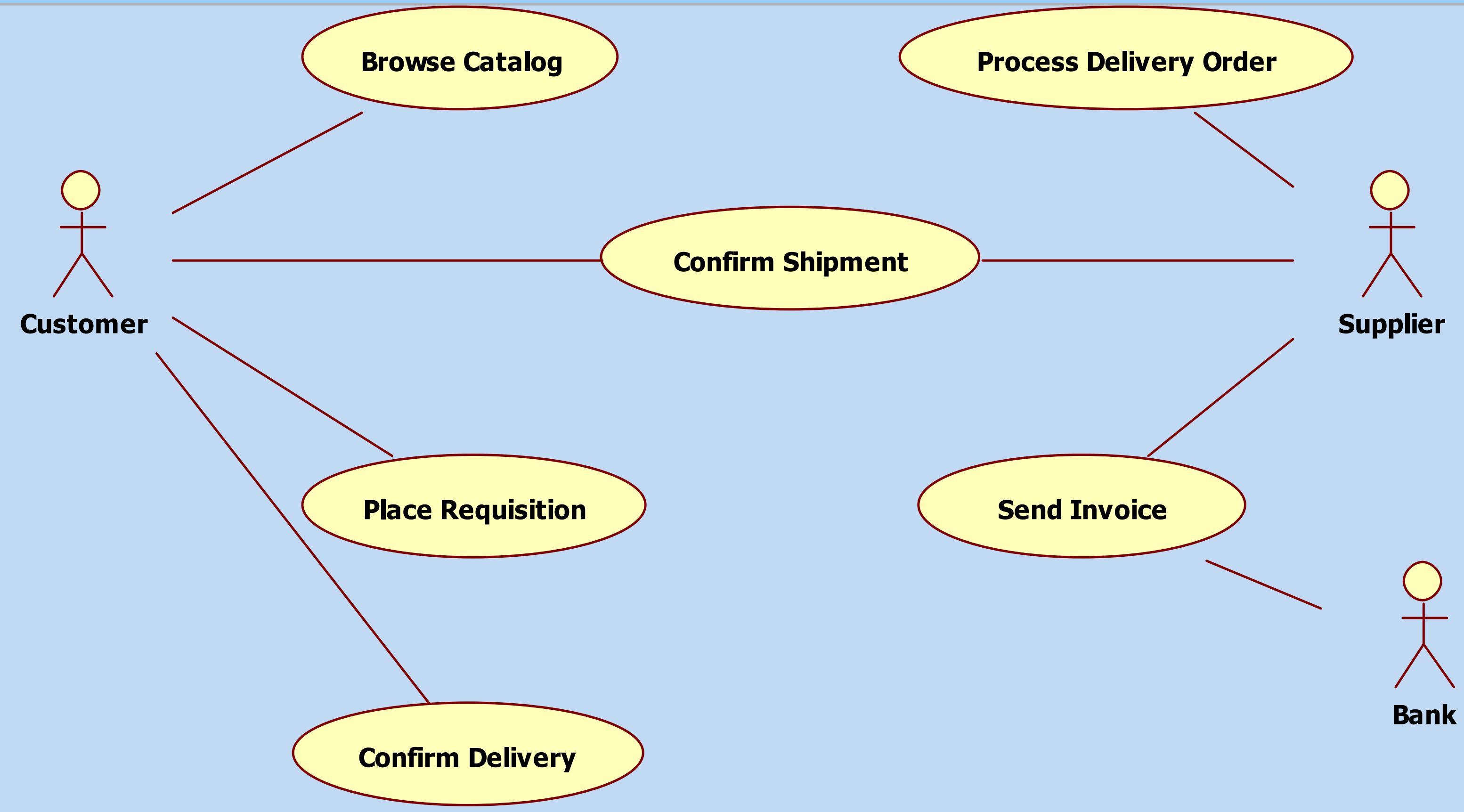
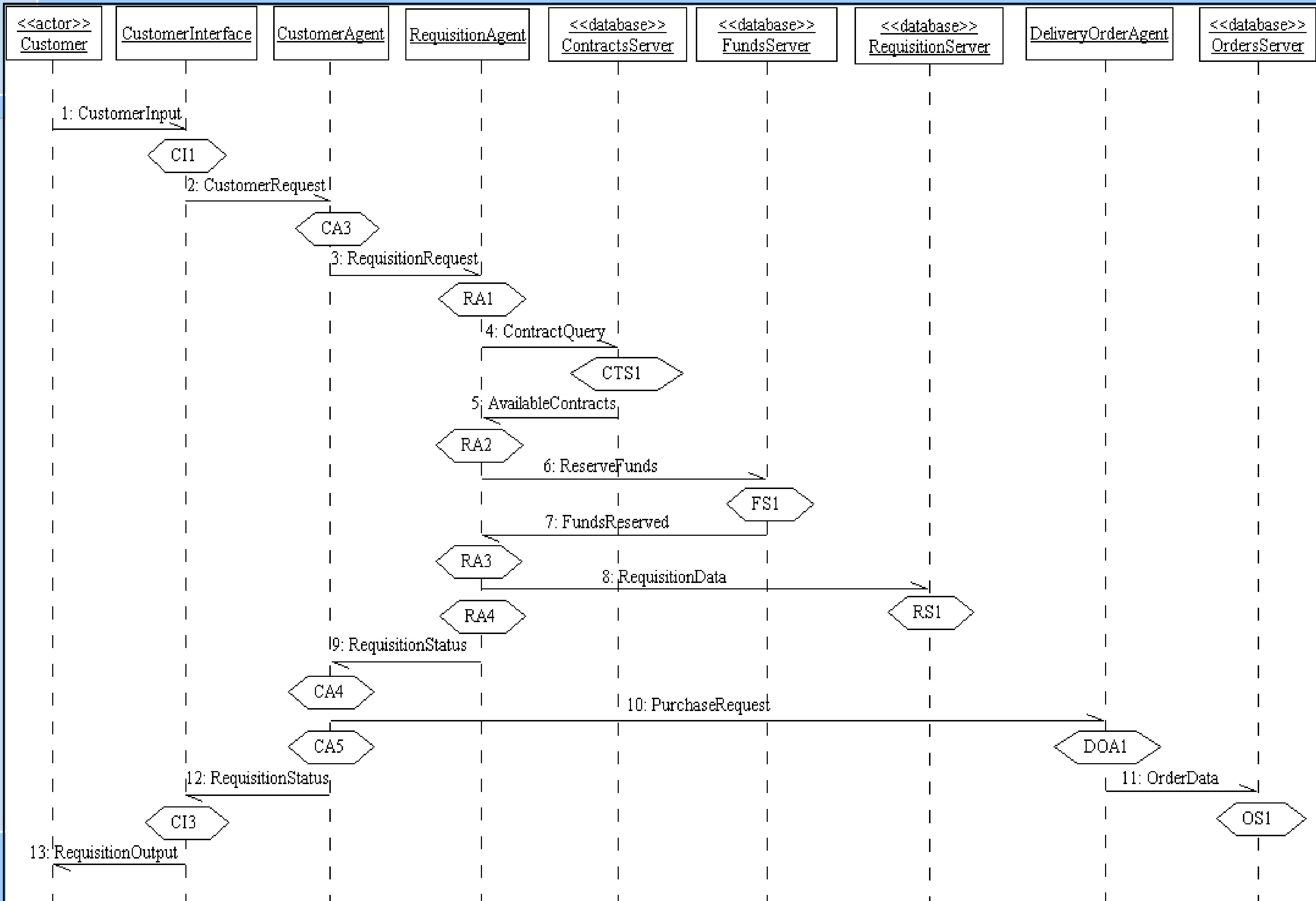


