Architectural Patterns/Styles

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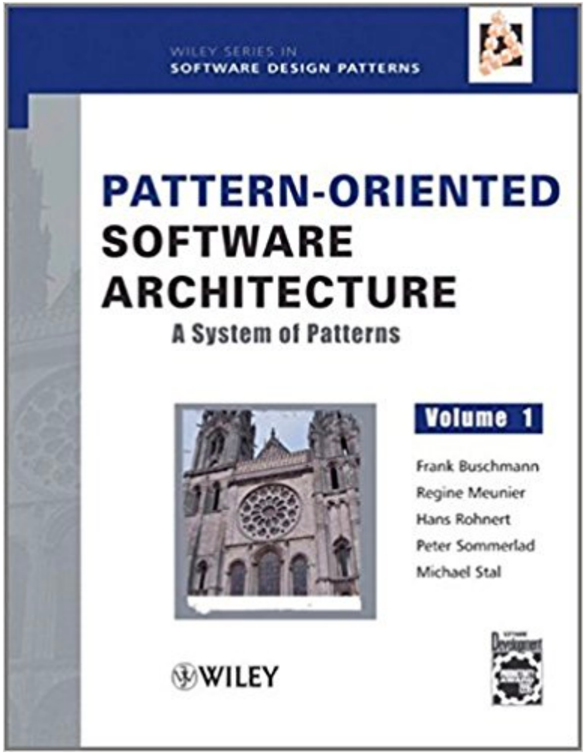
Administrivia

- Homework 6 checkpoint – Monday Dec 4th
- Final Exam Review: Dec 13th, 2-4pm Wean 5409
- Final Exam: Dec 15th, 5:30-8:30pm Wean 7500

Last Time:

- Design Patterns



WILEY SERIES IN
SOFTWARE DESIGN PATTERNS

PATTERN-ORIENTED
SOFTWARE
ARCHITECTURE
A System of Patterns

Volume 1

Frank Buschmann
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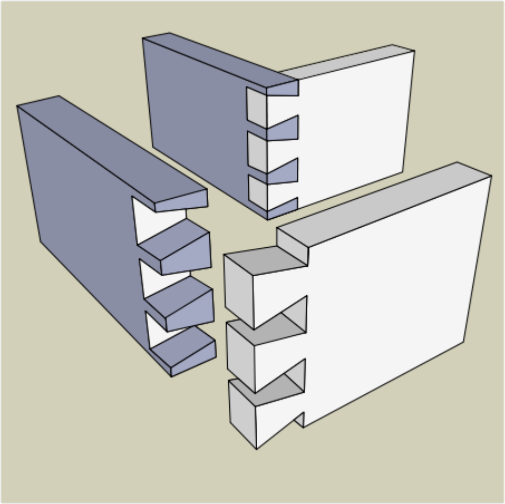
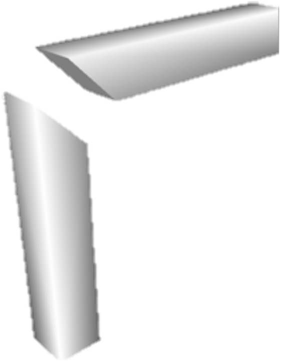
ARCHITECTURAL PATTERNS/STYLES

