Patterns in Software Engineering

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Lecture 9

GoV Patterns: Design

GoV Design Patterns: Categories

- **Structural Decomposition**
  - Support a suitable decomposition of subsystems and complex components into cooperating parts.
  - *Whole-Part*
- **Organization of Work**
  - Define how components collaborate together to solve a complex problem.
  - *Master-Slave*
- **Access Control**
  - Guard and control access to services or components.
  - *Proxy*
- **Management**
  - Handle homogenous collections of objects, services and components in their entirety.
  - *Command Processor* and *View Handler*
- **Communication**
  - Help to organize communication between components.
  - *Forwarder-Receiver*, *Client-Dispatcher-Server*, and *Publisher-Subscriber*

Design: Structural Decomposition

- **Whole-Part :** Helps with the aggregation of components that together form a semantic unit.
  - An aggregate component, the *whole:*
    - encapsulates its constituent components: the *parts;*
    - organizes the parts' collaboration; and
    - provides a common interface to its functionality.
  - Direct access to the parts is not possible.
  - Analogous to the *State-over-a-Collection* and *Behavior-over-a-Collection* patterns

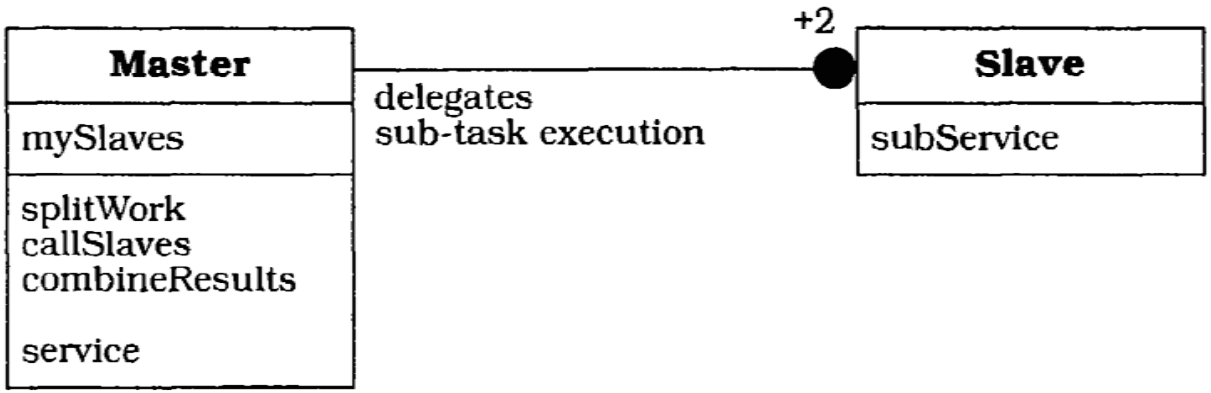
- The **Composite** pattern also belongs to this category.

Design: Organization of Work

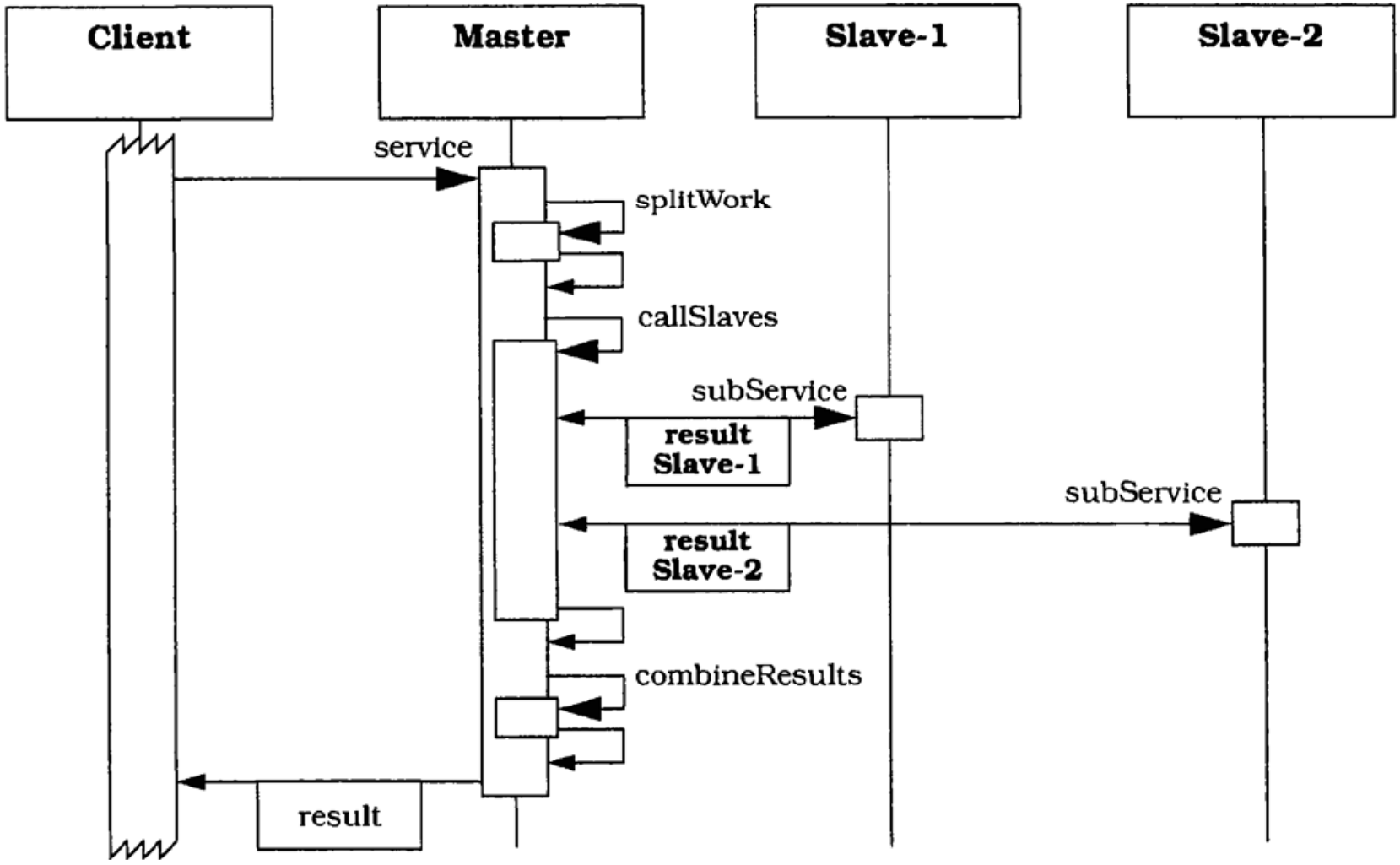
- **Master-Slave:** supports fault tolerance, parallel computation and computational accuracy. A *master* component:
  - distributes work to identical *slave* components, and
  - computes a final result from the results these slaves return.
- The **Chain of Responsibility**, **Command** and **Mediator** patterns also belong to this category.

