Chapter 13

Starting Design:

Logical Architecture
and
UML Package Diagrams

Logical Architecture

- Logical architecture: Large-scale organization of the software classes into
  - packages (or namespaces)
  - subsystems
  - layers
- Distinct from “deployment architecture”
  - No decision about how the elements are deployed
    - to different OS processes
    - across physical computers in a network
- A layer: A coarse-grained grouping of classes, packages or subsystems that together have responsibility for one major aspect of a system
- Examples of layers:
  - UI layer
  - Application logic and domain objects layer
  - Technical services (interfacing with a database, error logging)
    - Typically application-independent and reusable

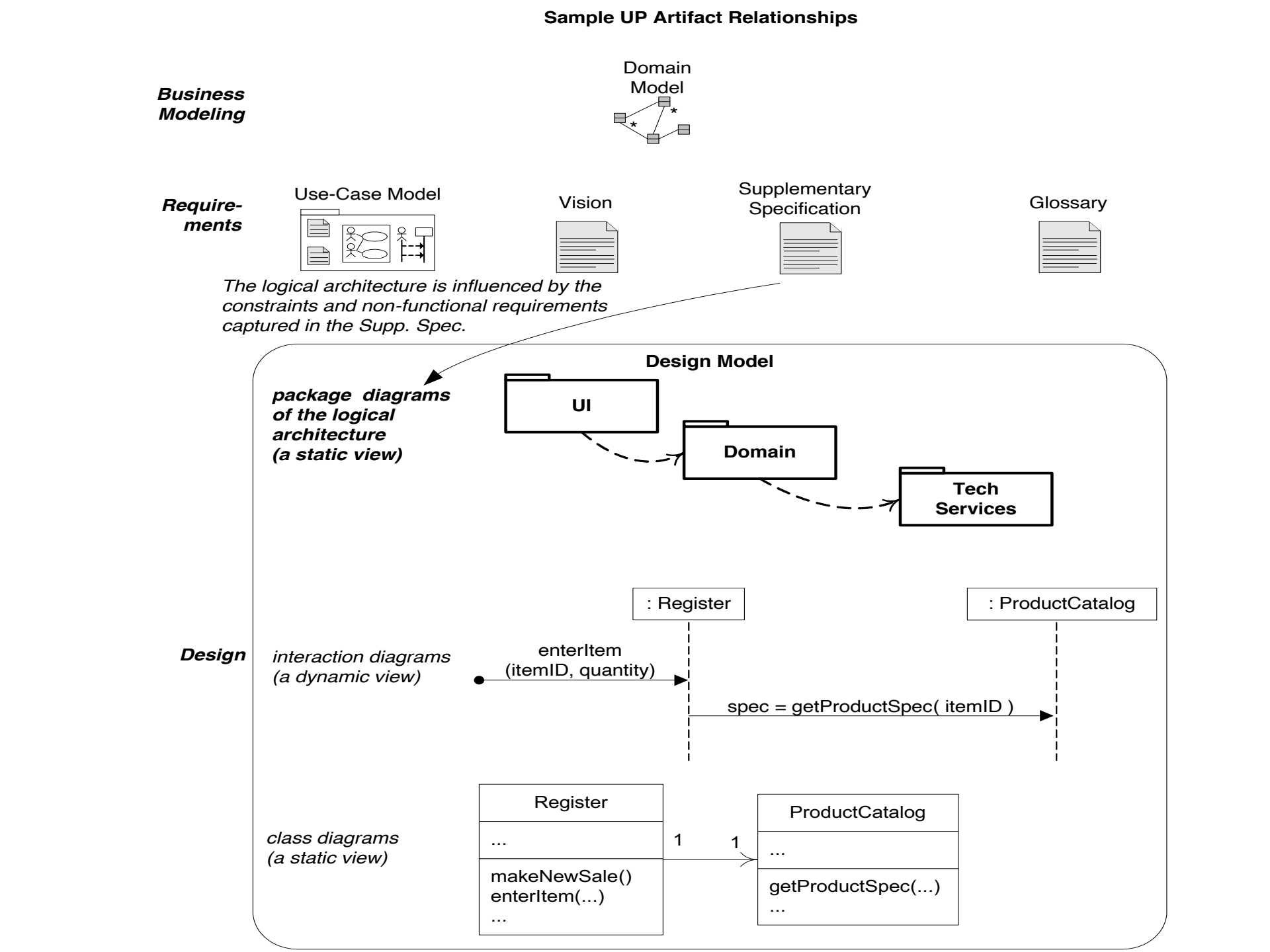
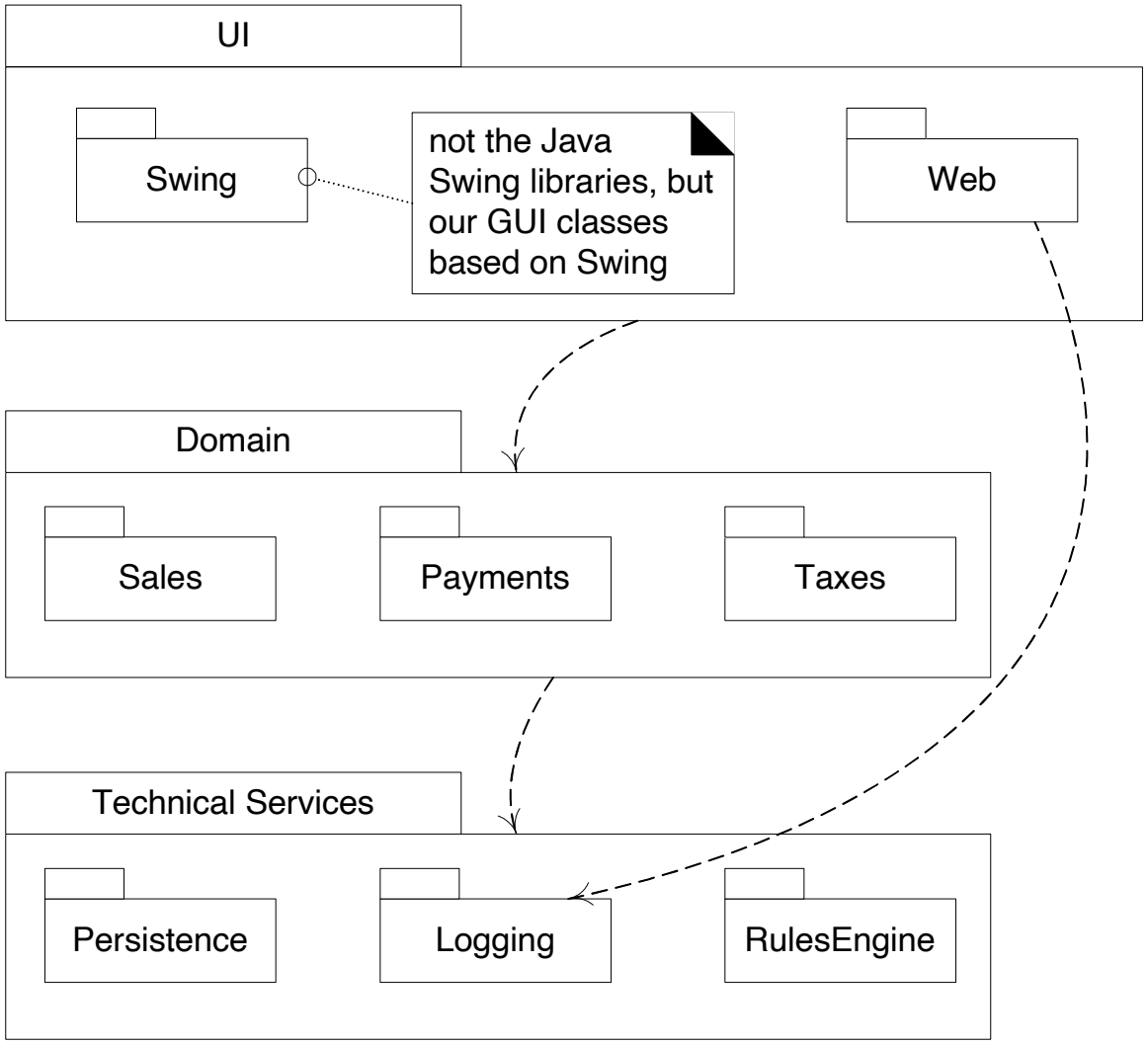

