Object Oriented Software Counting with Multiple Boundaries

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Overview

- Functional Analysis and Architecture
  - Boundaries
- Functional Analysis and Specification
  - UML Analysis Artifacts
- Functional View of an Object
  - Elements of IFPUG Function Point Analysis
- Components
  - Services

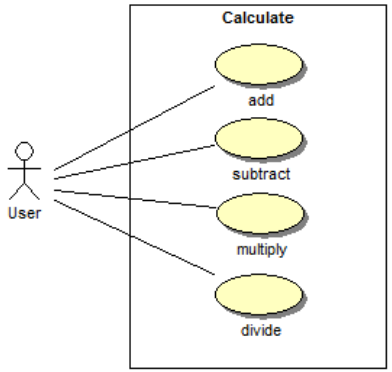
Functional Analysis and Architecture

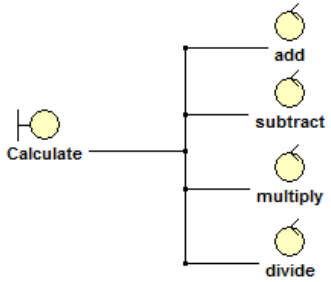
- Functional Analysis organizes information into a model
  - Its “primary purpose is to formulate a model of the problem domain that is independent of implementation considerations.” [UML 2.0 Infrastructure]
  - “The definition of functionality, also referred to as functional analysis, is not the same as structured analysis in software development and does not presume a functionally oriented software design. The definition of functions, their logical groupings, and their association with requirements is referred to as a functional architecture.” [CMMI Second Edition]
- Functional Architecture
  - Specified using a formal language
  - Illustrated using Unified Modeling Language (UML)
  - Measured using ISO Functional Size Method

Calculator Example

- User Requirements -- Four-Function Calculator
- Provide the capability to:
  - Add
  - Subtract
  - Multiply
  - Divide
- Represents an example of stateless software
  - There are no storage requirements
  - All functional size is transactional

Specification and Analysis Artifacts

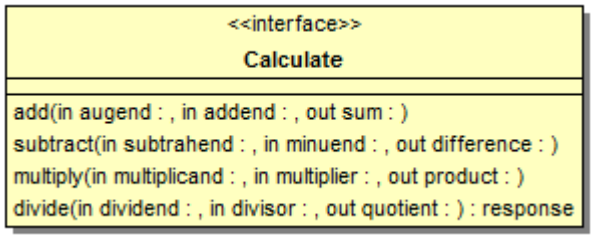


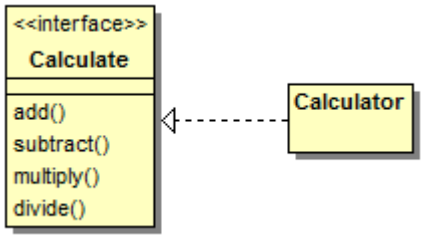


Analysis Models

```
Boundary Calculate
    add : EO
        Inputs
            augend, addend
        Outputs
            sum
    subtract : EO
        Inputs
            subtrahend, minuend
        Outputs
            difference
    multiply : EO
        Inputs
            multiplicand, multiplier
        Outputs
            product
    divide : EO
        Inputs
            dividend, divisor
        Outputs
            quotient
        Responses
            DivideByZero
```

Functional Specification





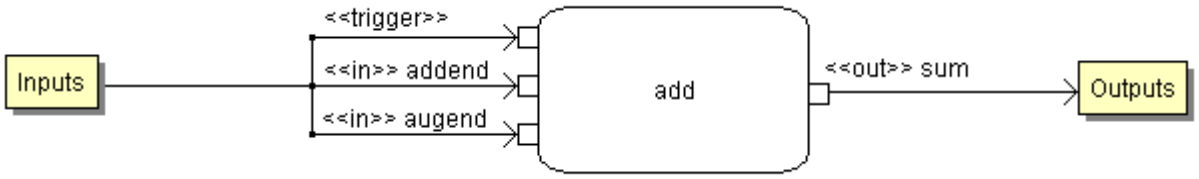
Interface Models

Multiple Views of a Four-function Calculator

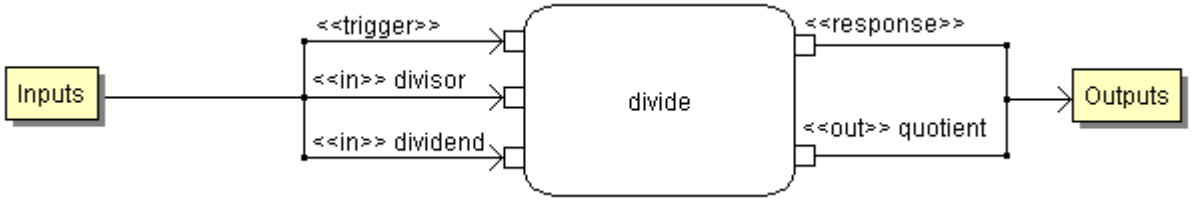
Action Model of Functions

A UML Action is “the fundamental unit of executable functionality”

-- All functions have a trigger input



-- Some functions have a response output

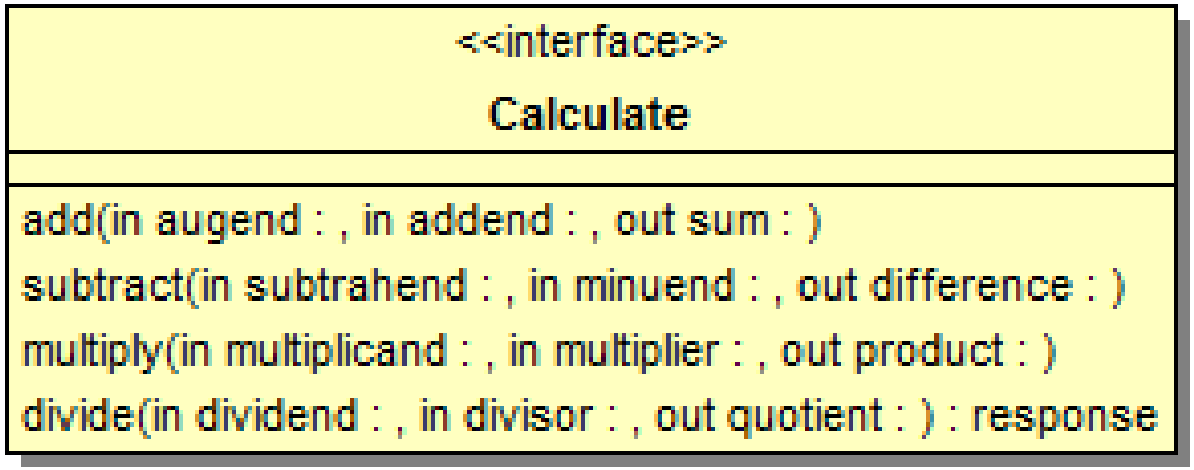


Functional Size Methods quantify functionality
by accounting for the amount of data a function processes