Organization of Work: Master-Slave – Structure

- A *master* component
  - distributes work to identical *slave* components;
  - computes a final result from the results these slaves return.
- The master component provides a service that can be solved by applying the 'divide and conquer' principle.



Organization of Work: Master-Slave – Dynamics



Design: Access Control

- **Proxy:** makes the clients of a component communicate with a representative rather than to the component itself.
- The **Facade** and **Iterator** patterns also belong to this category.

Design: Management

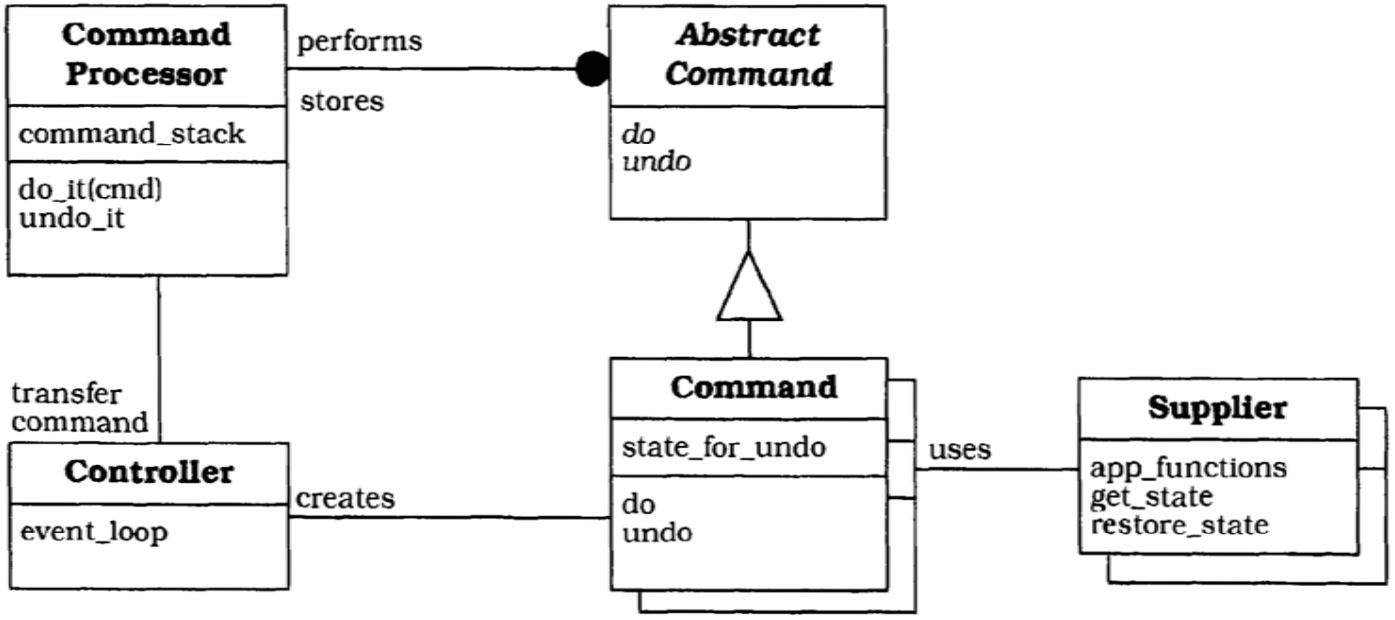
- **Command Processor:** separates the request for a service from its execution. A command processor component:
  - manages requests as separate objects,
  - schedules the execution of the requests, and
  - provides additional services such as the storing of request objects for later undo.

- **View Handler:** helps to manage views in a software system. A view handler component:
  - allows clients to open, manipulate and dispose of views,
  - coordinates dependencies between views, and
  - organizes the update of the views.