Design Patterns

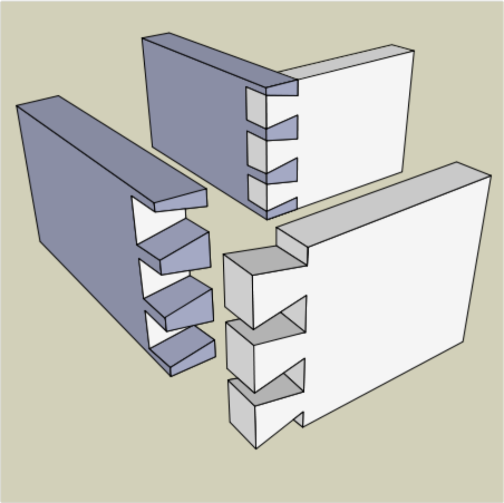


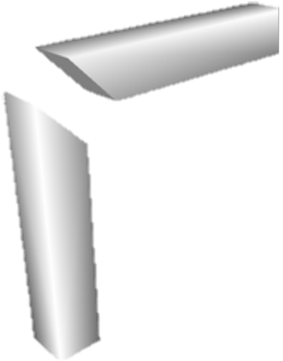


Architectural Styles

Architectural Styles

Architectural Styles vs Design Patterns

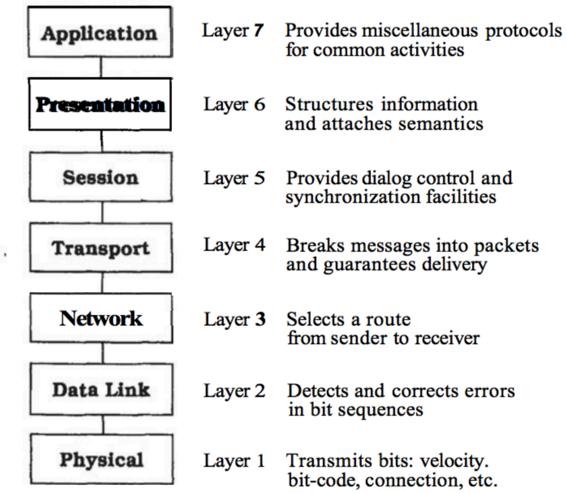




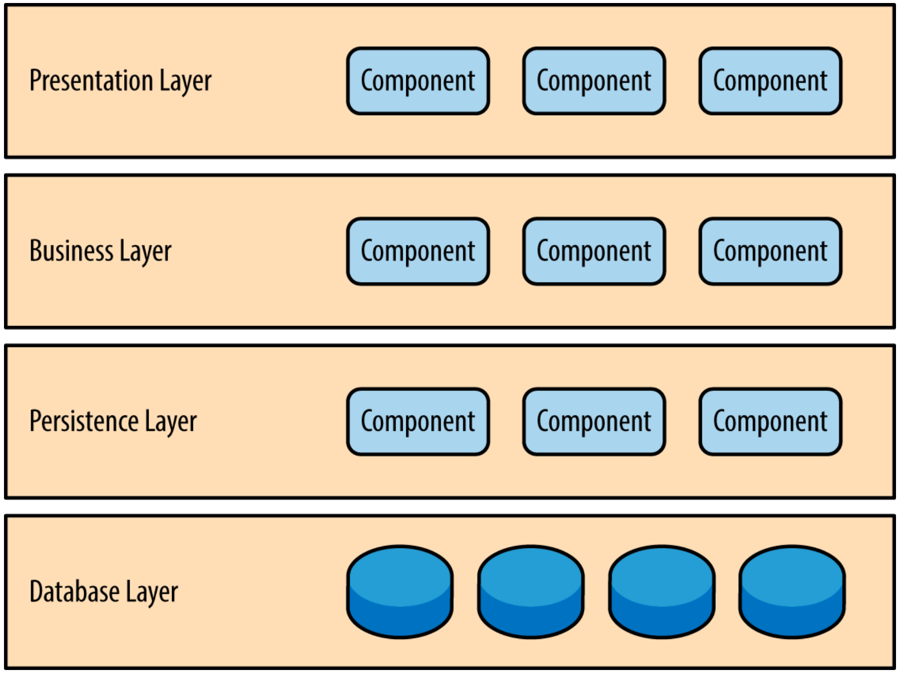
Monolithic Application

+ Simple to start
+ Simple to deploy
+ Fast time to first feature
- Difficult for new developers to come up to speed
- Continuous deployment is difficult
- Scaling can be difficult
- Can devolve into “big ball of mud”

Layers



Application	Layer 7	Provides miscellaneous protocols for common activities
Presentation	Layer 6	Structures information and attaches semantics
Session	Layer 5	Provides dialog control and synchronization facilities
Transport	Layer 4	Breaks messages into packets and guarantees delivery
Network	Layer 3	Selects a route from sender to receiver
Data Link	Layer 2	Detects and corrects errors in bit sequences
Physical	Layer 1	Transmits bits: velocity. bit-code, connection, etc.