Calculator Functional Size

Boundary: Calculate

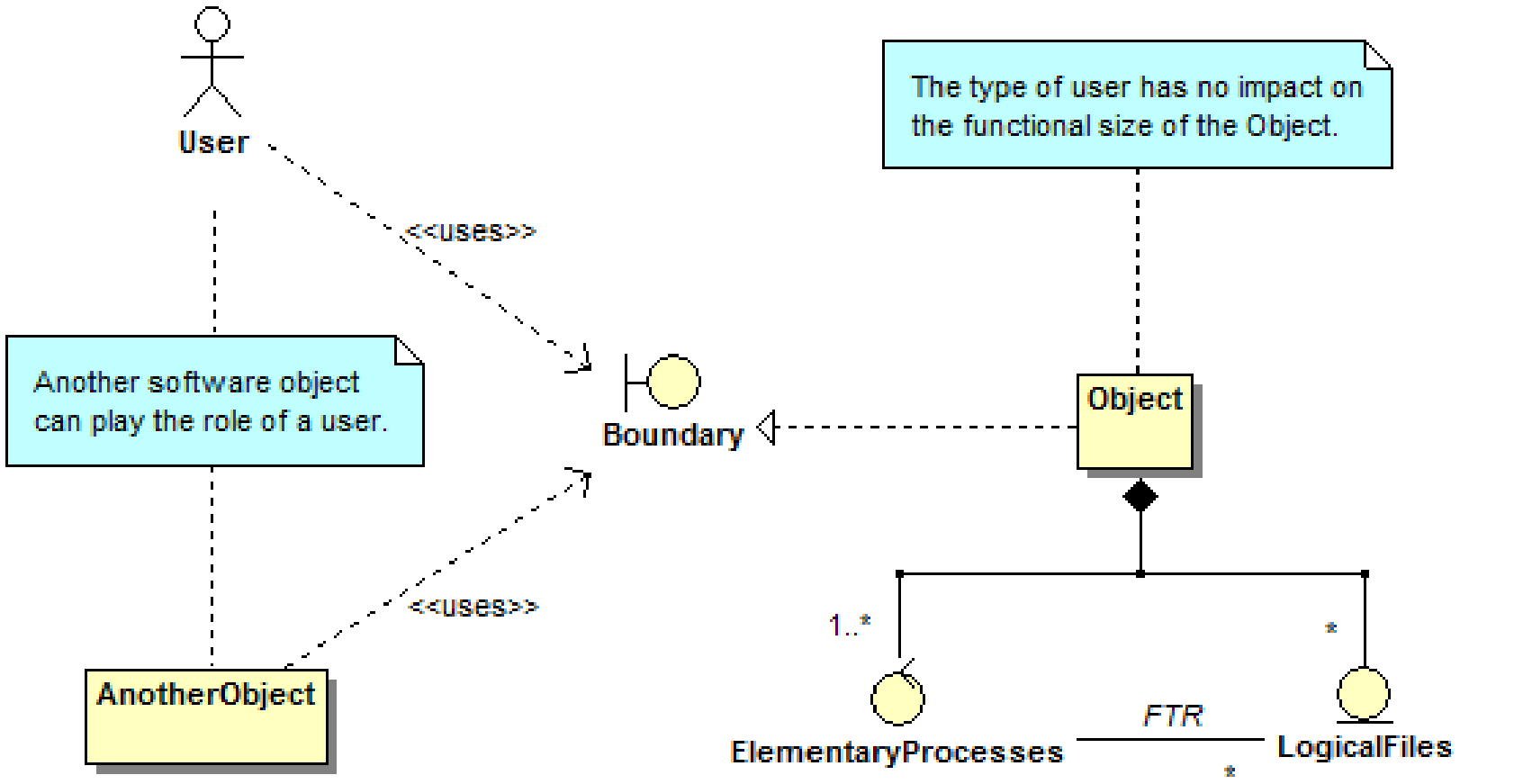
Transactional Functions:	Type	DET	FTR	Function Points
add	EO	4	0	4
subtract	EO	4	0	4
multiply	EO	4	0	4
divide	EO	5	0	4



Elements of Functional Architecture

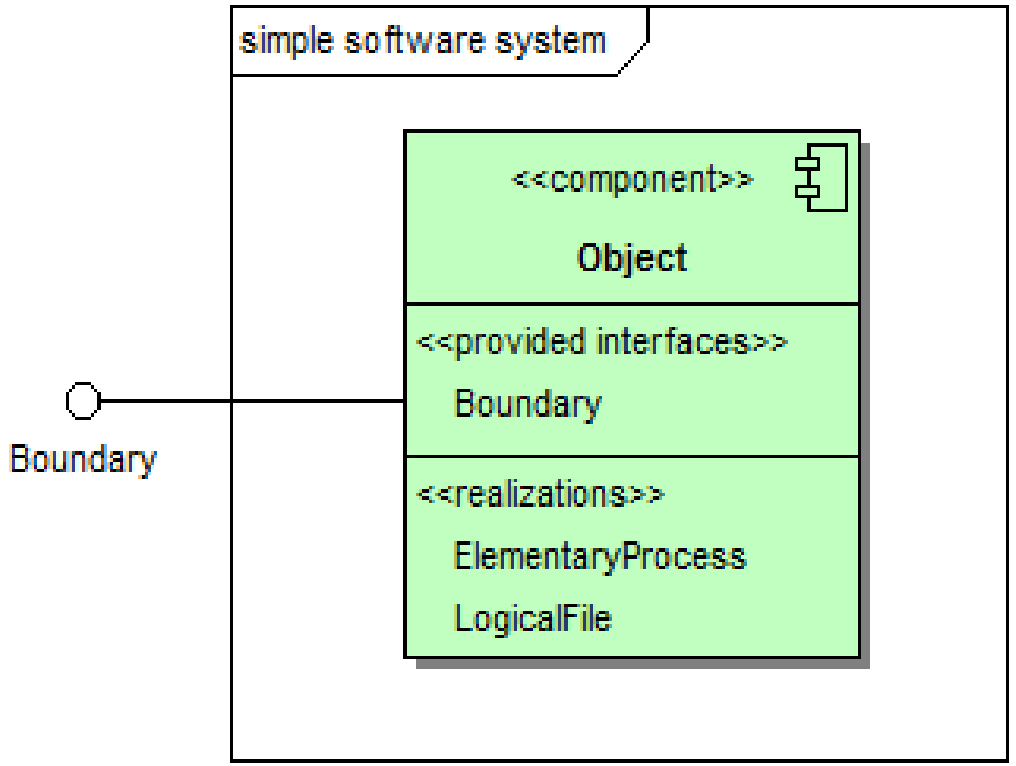
- Boundary
  - A structural element that indicates a partition
    - Represents a group of Functional User Requirements
- Function
  - A behavioral element that indicates an operation
    - Represents a Functional User Requirement
    - Characterized by Inputs, Outputs, Responses, Reads, Writes
- Entity
  - A structural element that indicates persistent data
    - Represents Domain Objects
    - Organized by groups of data