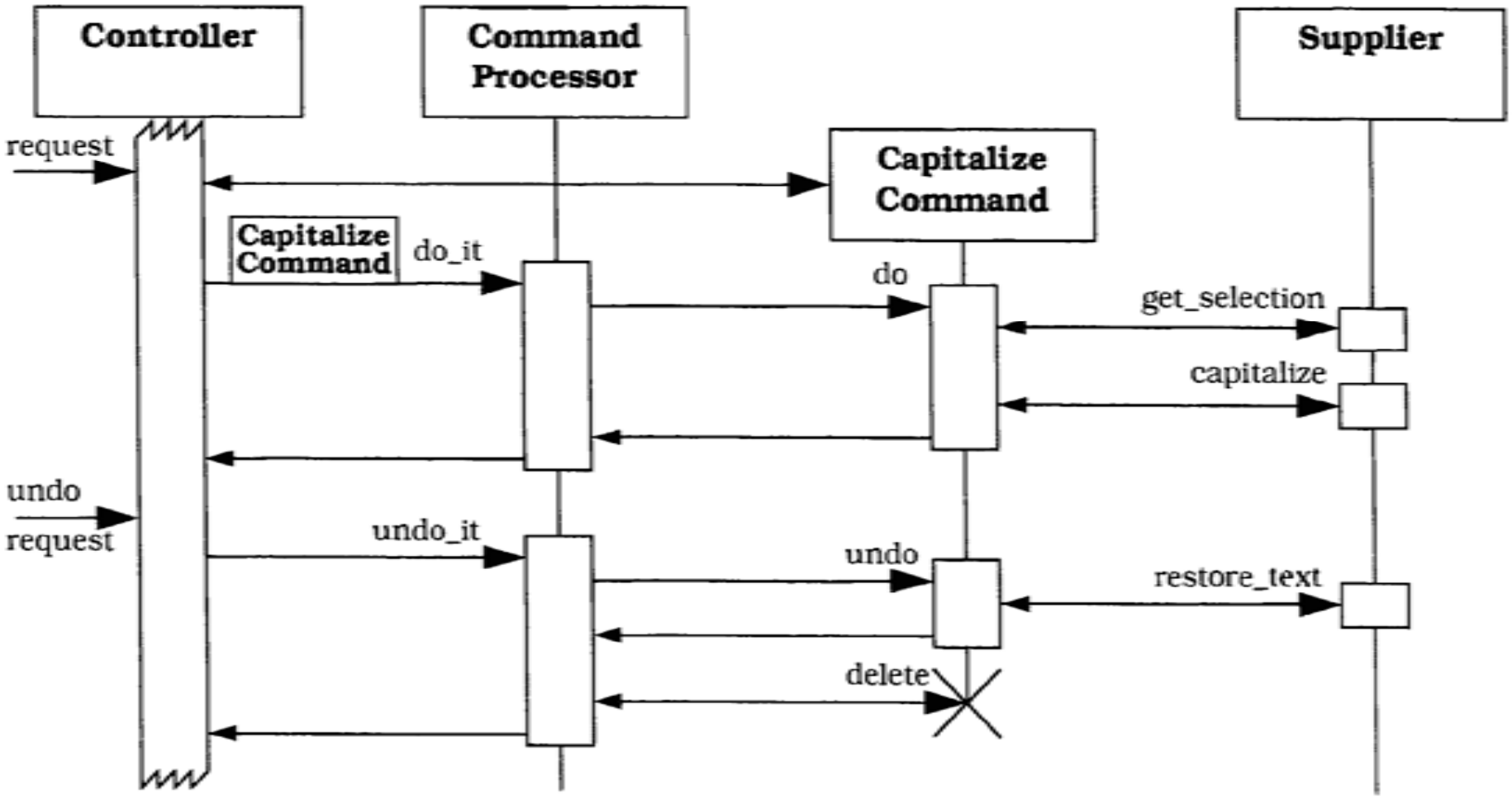
- The **Memento** pattern also belongs to this category.

Management: Command Processor – Structure

- Manages requests as separate objects, schedules their execution, and provides relevant services.
- Builds on the **Command** design pattern.
  - Whenever a user calls a specific function of the application, the request is turned into a Command object.
  - A Command object delegates the execution of its task to supplier components.
  - The Command Processor takes care of all command objects.