Sample UP Artifact Relationships
Business Modeling
Domain Model
Requirements
Use-Case Model
Vision
Supplementary Specification
Glossary
The logical architecture is influenced by the constraints and non-functional requirements captured in the Supp. Spec.
Design Model
package diagrams of the logical architecture (a static view)
UI
Domain
Tech Services
Design
interaction diagrams (a dynamic view)
: Register
: ProductCatalog
enterItem (itemID, quantity)
spec = getProductSpec(itemID)
class diagrams (a static view)
Register
...
makeNewSale()
enterItem(...)
...
1
1
ProductCatalog
...
getProductSpec(...)
...

Fig. 13.2


UI
Swing
not the Java Swing libraries, but our GUI classes based on Swing
Web
Domain
Sales
Payments
Taxes
Technical Services
Persistence
Logging
RulesEngine

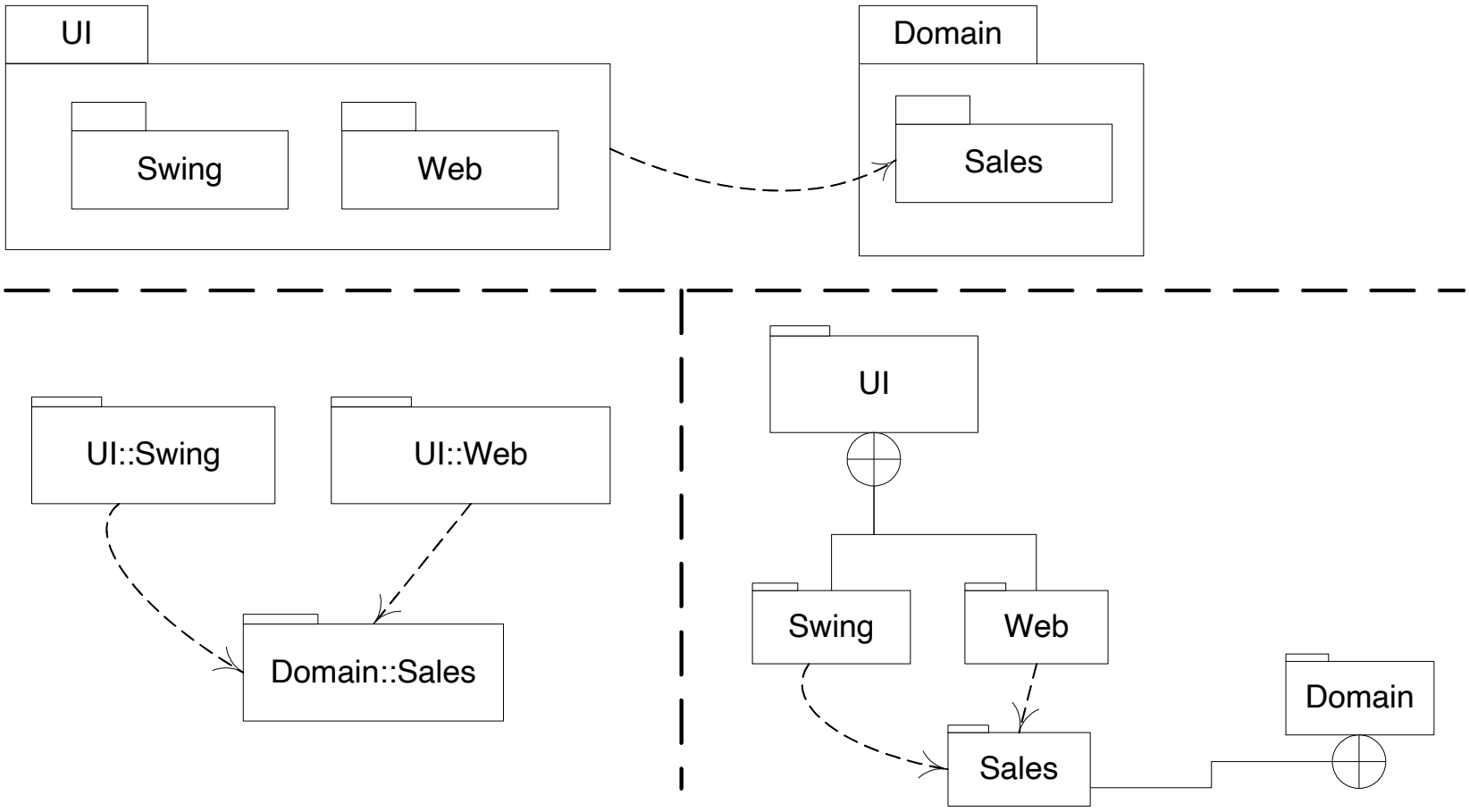
Architecture

- Strict layered architecture: Each layer only calls upon services of the layer directly below it.
  - Common in network protocol stacks
  - Not so common in information systems
- You do NOT have to use a layered architecture
  - But it is very common to do so
- What is architecture then?
  - The set of significant decisions about
    - the organization of a software system
      - hiearchical composition of smaller subsystems to progressively larger subsystems
      - the selection of structural elements and interfaces
    - the style that guides this organization
- Architecture: Related to large scale, not implementation details.

UML Package Diagrams

- UML Package Diagrams:
  - Used to illustrate the logical architecture of a system
    - Layers, subsystems, Java packages
  - Provides a way to group elements
    - Different from (more general than) a Java package
    - Can group anything
      - Classes, other packages, diagrams, use cases, …
    - Nesting packages is very common

Alternative UML Package Diagram Notations



UML Packages

- A package represents a “namespace”
  - Example: A Date class can be defined in two packages
    - Fully qualified names: java::util::Date