Presentation Layer: Component, Component, Component

Business Layer: Component, Component, Component

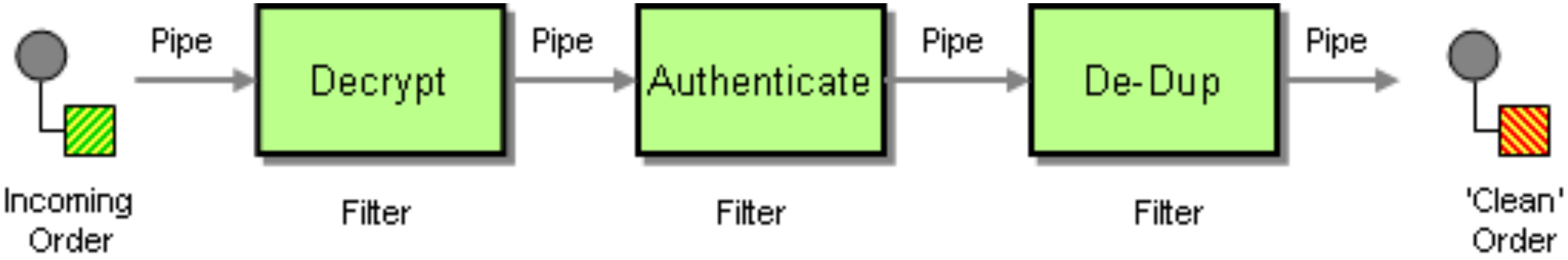
Persistence Layer: Component, Component, Component

Database Layer

Layers

- Context:
  - A large system that requires decomposition
- Problem:
  - Low separation of concerns.
  - Parts of system are not interchangeable
  - Lack of grouped components hurts understandability and maintainability
  - Lack of boundaries makes tasking difficult
- Solution:
  - Define layers of abstraction
  - Specify services between boundaries
- Beware:
  - Antipattern: Sinkhole
  - Antipattern: Lasagna