Management: Command Processor – Dynamics



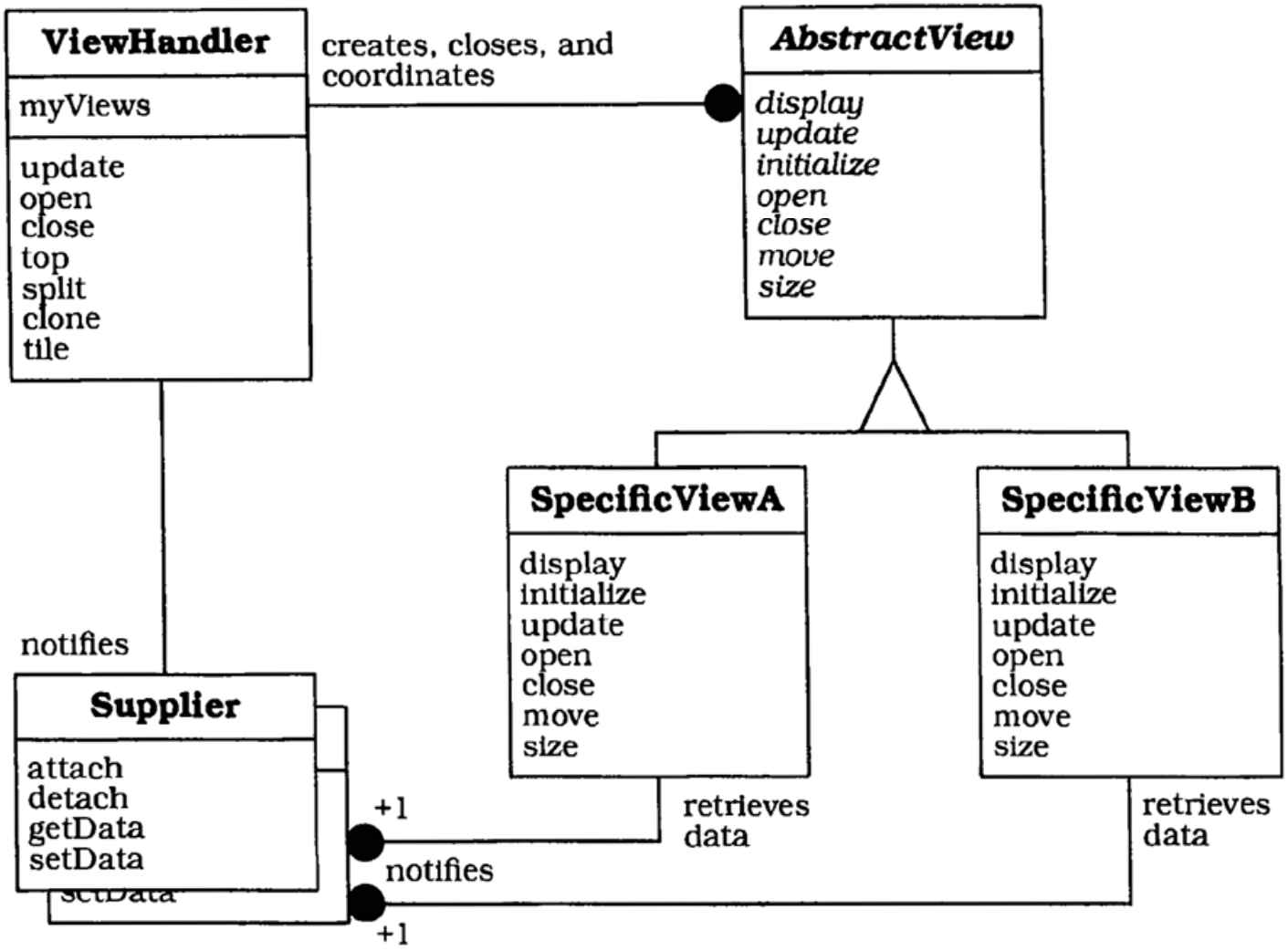
Management: View Handler

- A *view handler* component
  - manages all views that the software system provides,
  - allows clients to open, manipulate and dispose of views, and
  - coordinates dependencies between views and organizes their update.

- Specific views, together with functionality for their presentation and control, are encapsulated within separate *view* components - one for each kind of view.

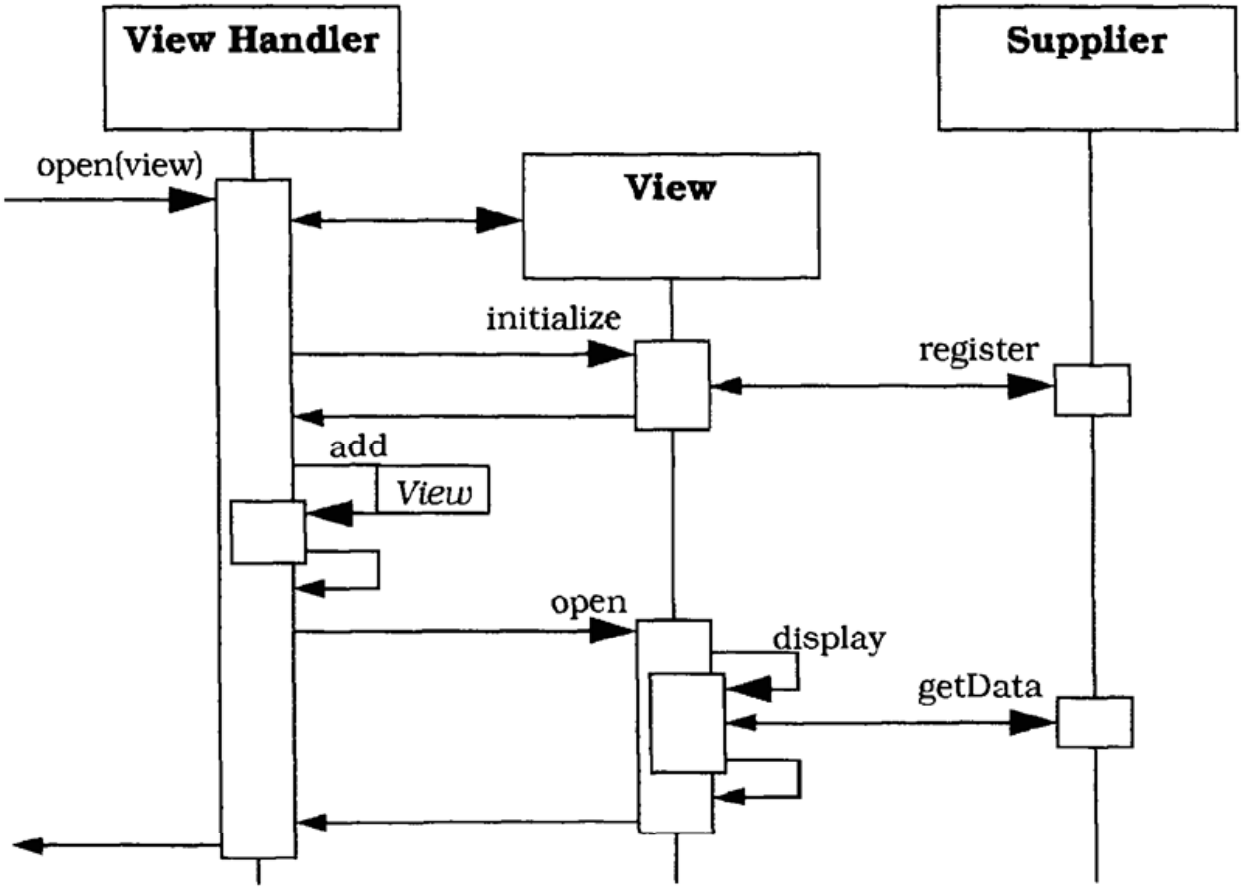
- *Suppliers* provide views with the data they must present.