Functional Size is measured from the User Perspective



At a minimum the functional size of the Object is the size of its elementary processes and the state information that it encapsulates as its internal logical files.

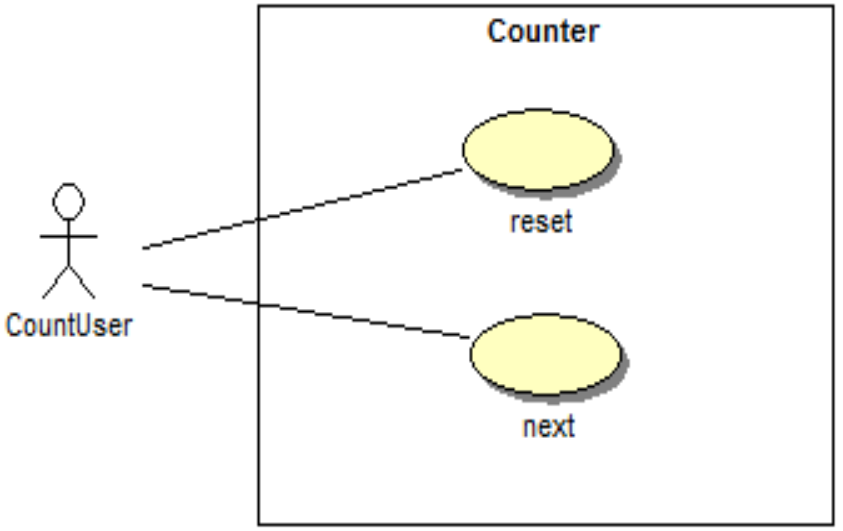
Component View of a Simple Software System



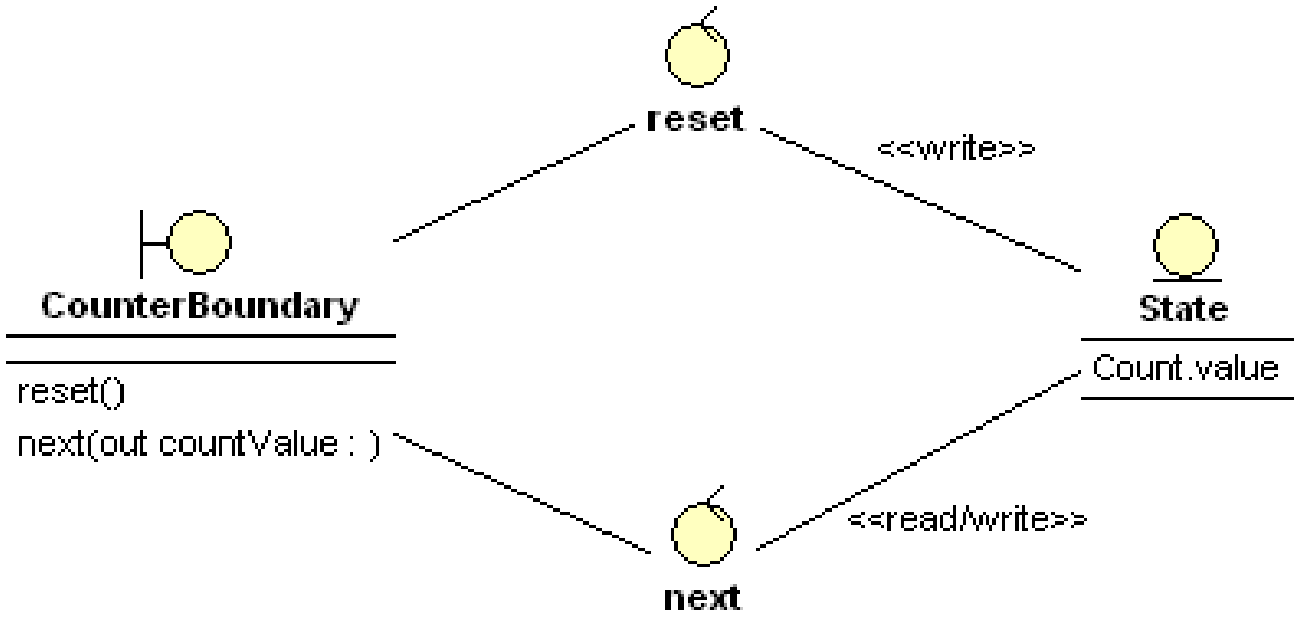
Components are key elements of software architecture that indicate countable software boundaries
They represent the fundamental partitions in Service Oriented Architectures

Counter Example

- Counter Software – User Requirements
  - The software shall provide an operation to reset the counter to zero.
  - The software shall provide an operation to increment the counter and output its current value.
- Use Case Model