Figure 21.17. Sequence diagram: ATM client Withdraw Funds use case

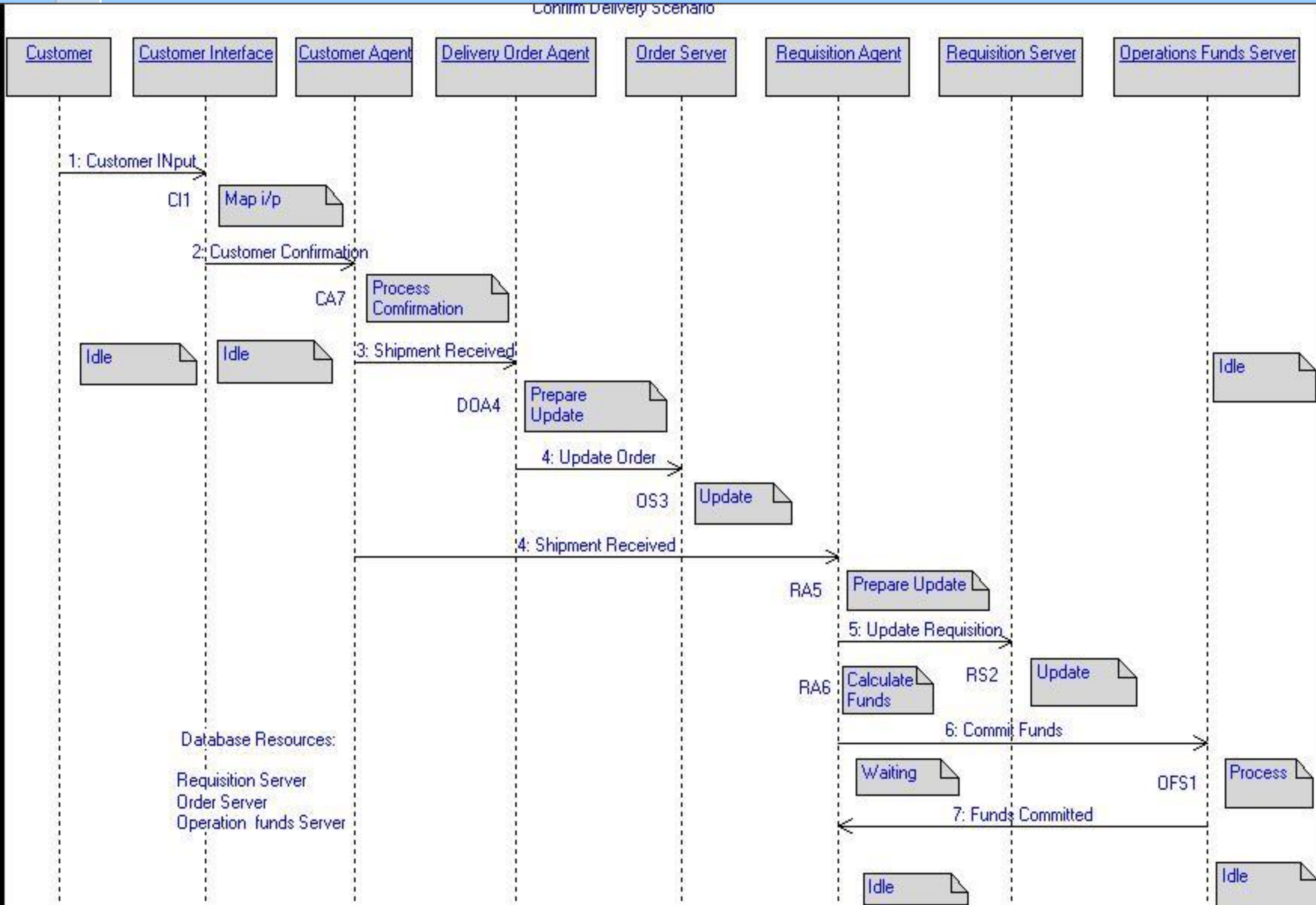
Example: Use Case Diagram of the E-Commerce System