Management: View Handler – Structure



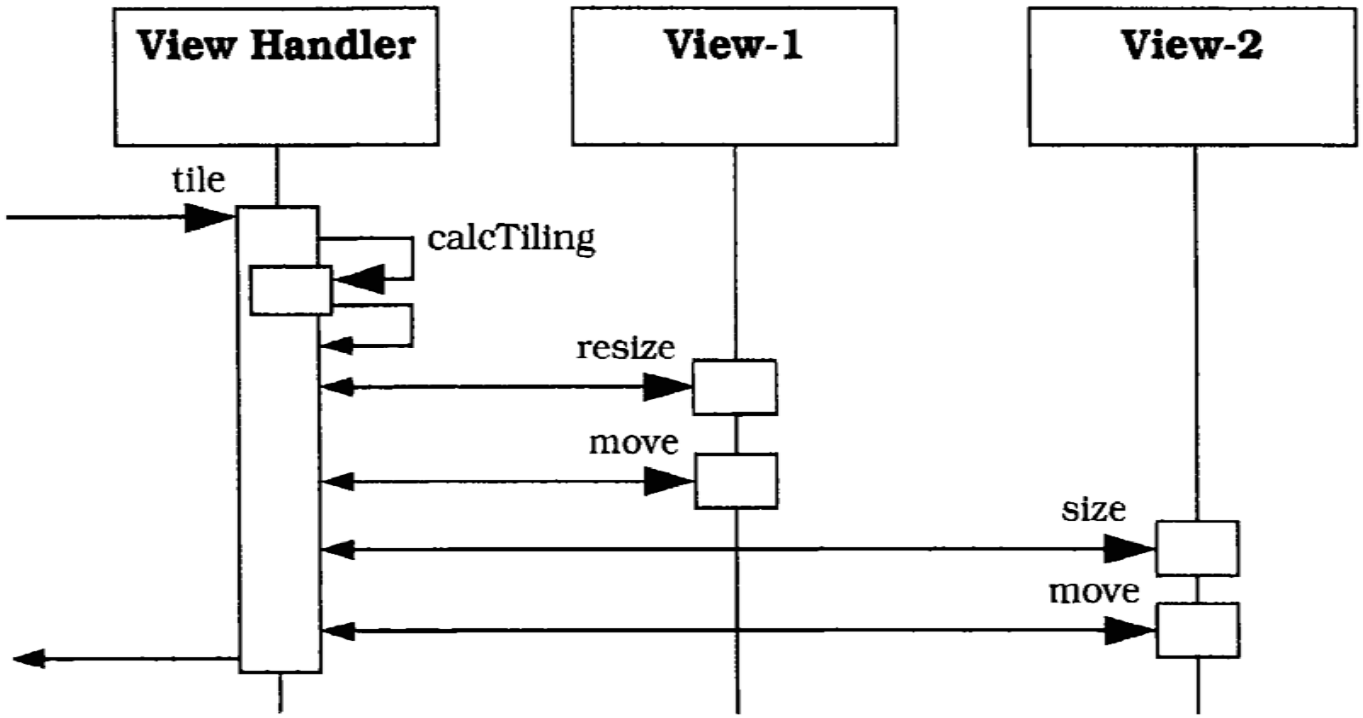
Management: View Handler – Dynamics (1)

- **Scenario I:** The view handler creates a new view.



Management: View Handler – Dynamics (2)

- **Scenario II:** The view handler organizes the tiling of views.