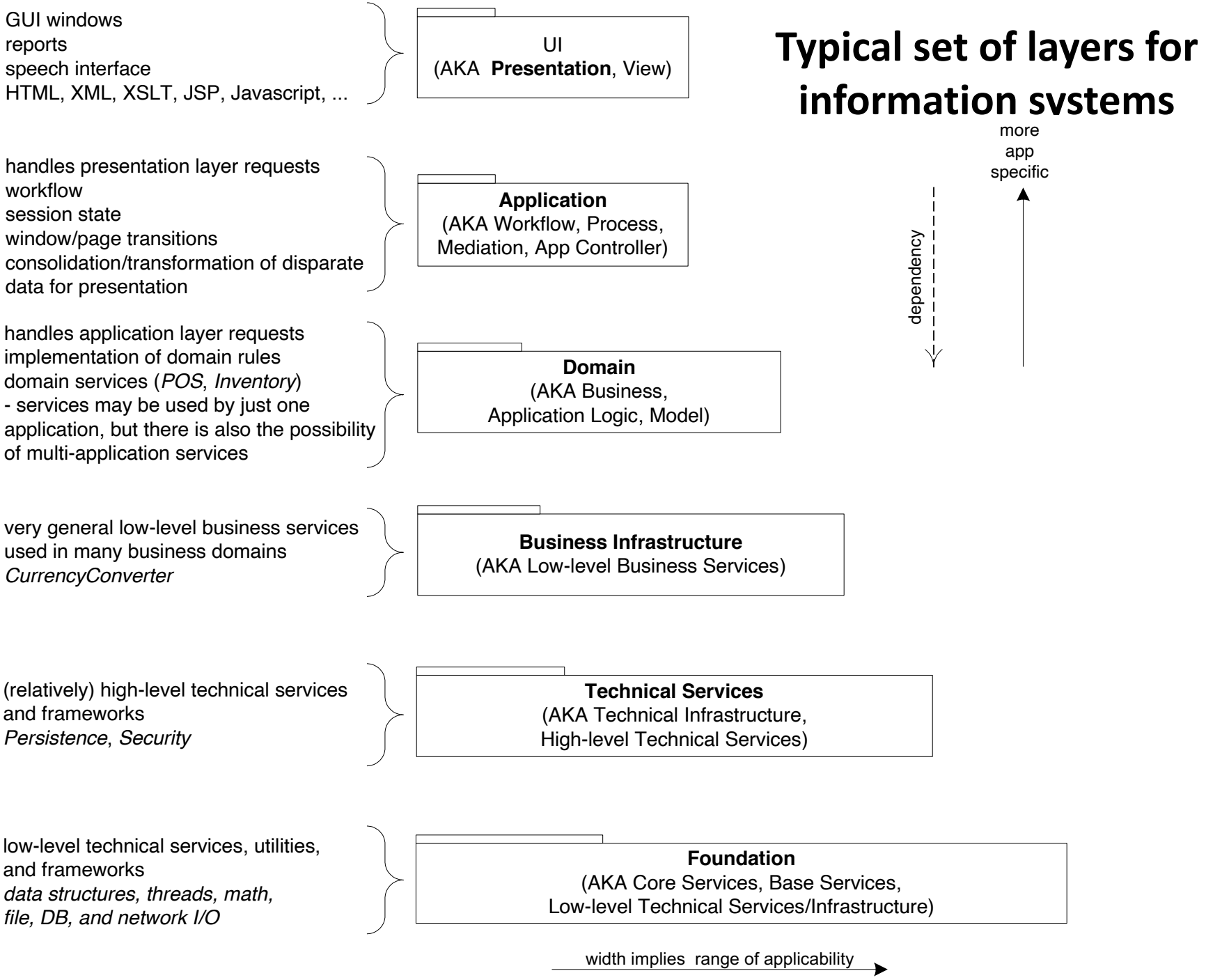
Layers: Why?

- Two key architectural principles
  - Separation of concerns
  - Maintaining high cohesion
- Separation of concerns:
  - Discrete layers of distinct, related responsibilities
  - Clean cohesive separation of duties:
    - Lower layers: Low-level, general services
    - Higher layers: More application-specific services
  - Easier to define boundaries for different developers
- Collaboration and coupling from higher to lower layers

Layers: Why? (continued)

- Limiting dependencies between subsystems:
  - Source code changes ripple throughout the system if many parts are tightly coupled
  - Example: If application logic is intertwined with UI,
    - it cannot be distributed to another physical node
    - It cannot be used with a different UI
- General technical services and business logic can be re-used, replaced or moved to another physical node