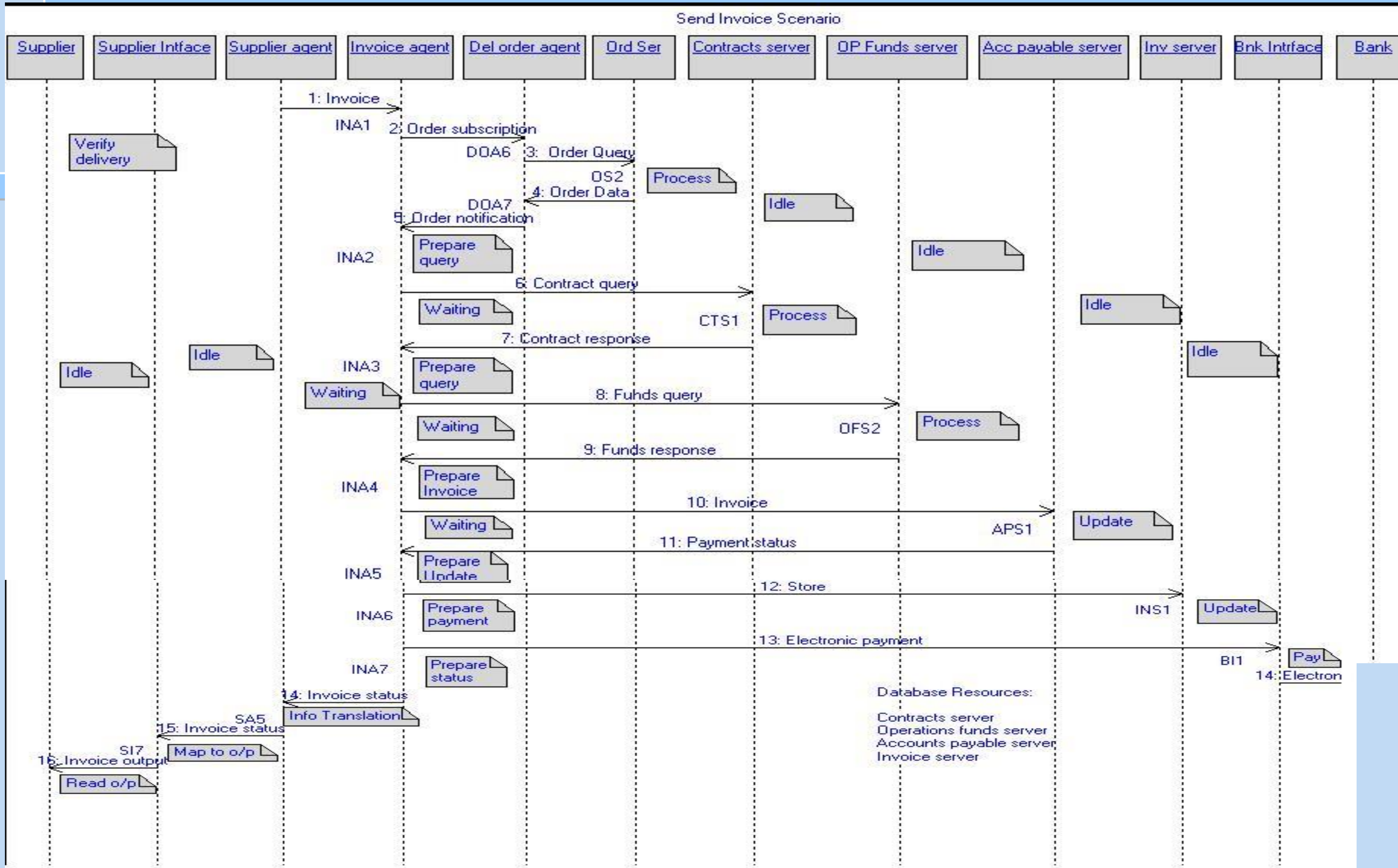
Place Requisition Scenario



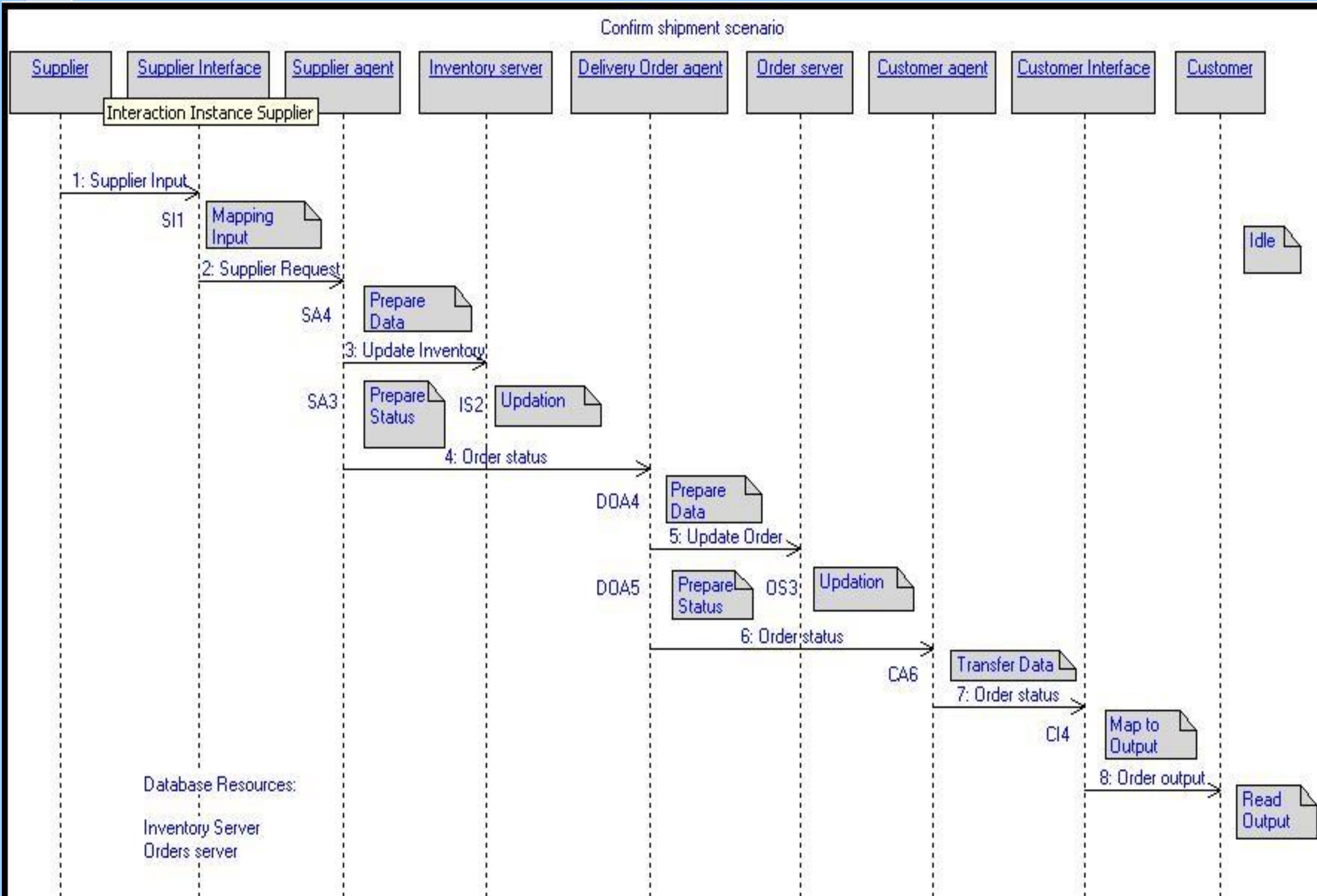
Confirm Delivery Scenario

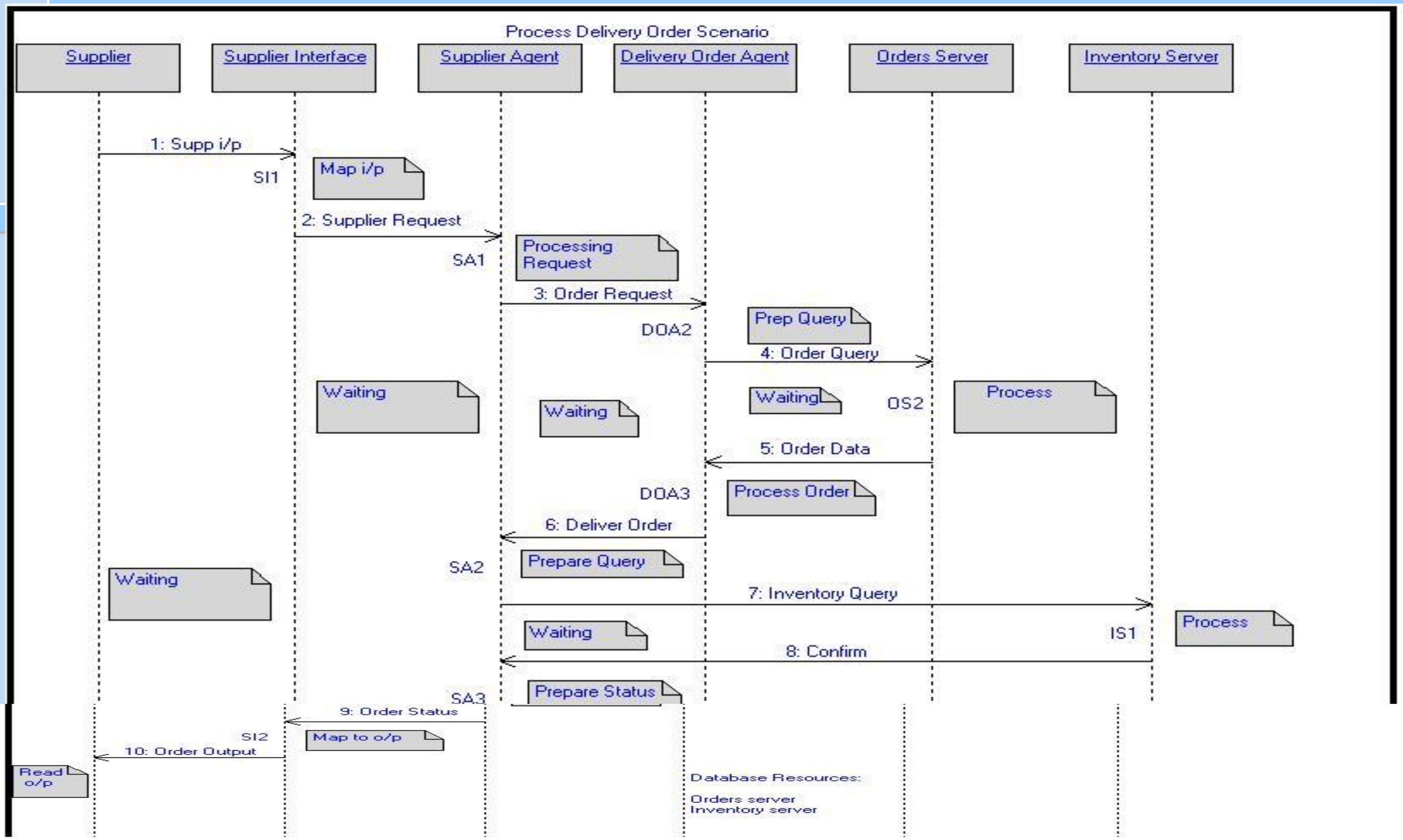


Send Invoice Scenario



Confirm Shipment Scenario




Process Delivery Order Scenario
Supplier
Supplier Interface
Supplier Agent
Delivery Order Agent
Orders Server
Inventory Server
1: Supp i/p
SI1
Map i/p
2: Supplier Request
SA1
Processing Request
3: Order Request
DOA2
Prep Query
4: Order Query
Waiting
Waiting
Waiting
OS2
Process
5: Order Data
DOA3
Process Order
6: Deliver Order
SA2
Prepare Query
Waiting
7: Inventory Query
Process
Waiting
IS1
8: Confirm
SA3
Prepare Status
9: Order Status
SI2
Map to o/p
10: Order Output
Read o/p
Database Resources:
Orders server
Inventory server