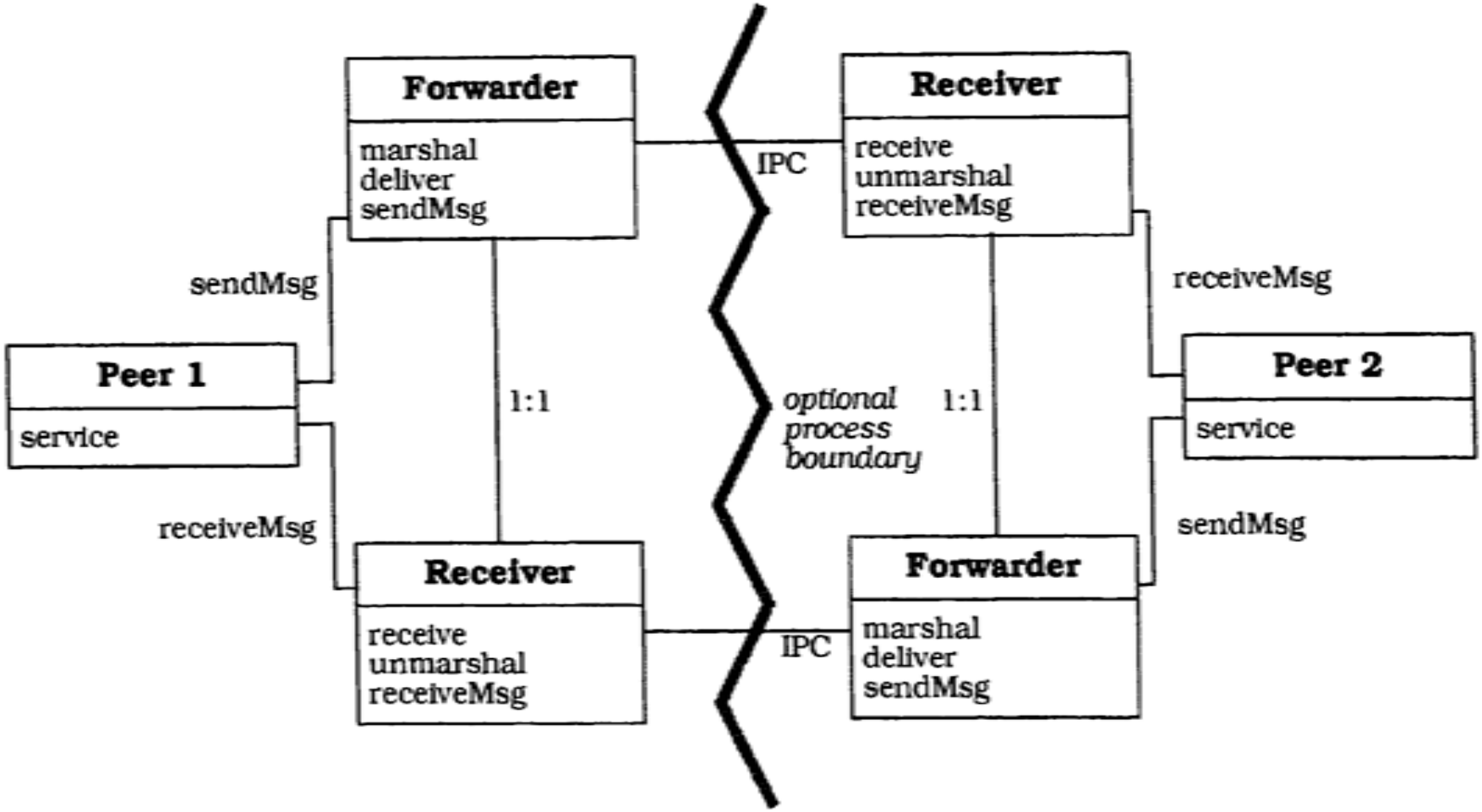
Design: Communication

- **Forwarder-Receiver:** provides transparent inter-process communication for software systems with a peer-to-peer interaction model.
  - Introduces *forwarders* and *receivers* to decouple peers from the underlying communication mechanisms.
- **Client-Dispatcher-Server:** introduces an intermediate layer between *clients* and *servers:* the *dispatcher* component.
  - Provides location transparency by means of a name service.
  - Hides the details of the establishment of the communication connection between clients and servers.
- **Publisher-Subscriber:** The same as the **Observer** pattern.