Typical set of layers for information systems



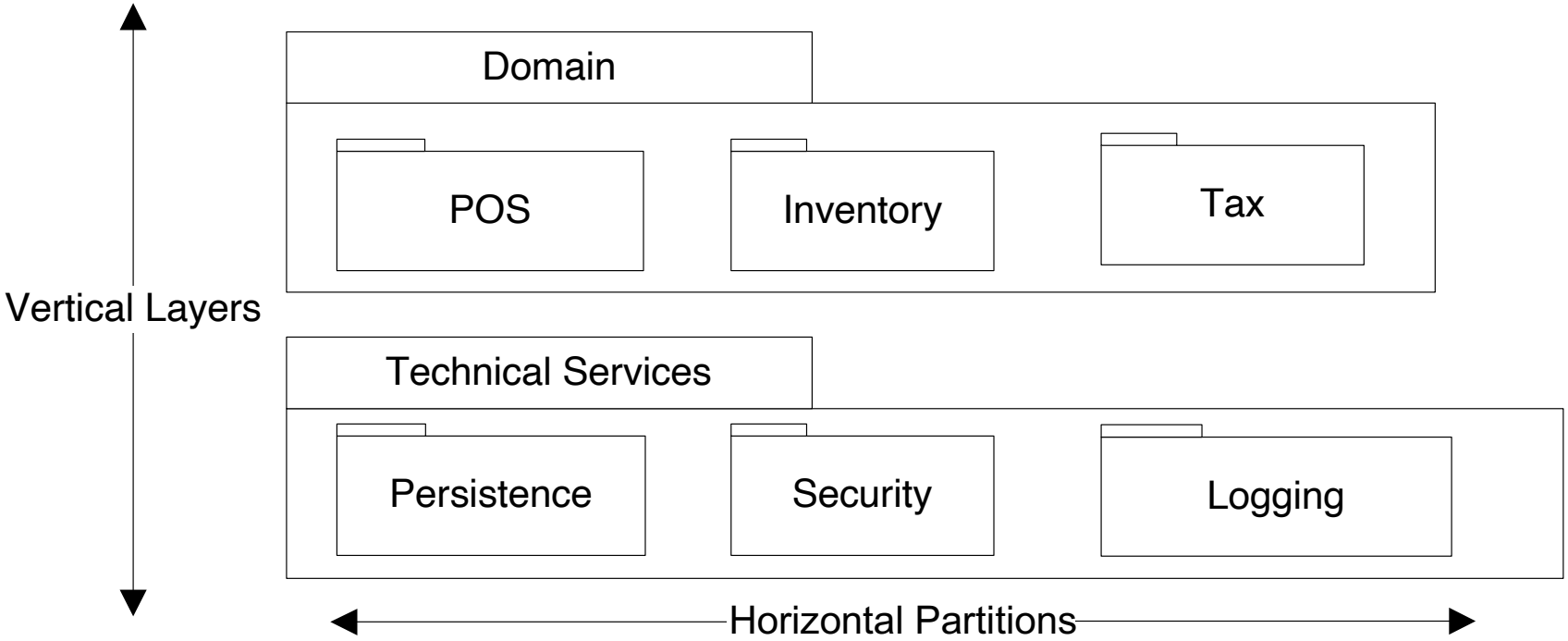
Mapping Code Organization to Layers and UML Packages