Another Example: Pace Maker Use-Case model

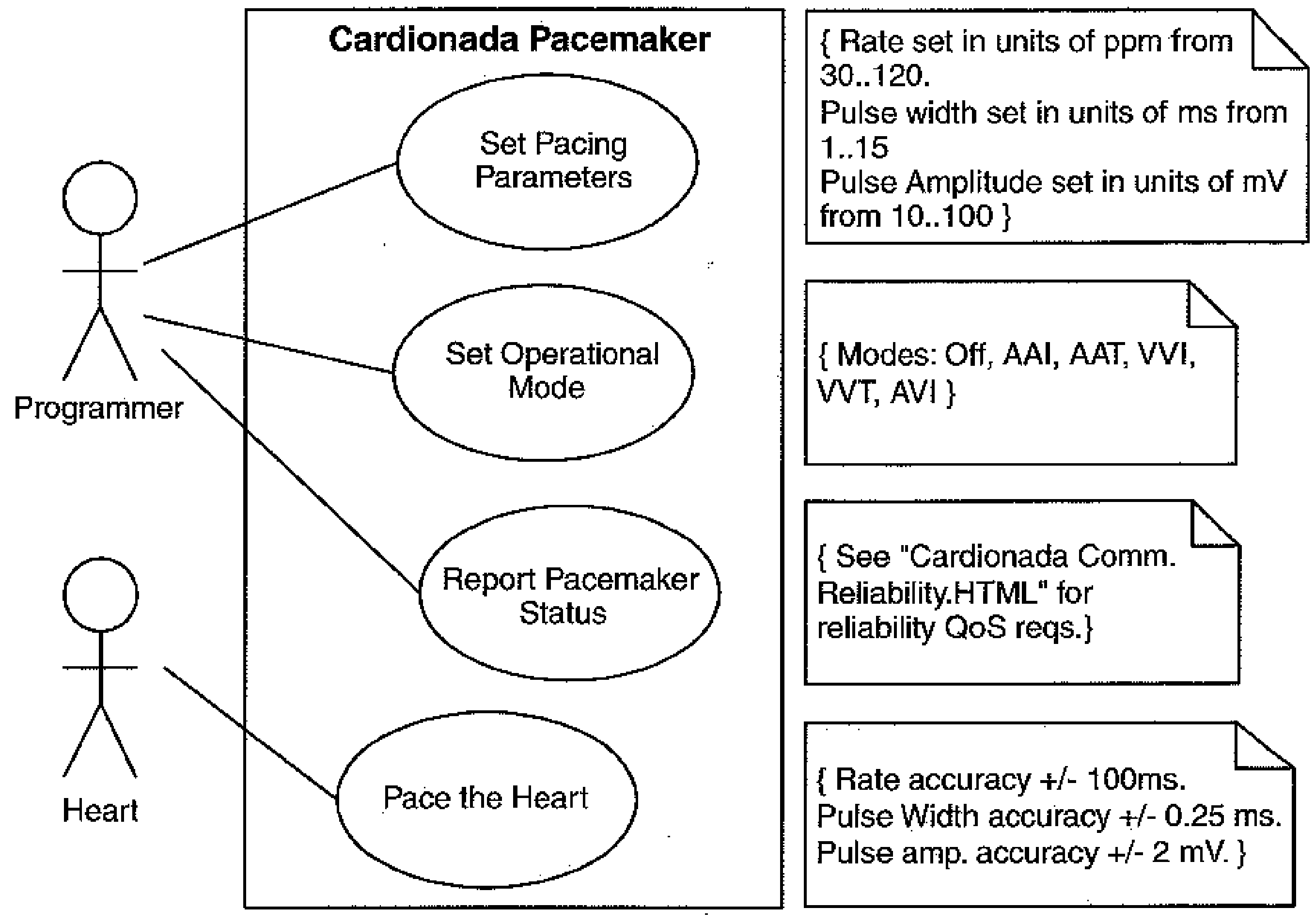


Figure 2-6: *Capturing QoS Requirements*

Pace Maker Sys. Seq. Diag