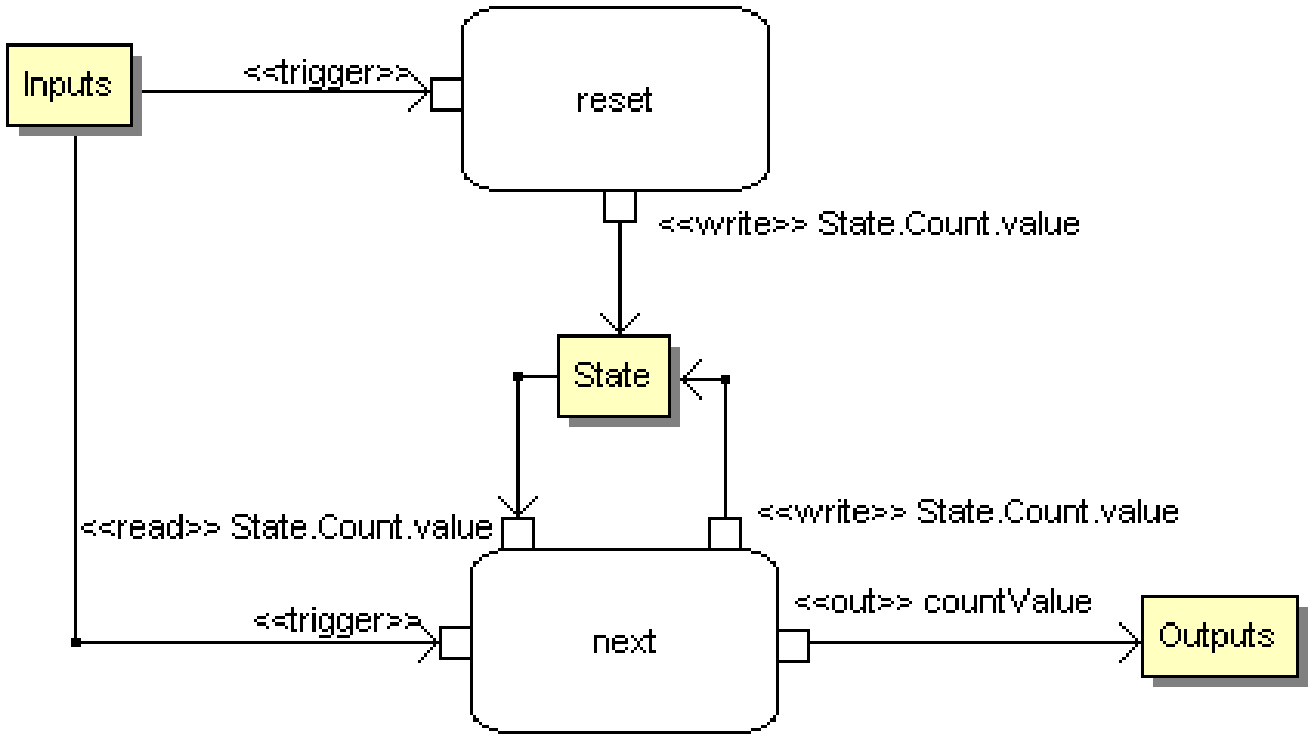


Robustness Analysis Model of Counter



Robustness Analysis links the behavioral model to the persistent data model
This view assists in identifying FTRs and Data Function types

Action Model of Counter



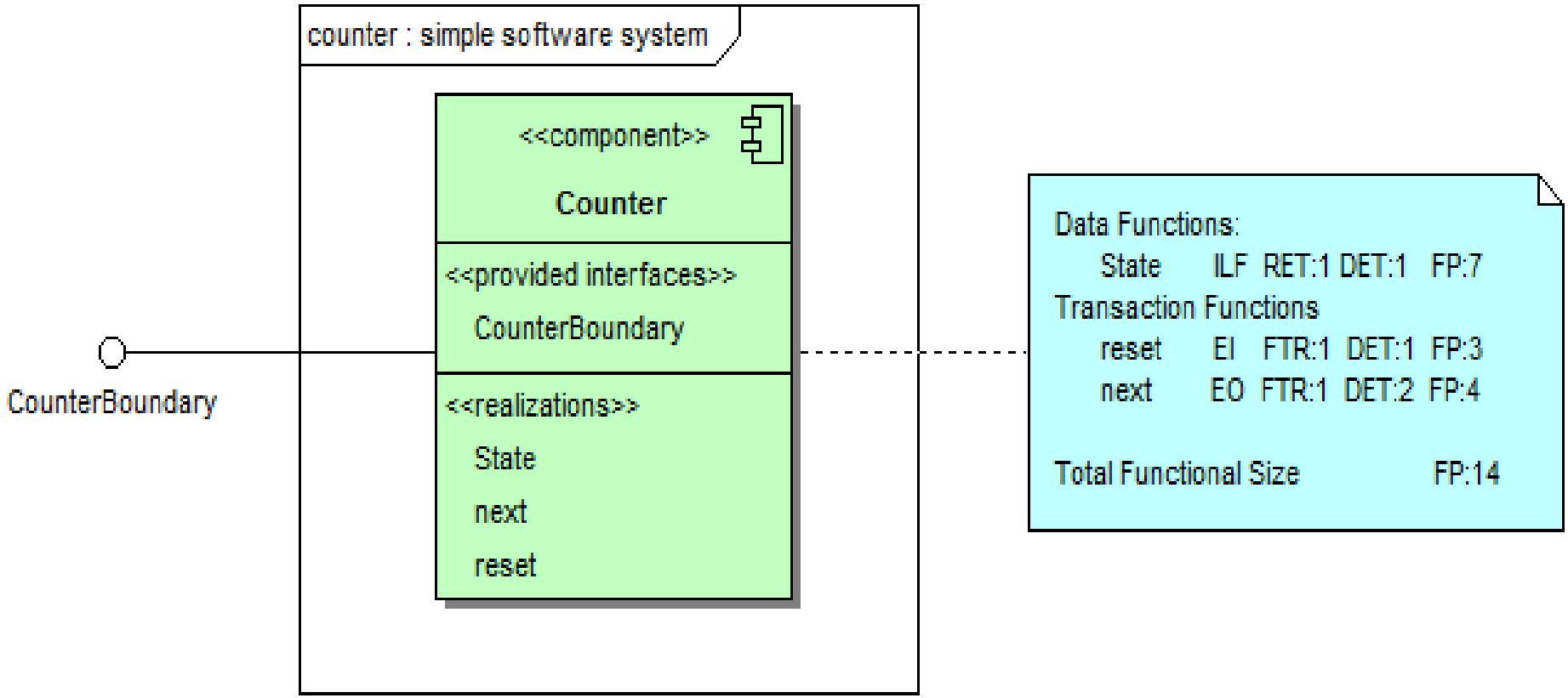
Action Models detail data coupling between Elementary Processes
And assist in counting logical files