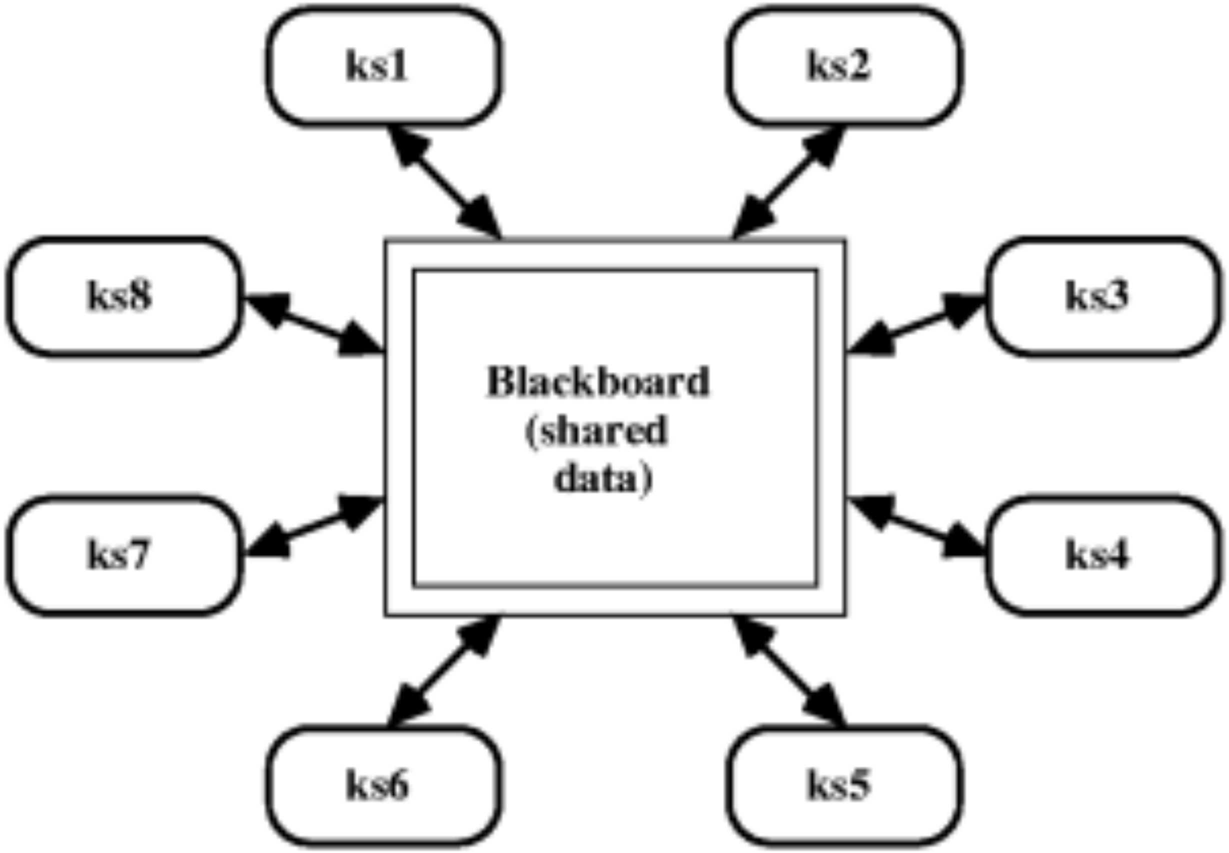
Pipe and filter



Pipe and filter

- Context:
  - Processing data stream
- Problem:
  - Need to process or transform a stream of data
  - Non-adjacent steps don’t share information
  - Need to reuse certain steps in the process
- Solution:
  - Each filter transforms the data, then moves it on to the next step
- Beware:
  - Error Handling
  - Data transformation overhead