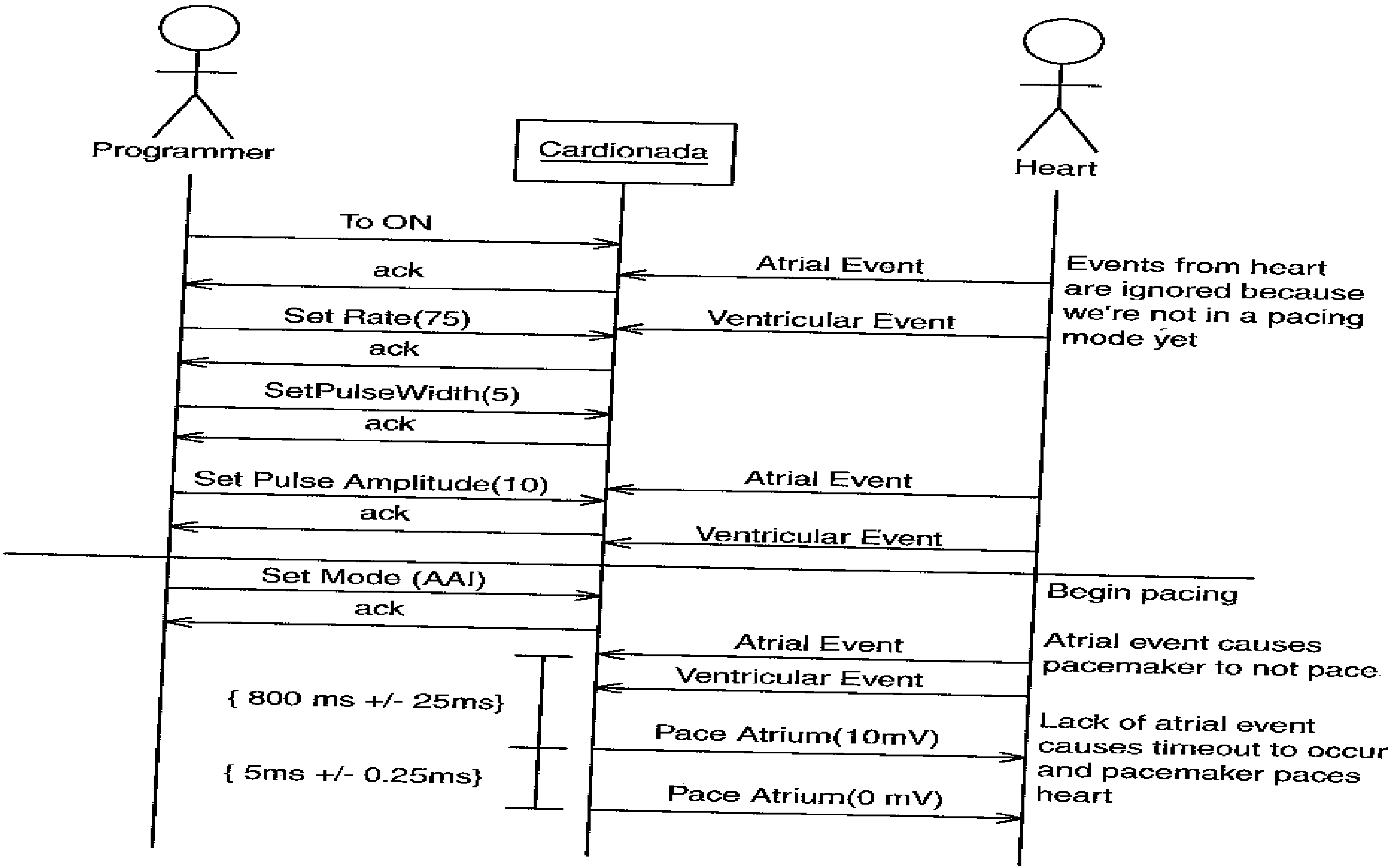


Figure 3-6: *Pace the Heart in AAI Mode (Use Case Level)*

Seq. Diag. at the object level (The Analysis Model)