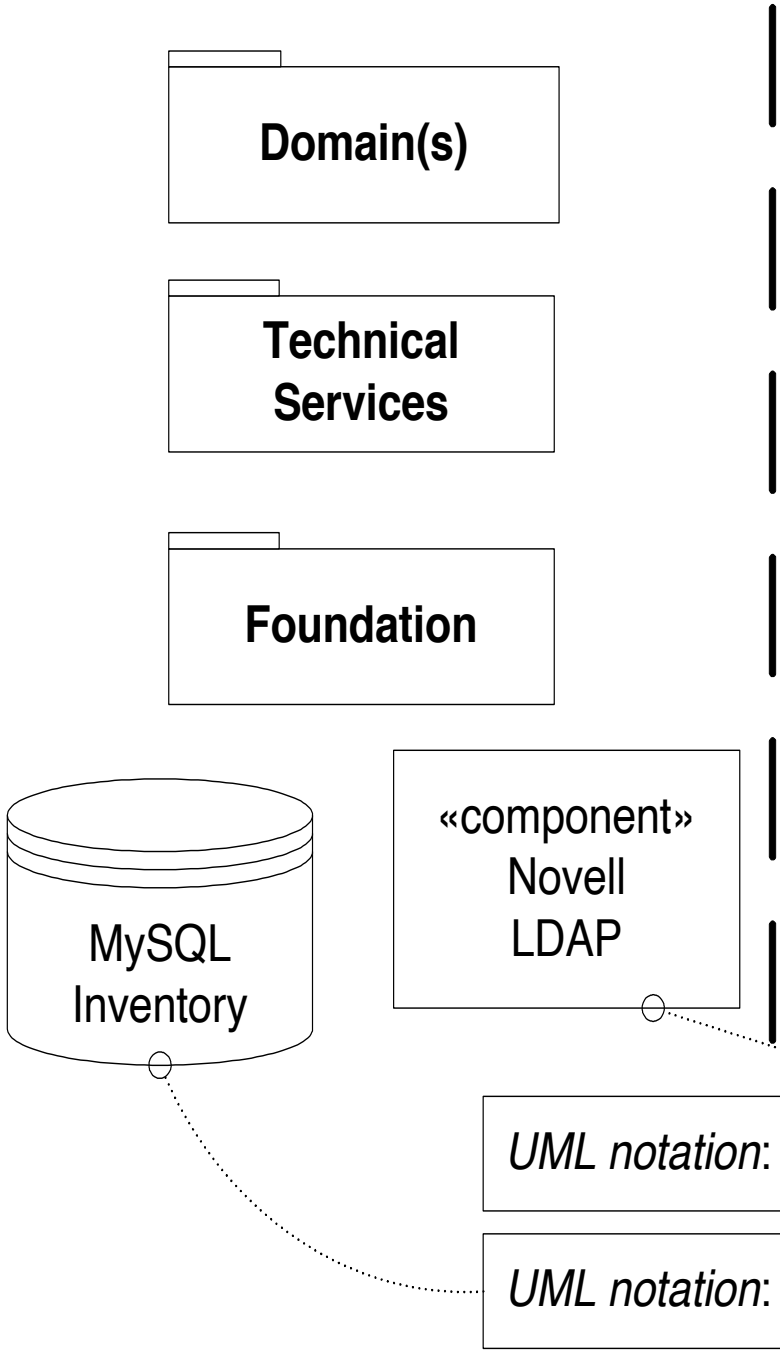
```
//---- PRESENTATION

com.foo.nextgen.ui.swing
com.foo.nextgen.ui.text


//---- DOMAIN

    // packages relatively specific to the NextGen project
com.foo.nextgen.domain.sales com.foo.nextgen.domain.pricing
com.foo.nextgen.domain.serviceaccess
com.foo.nextgen.domain.posruleengine

    // packages that can easily be designed as
    // multi-application common business services
com.foo.domain.inventory
com.foo.domain.creditpayment


// ---  TECHNICAL SERVICES

    // our team creates
com.foo.service.persistencelite

    // third party
org.apache.log4j
org.apache.soap.rpc
jess


// ---  FOUNDATION

    // our team creates
com.foo.util
com.foo.stringutil
```