Counter Functional Specification

```
Entity State
        Count                   # RET
                value           # DET

Boundary Counter
        reset : EI              # EP
                Writes
                        State.Count.value

        next : EO               # EP
                Outputs
                        countValue
                Reads
                        State.Count.value
                Writes
                        State.Count.value
```

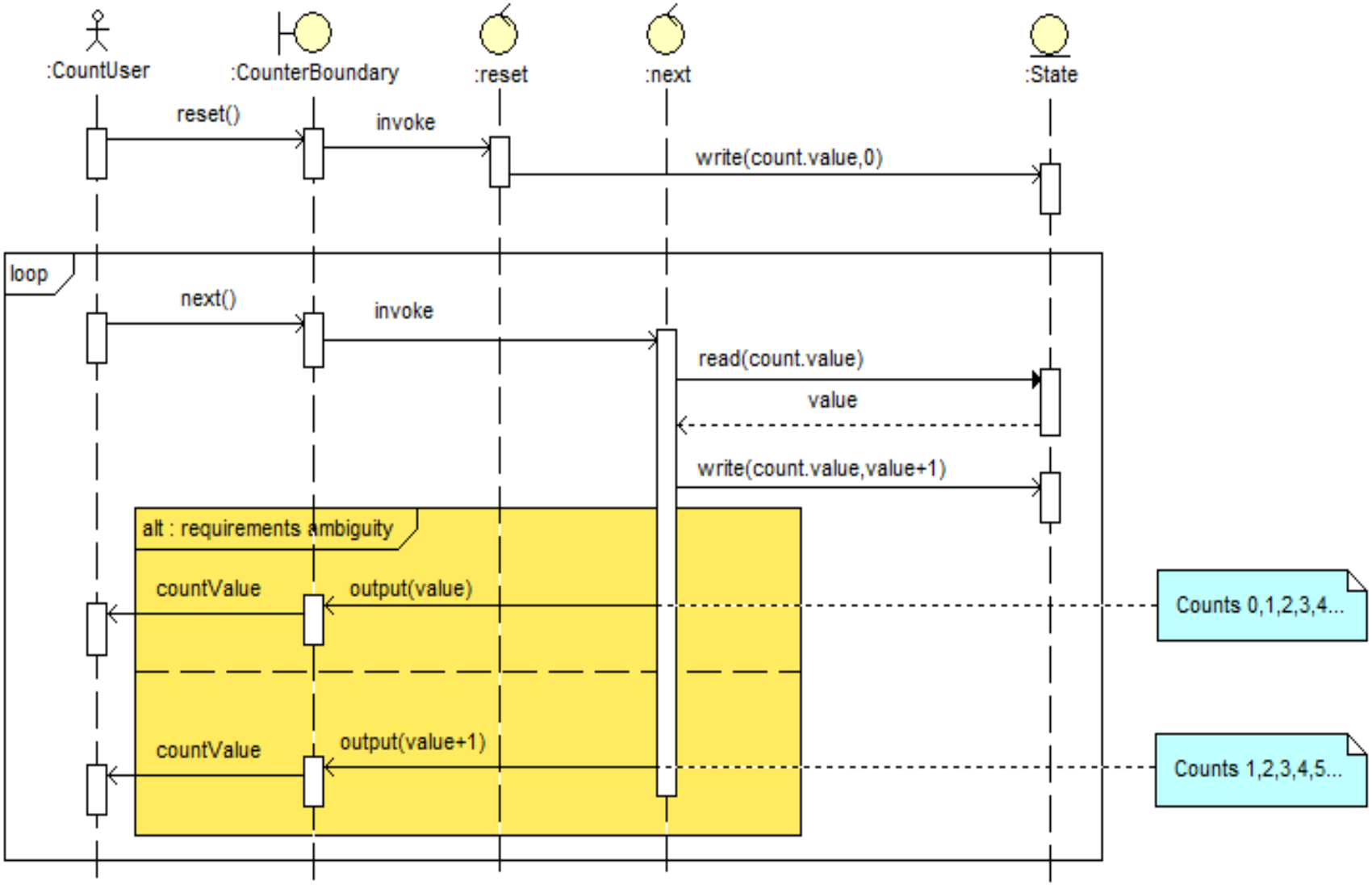
The functional specification contains all information necessary to compute functional size
All UML analysis artifacts are traced to the specification