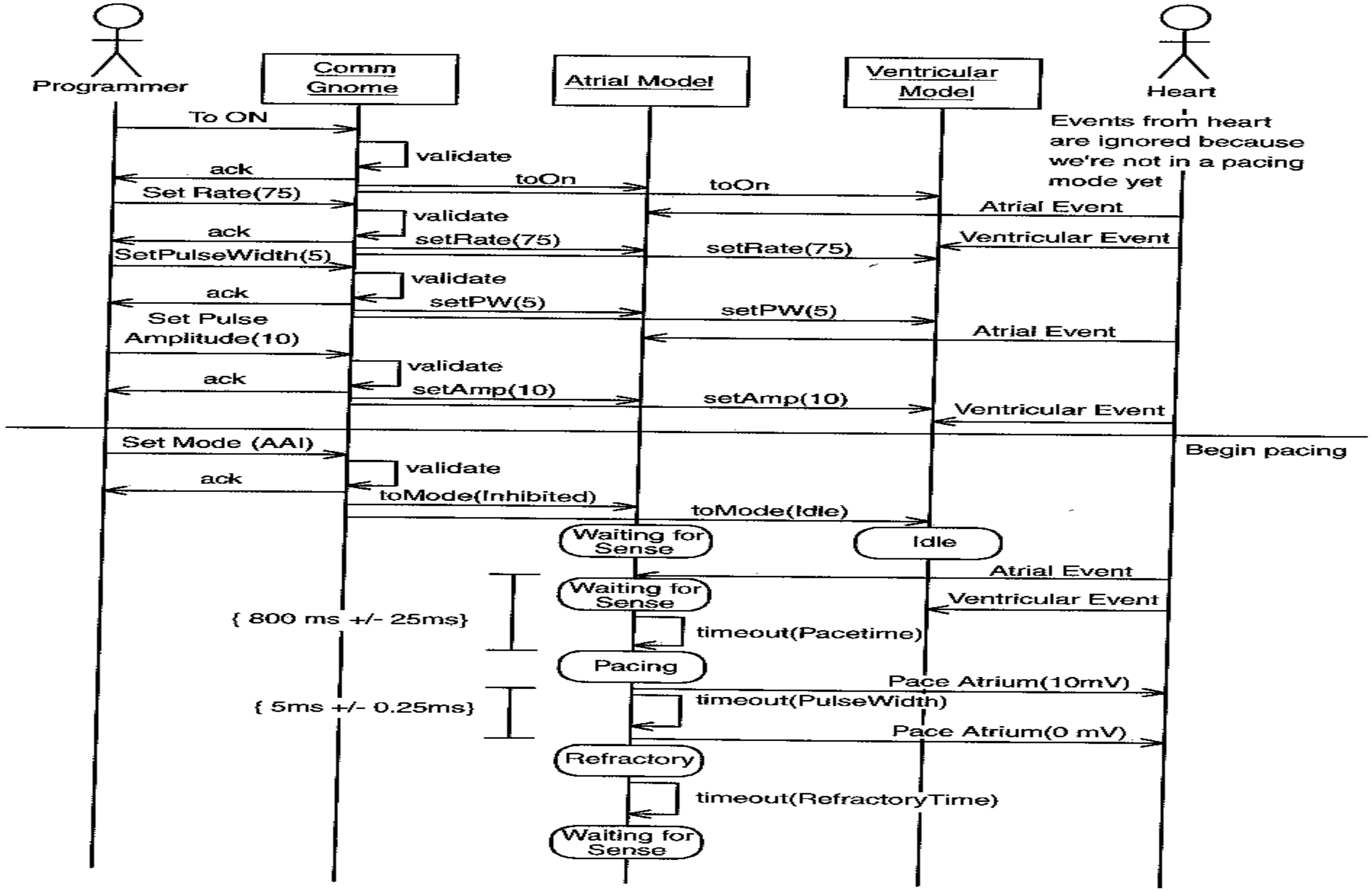
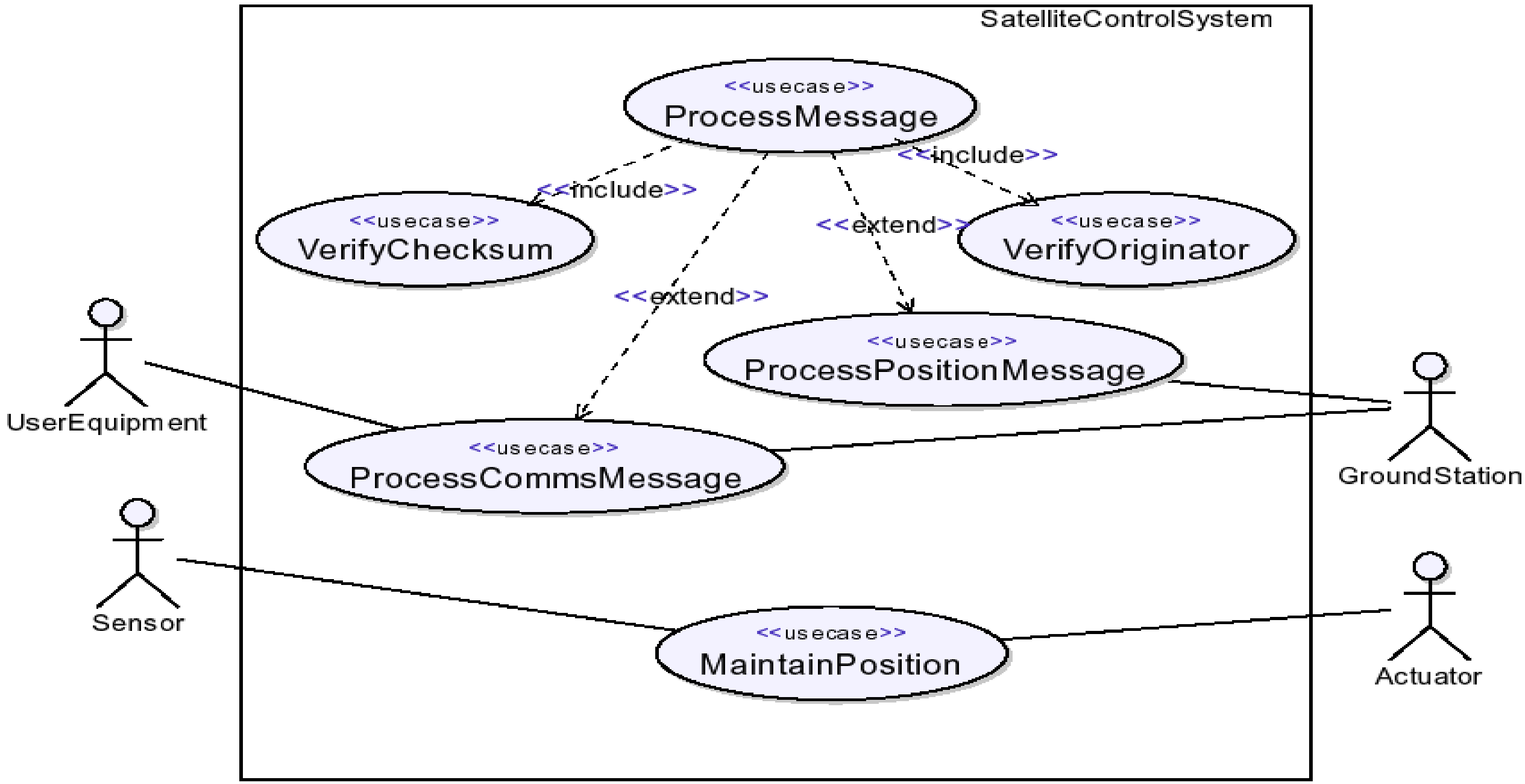
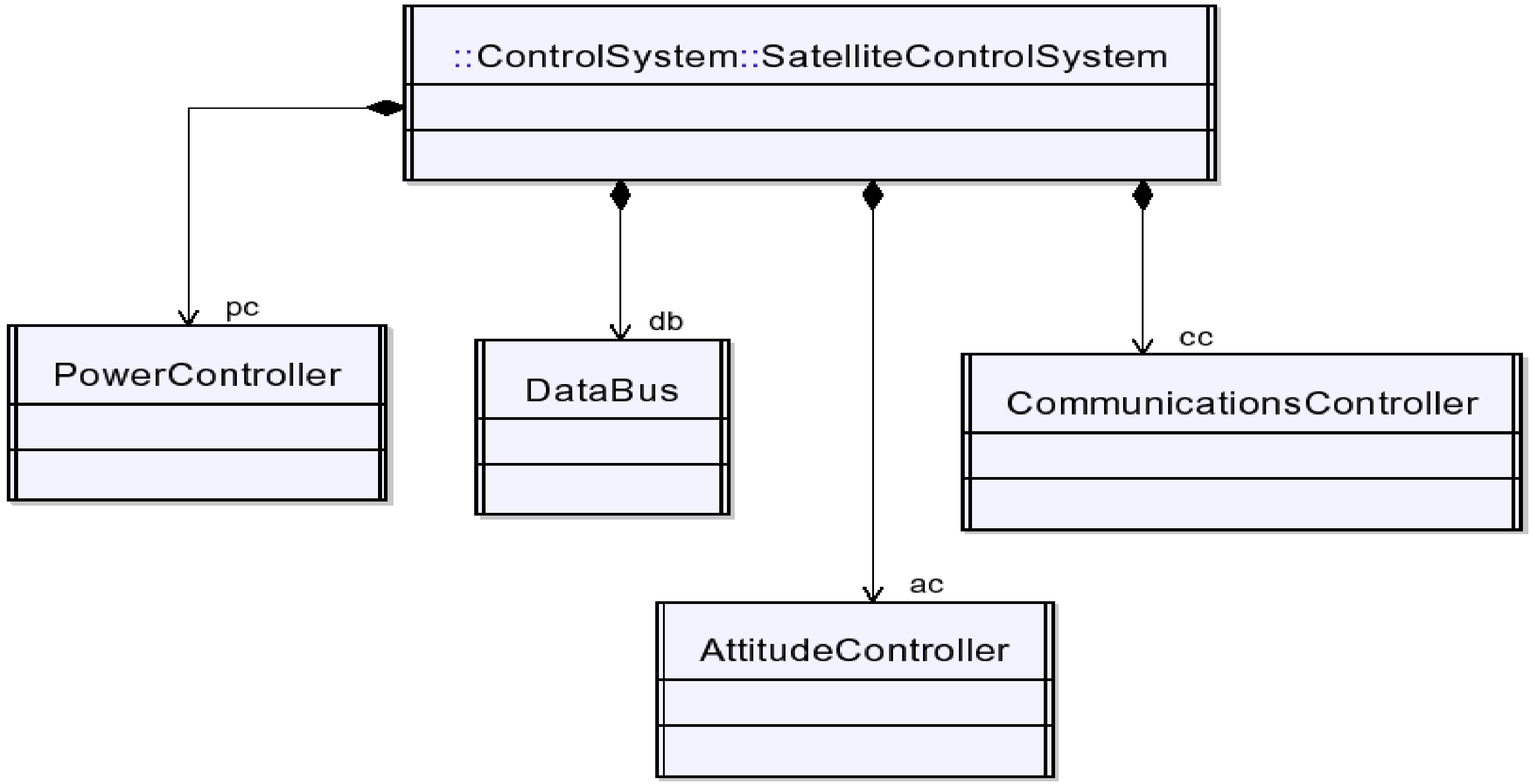


Figure 3-8: *Pace the Heart in AAI Mode (Object Level)*

A Simple Example of Using UML2



Example of Software Architecture Using UML2



A Simple Example Using UML2