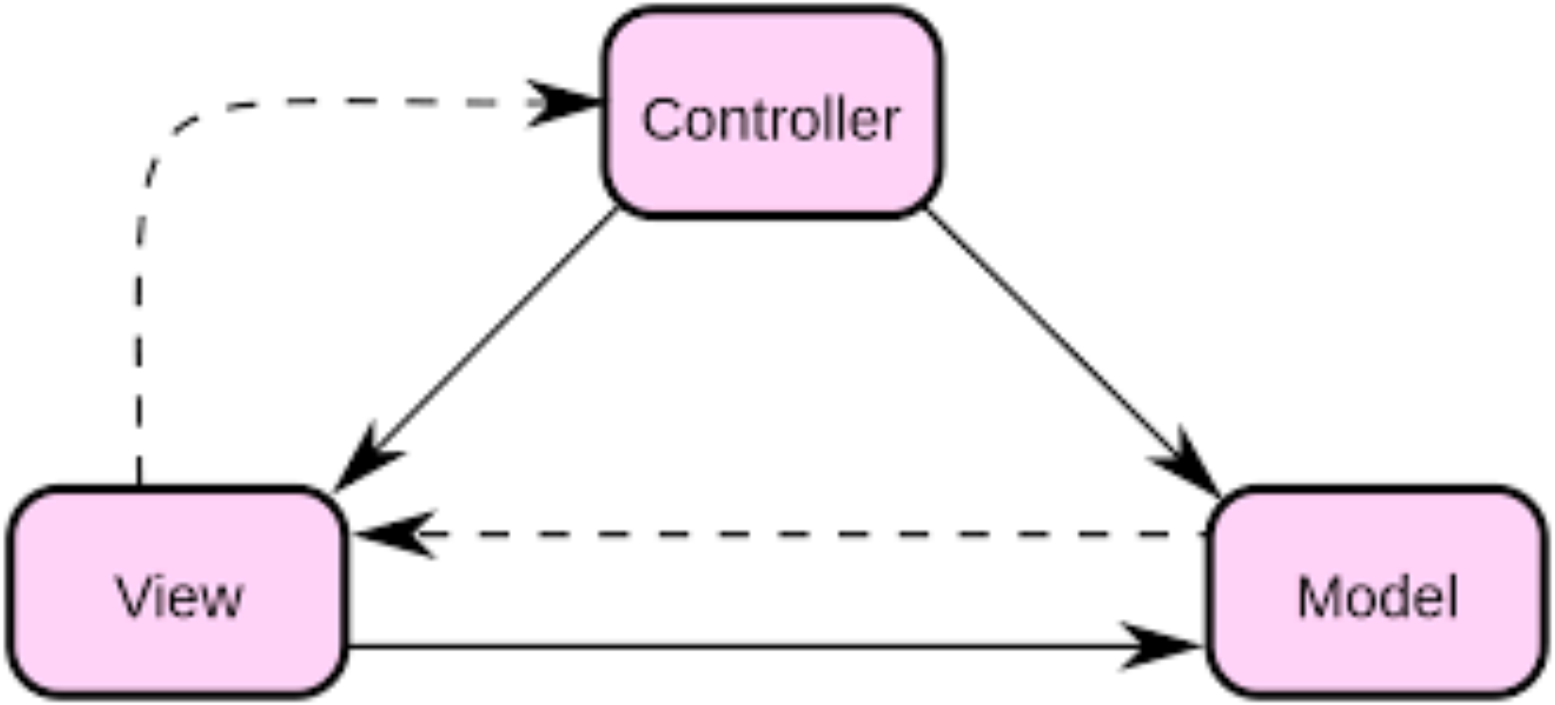
Blackboard



Blackboard

- Context:
  - An immature domain where no closed approach is known to be feasible
- Problem:
  - A complete search of solution space is not feasable
  - Multiple algorithms possible for different subtasks
  - Some algorithms work on the output of others
  - Uncertain data and aprox solutions are involved
- Solution:
  - Independent programs working cooperatively on common data
  - Inspect and update data
- Beware:
  - Difficult to test
  - Difficult establishing a good control strategy

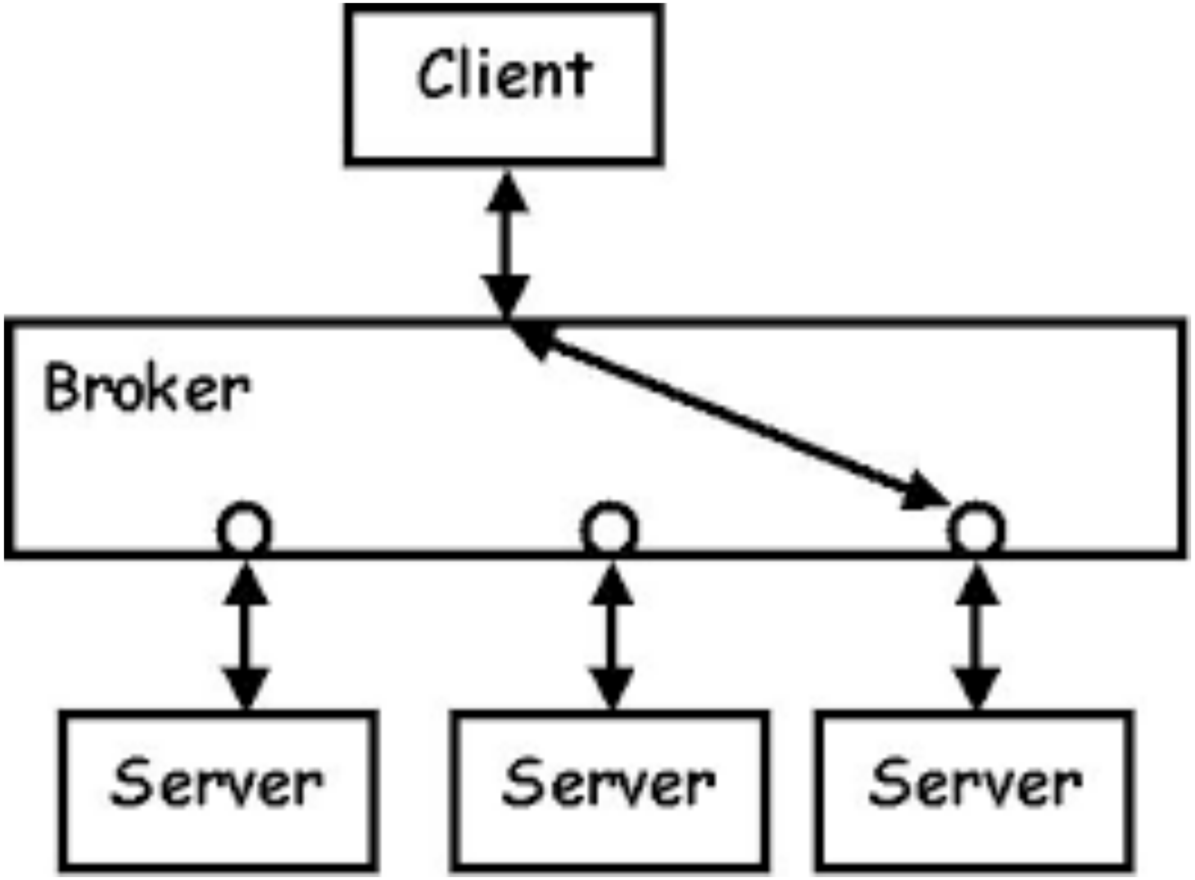
Model-View-Controller



Model-View-Controller

- Context:
  - Interactive applications with a flexible Human-Computer interface
- Problem:
  - How to develop an application not dependent on interface
  - Need ability for application to support different interfaces
  - Allow simultaneous development
- Solution:
  - Model – View – Controller division
- Beware:
  - Code navigability
  - Increased complexity