Component View of Counter

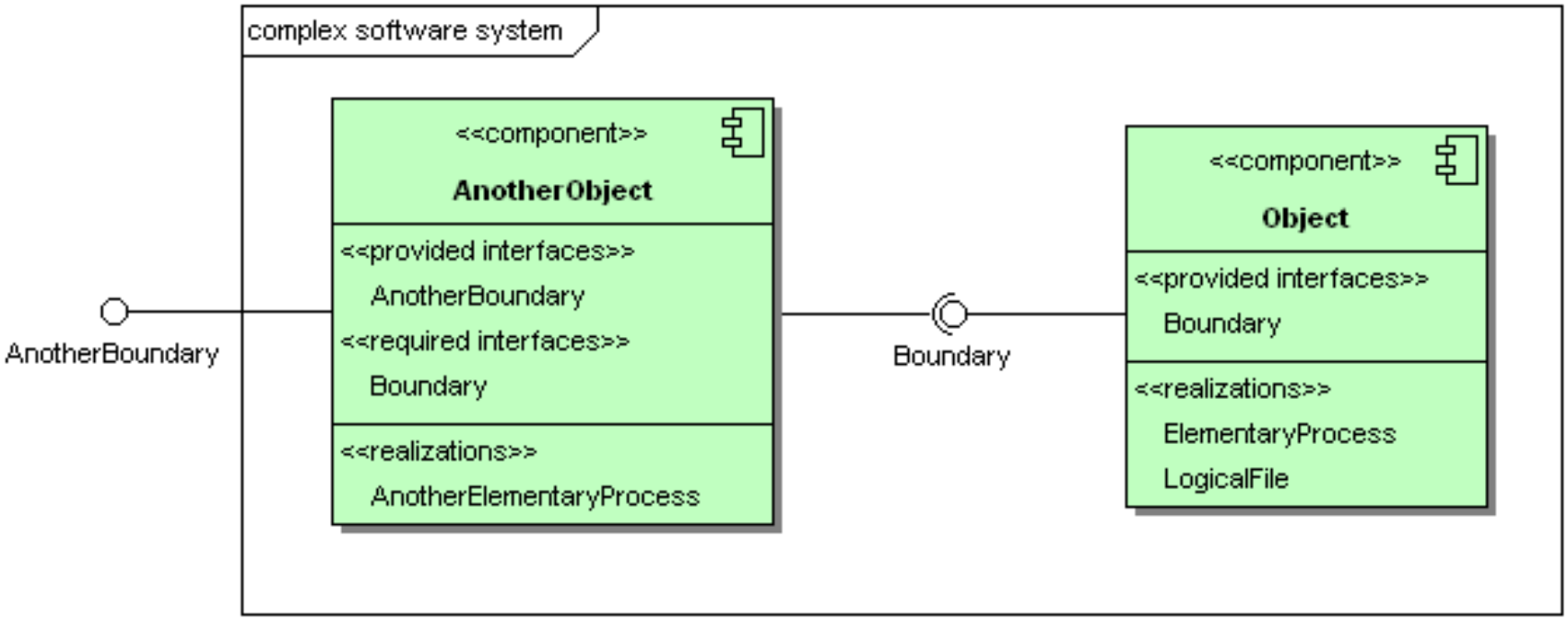


Component models represent reusable functional software entities
The mechanics of constructing and deploying components relates to Software Technical Requirements

Analysis Reveals Requirements Ambiguity



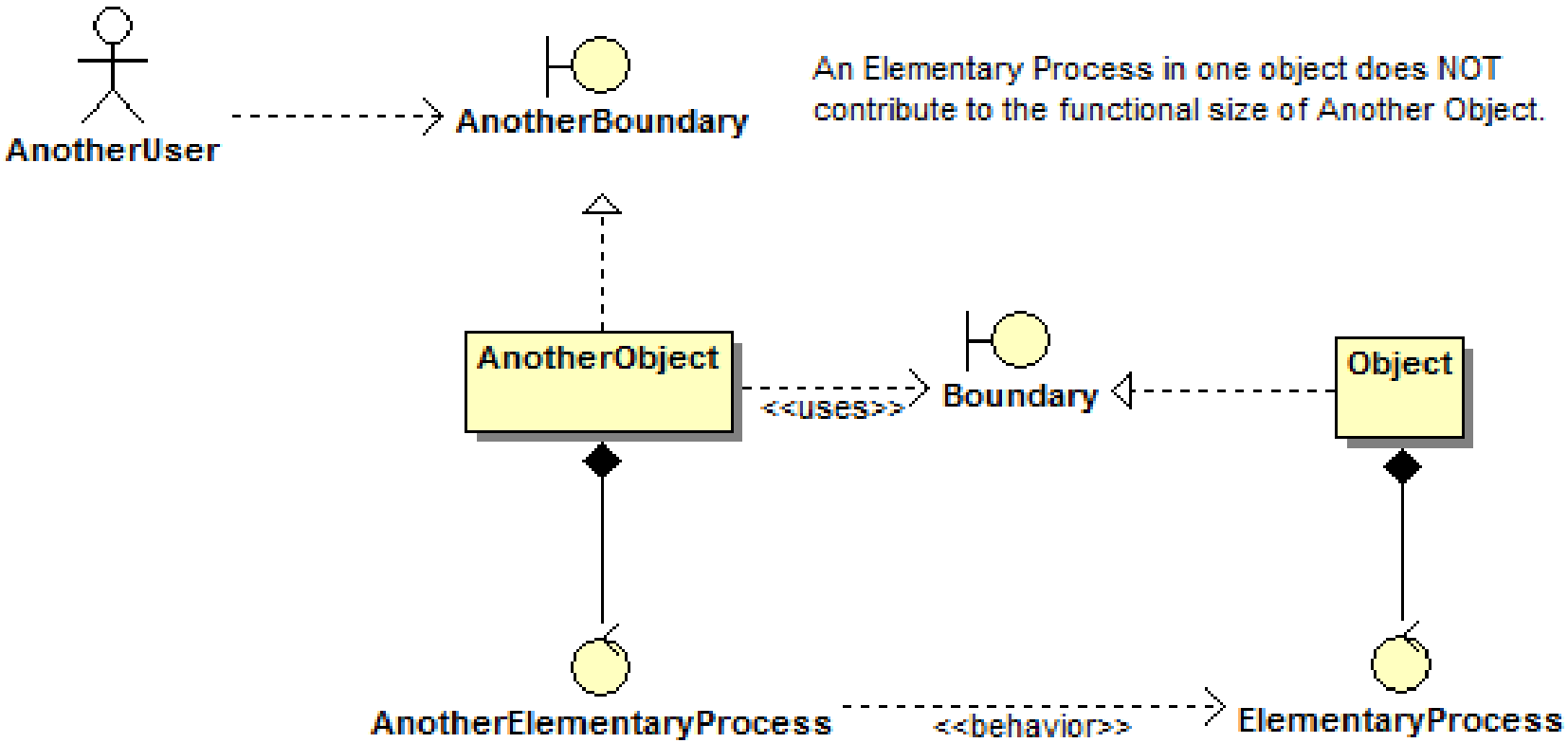
Component View of Complex Software System



A software system partitioned by non-functional user requirements.