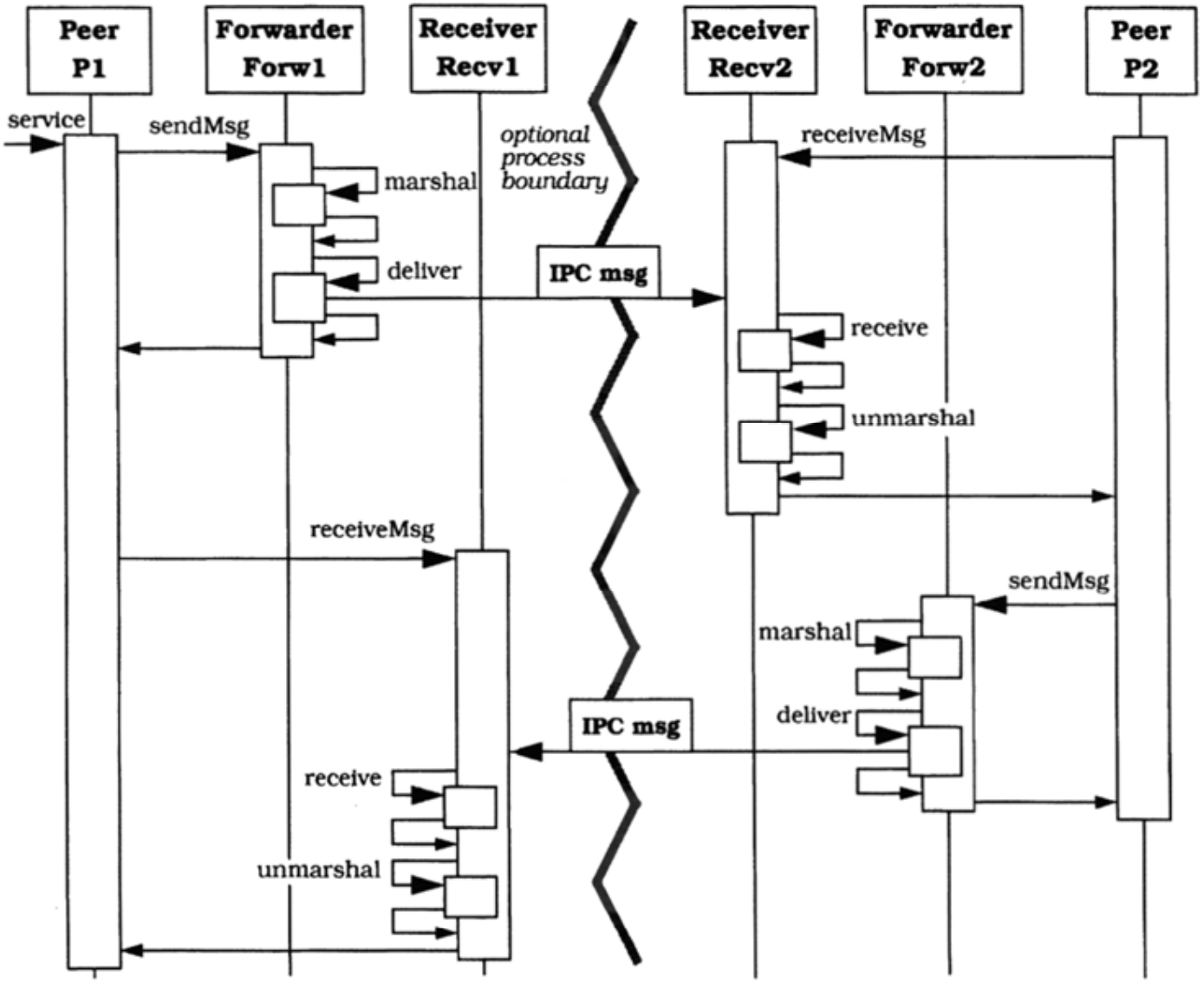
Communication: Forwarder-Receiver

- *Peer* components:
  - are responsible for application tasks,
  - know the names of the remote peers with which they need to communicate, and
  - use a *forwarder* to send messages to other peers and a *receiver* to receive messages from other peers.
- *Forwarder* components:
  - send messages across process boundaries,
  - provide a general interface for sending messages,
  - marshal and deliver messages to remote receivers, and
  - map names to physical addresses.
- *Receiver* components:
  - are responsible for receiving messages,
  - provide a general interface for receiving messages, and
  - receive and unmarshal messages from remote forwarders.