Some more issues, terms

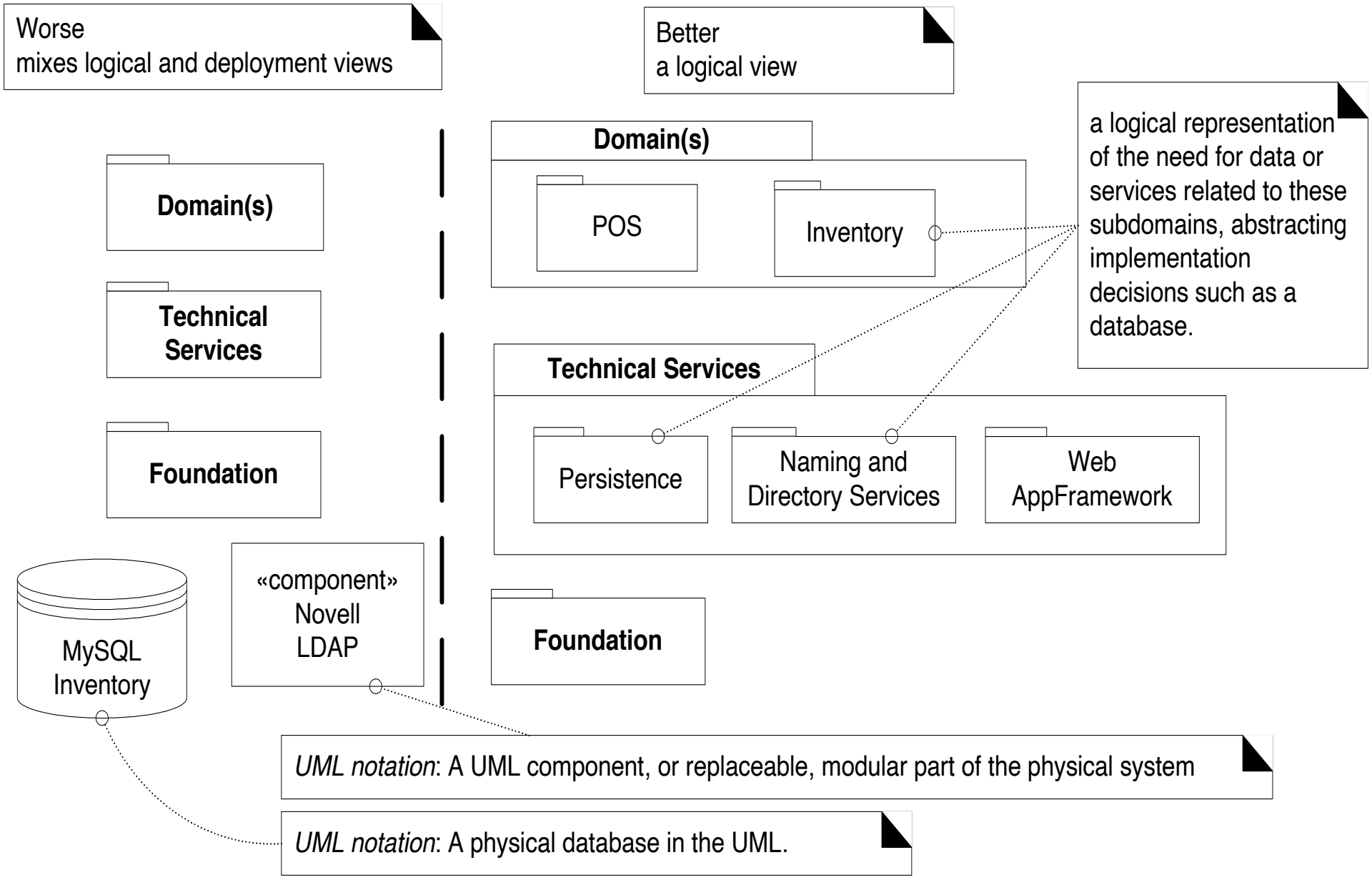
- What if the organization of code into packages changes later on?
  - Follow a good package naming convention
  - Use CASE tools to reverse-engineer code into UML packages
- What is a tier?
  - Originally, it meant a logical layer
  - Common usage today: Physical processing node (or cluster of nodes)
- What is a partition?
  - Division into relatively parallel subsystems for a layer

Layers vs. Partitions




Domain(s)
Technical Services
Foundation
«component» Novell LDAP
MySQL Inventory
UML notation:
UML notation:

Don’t mix physical implementation components and logical architecture components



The Model-View Separation Principle

- Old terminology
  - Model: Domain layer (application logic)
  - View: UI objects (windows, web pages, reports, …)

- Model-view separation:
  - Do not put application logic (such as tax calculation code) in the UI objects
    - UI objects should only
      - initialize UI elements,
      - receive UI events (mouse click, etc.)
      - delegate requests for application logic on to non-UI objects
  - Do not connect non-UI objects to UI objects
  - Example: a Sale object should not have a reference to a JFrame window object
    - Why not?
    - What if we want to use the application logic with different windows or multiple views?

What if domain objects need to notify the UI?

- A relaxation of the model-view principle: the Observer pattern
  - Domain objects send messages to UI objects viewed only in terms of an interface
  - Example: PropertyListener interface
    - Domain object is aware of existence of object implementing PropertyListener
      - But not of particular object
    - Notification happens using interface methods

Motivation for the model-view principle

- Domain objects focus on domain processes
  - Not on user interfaces
- Domain objects and UI can be developed separately
- Effect of requirements changes in one component to the other one minimized
- New views (UIs) connected to existing domain layer
- Multiple simultaneous views (e.g. a GUI and a text-based interface) on the same model object
- Domain layer operable without needing UI layer to be on
- Basically, modularity.

Relationship between System Sequence Diagrams System Operations and Layers

- Messages on SSDs: Messages sent from UI layer to the domain layer