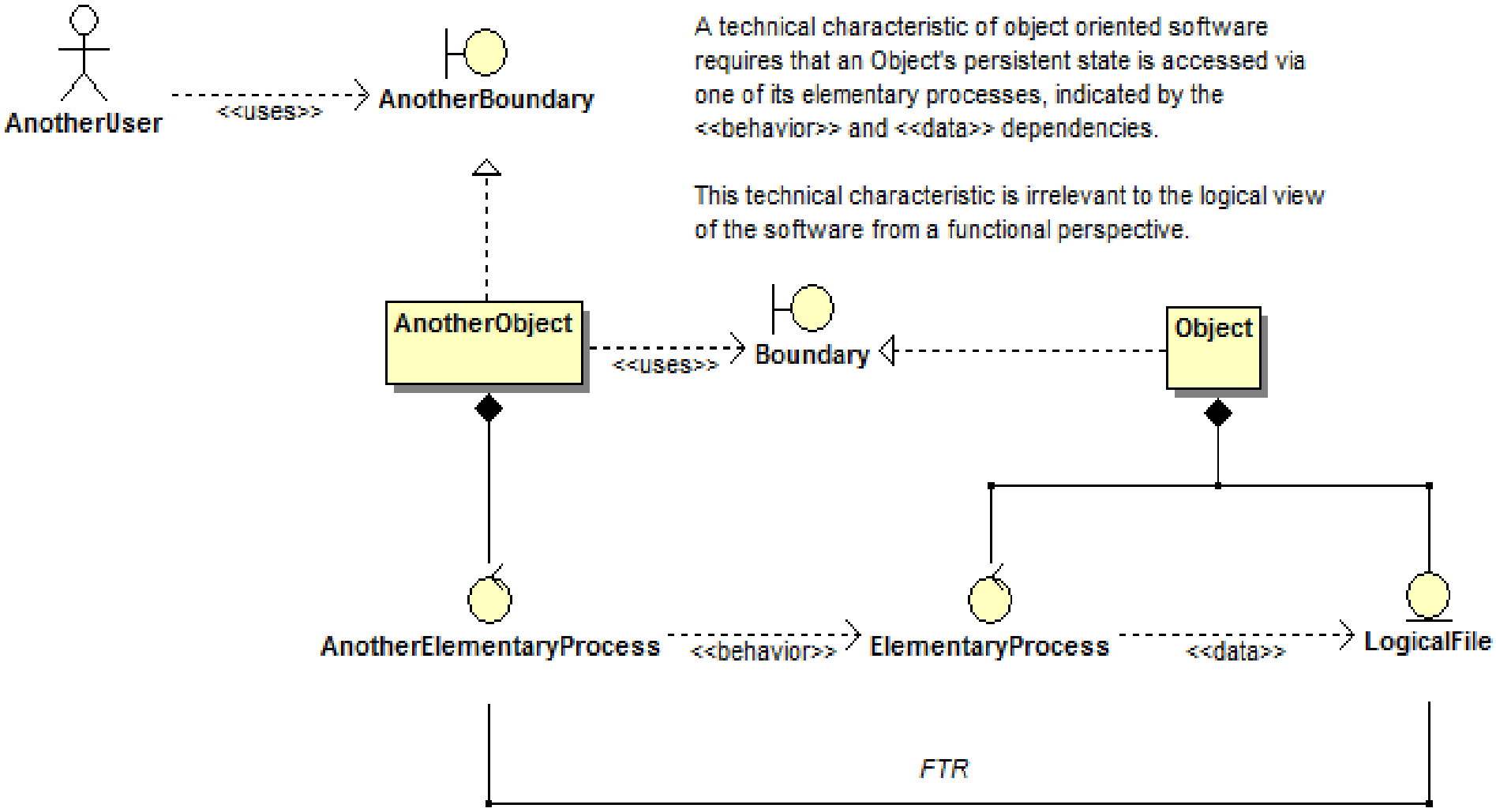
Complex software systems are comprised of coupled components
Each has its own functional size
Components may exhibit behavioral or data dependencies

Behavioral Dependency



Elementary Process only count toward the Transactional Function Size of their encapsulating object.

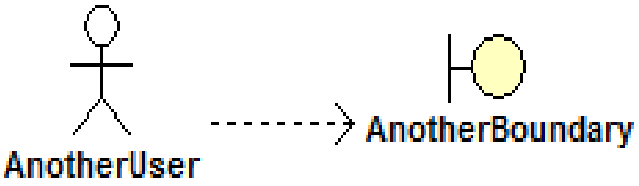
Technical Characteristic of OO Software



A technical characteristic of object oriented software requires that an Object's persistent state is accessed via one of its elementary processes, indicated by the <<behavior>> and <<data>> dependencies.

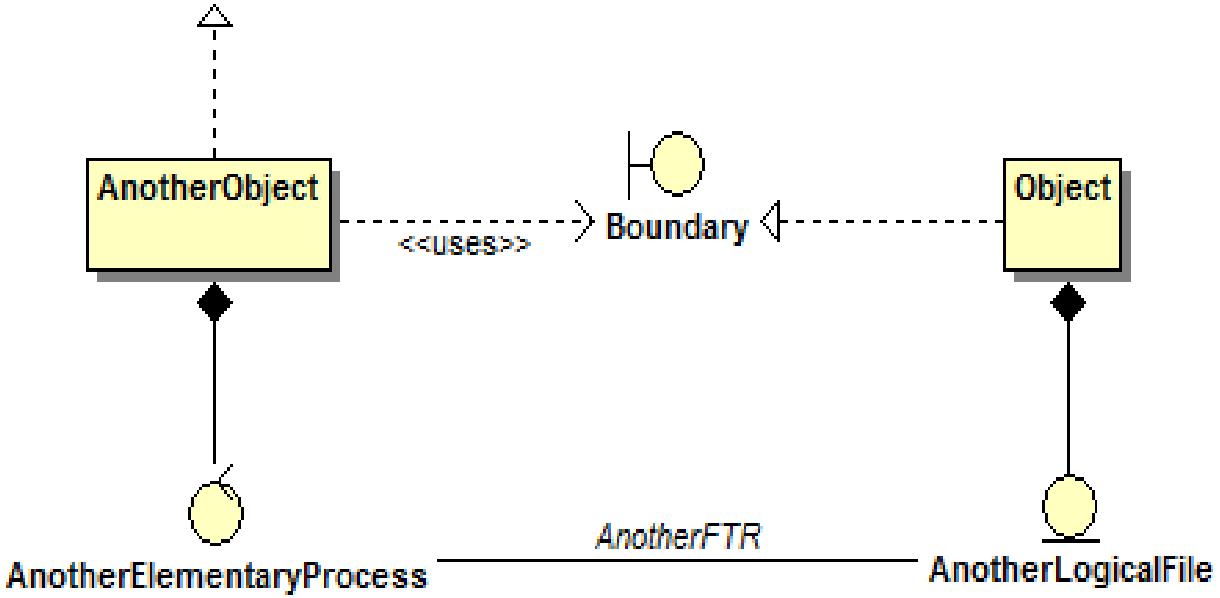
This technical characteristic is irrelevant to the logical view of the software from a functional perspective.

Logical Files in OO Software



An Object provides a Data Function Contribution to Another Object.

In this case, Object appears as Another Logical File to Another User.