Communication: Forwarder-Receiver – Structure



Communication: Forwarder-Receiver – Dynamics



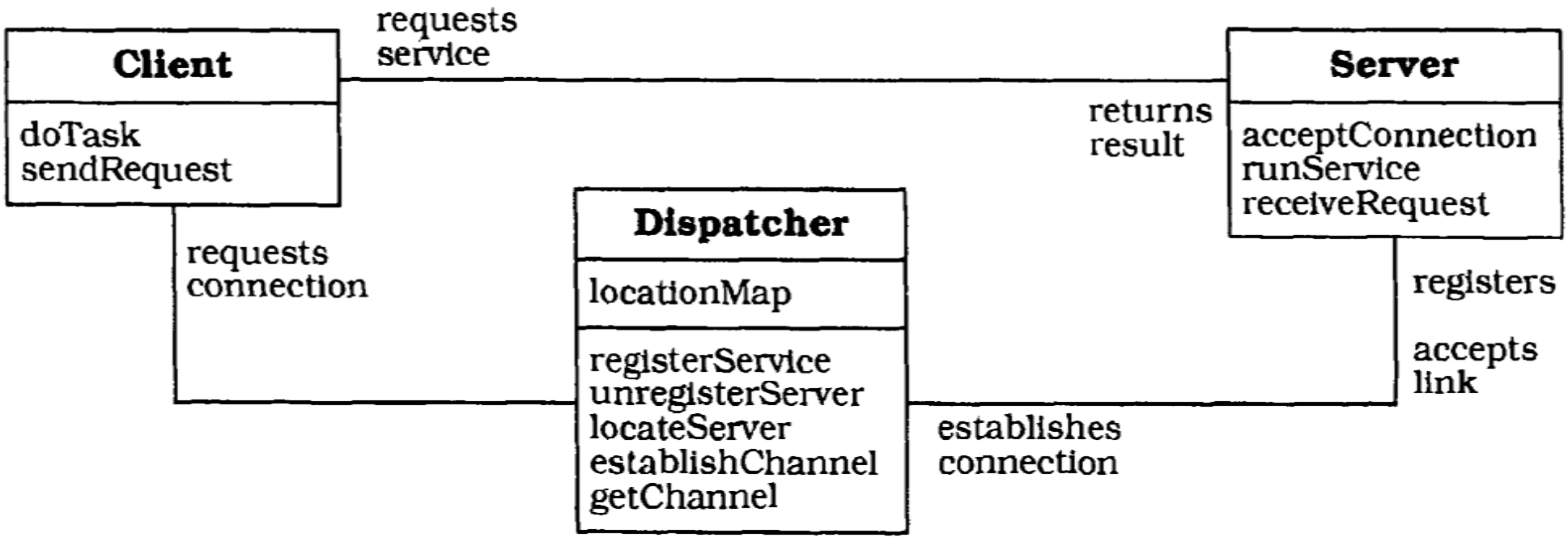
Communication: Client-Dispatcher-Server

- Provides a *dispatcher* component to act as an intermediate layer between *clients* and *servers*. The dispatcher
  - implements a name service that allows clients to refer to servers by names instead of physical locations, thus providing location transparency, and
  - is responsible for establishing the communication channel between a client and a server.

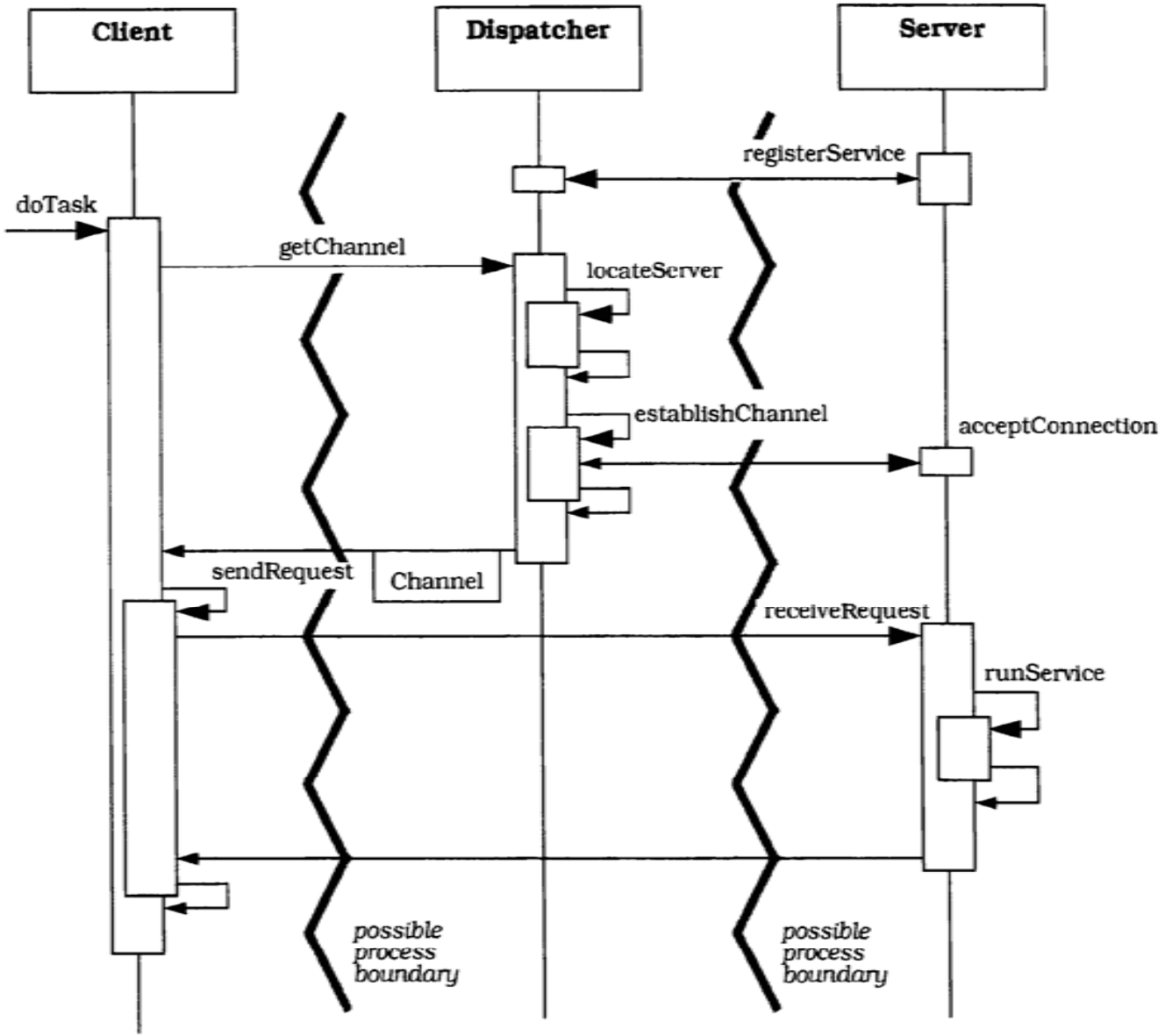
- Before sending a request to a server, the client asks the dispatcher for a communication channel.
  - The client uses this channel to communicate with the server.

- A server provides a set of operations to clients.
  - It either registers itself or is registered with the dispatcher by its name and address.

Communication: Client-Dispatcher-Server – Structure



Communication: Client-Dispatcher-Server – Dynamics



Reference

- Buschmann, F., Meunier, R., Rohnert, H., Sommerlad, P., and Stal, M., *Pattern-Oriented Software Architecture: A System of Patterns,* Vol. 1. Wiley, 1996.