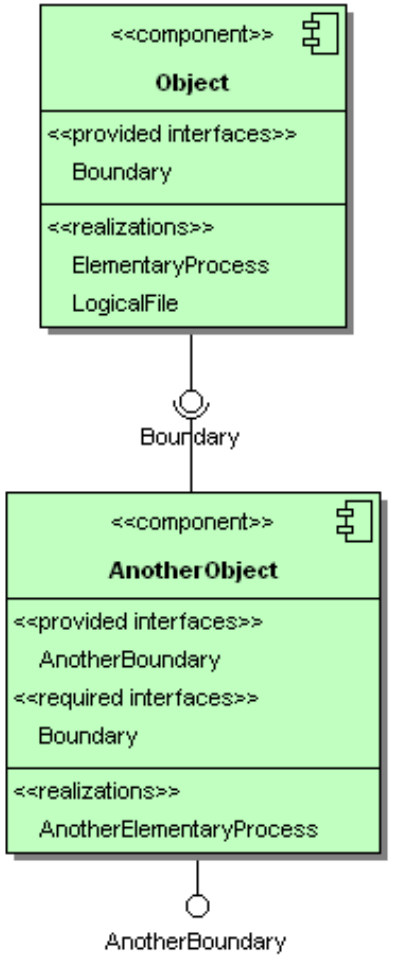


The behavior of Object NEVER contributes to the functional size of Another Object.

For that reason, it is not indicated on this diagram.

If Another Elementary Process modifies Another Logical File, it is classified as an ILF, otherwise it is classified as an EIF when computing the functional size of Another Object.

Complex Software System with Functional Specification

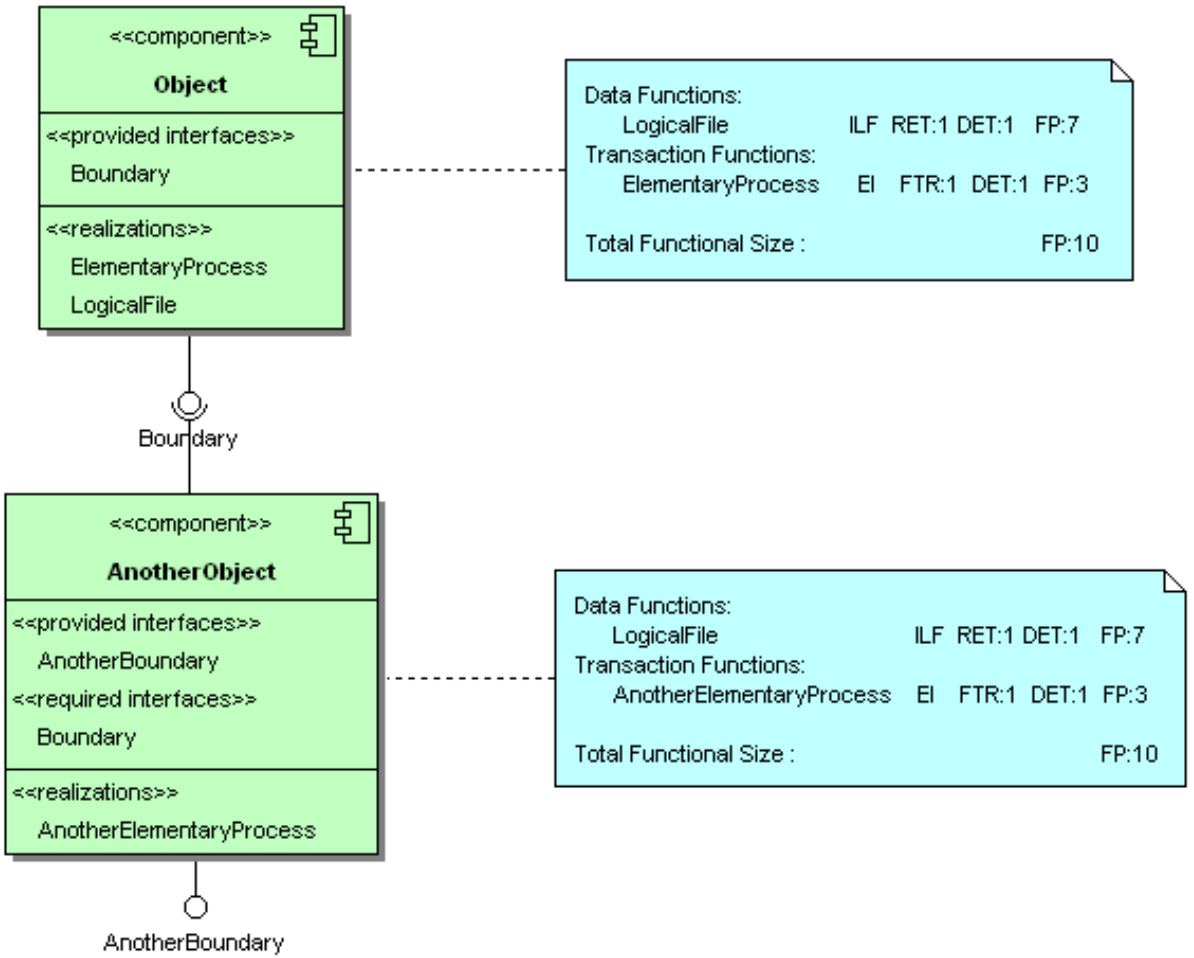



```
Entity LogicalFile
    Record
       value

Boundary Object
    ElementaryProcess : EI
        Inputs
            value
        Writes
            LogicalFile.Record.value

Boundary AnotherObject
    AnotherElementaryProcess : EI
         Inputs
              value
    Writes
         LogicalFile.Record.value
```

Functional Specification

Complex software systems are comprised of coupled components
Each has its own functional size
Components may exhibit behavioral or data dependencies

Counted Model
Multiple Boundaries



Logical File Encapsulated by Object boundary
makes a Data Function Contribution to AnotherObject boundary

Moving Forward

- Components are natural software boundaries
  - Modeled using UML
  - Conform to Object Oriented Software Paradigms
  - Encapsulate Services via Interface Specifications
  - Deployable in Service Oriented Architectures (SOA)
- Components are Countable using the IFPUG method
  - Proven measurement of functional size
  - Applied to industry best practice for software development
- Component Architectures
  - Facilitate communication of requirements to technical staff
  - Provide concrete rather than abstract partitions of functional analysis

Questions????

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Backup Slides

Functional View of an Object

Functional analysis of object oriented software requires understanding the techniques used to organize functionality and data within boundaries called objects, using a process of encapsulation that contributes to the cohesion of the software represented by the object.

Encapsulation groups functionality and data in the form of behaviors and persistent state information called an object. Function Point Analysis measures the functionality delivered to the user by describing the object in terms of its Elementary Processes and Logical Files.

An object is defined by a boundary specification called an interface, that contains an enumeration of its functionality expressed as operations.