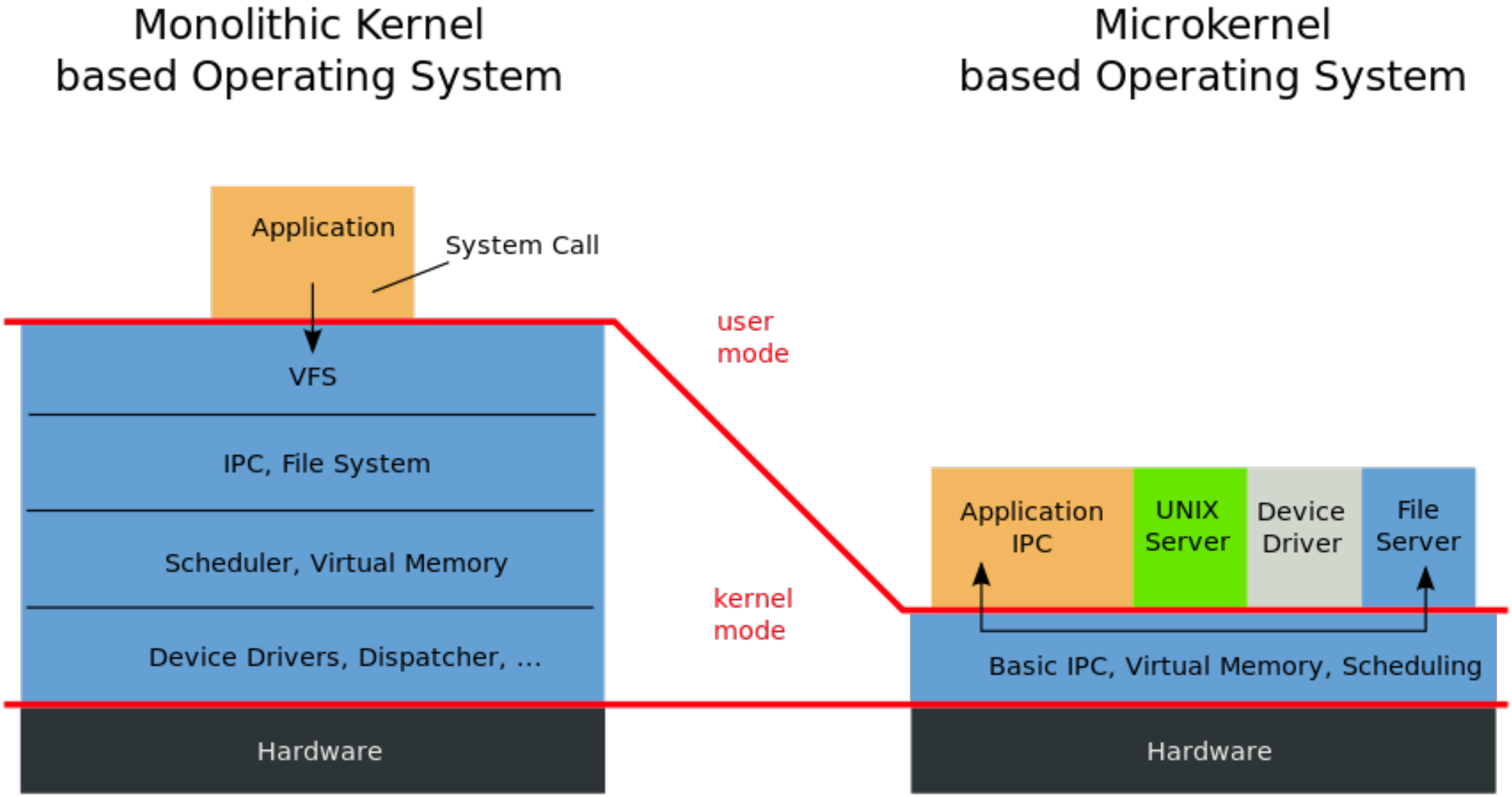
Broker



Broker

- Context:
  - Decoupled components interact through remote service invocations
- Problem:
  - Scaling for large scale systems
  - Components should be decoupled and distributed
- Solution:
  - Brokers mediate between clients and servers
- Beware:
  - Less efficient
  - Lower fault tolerance

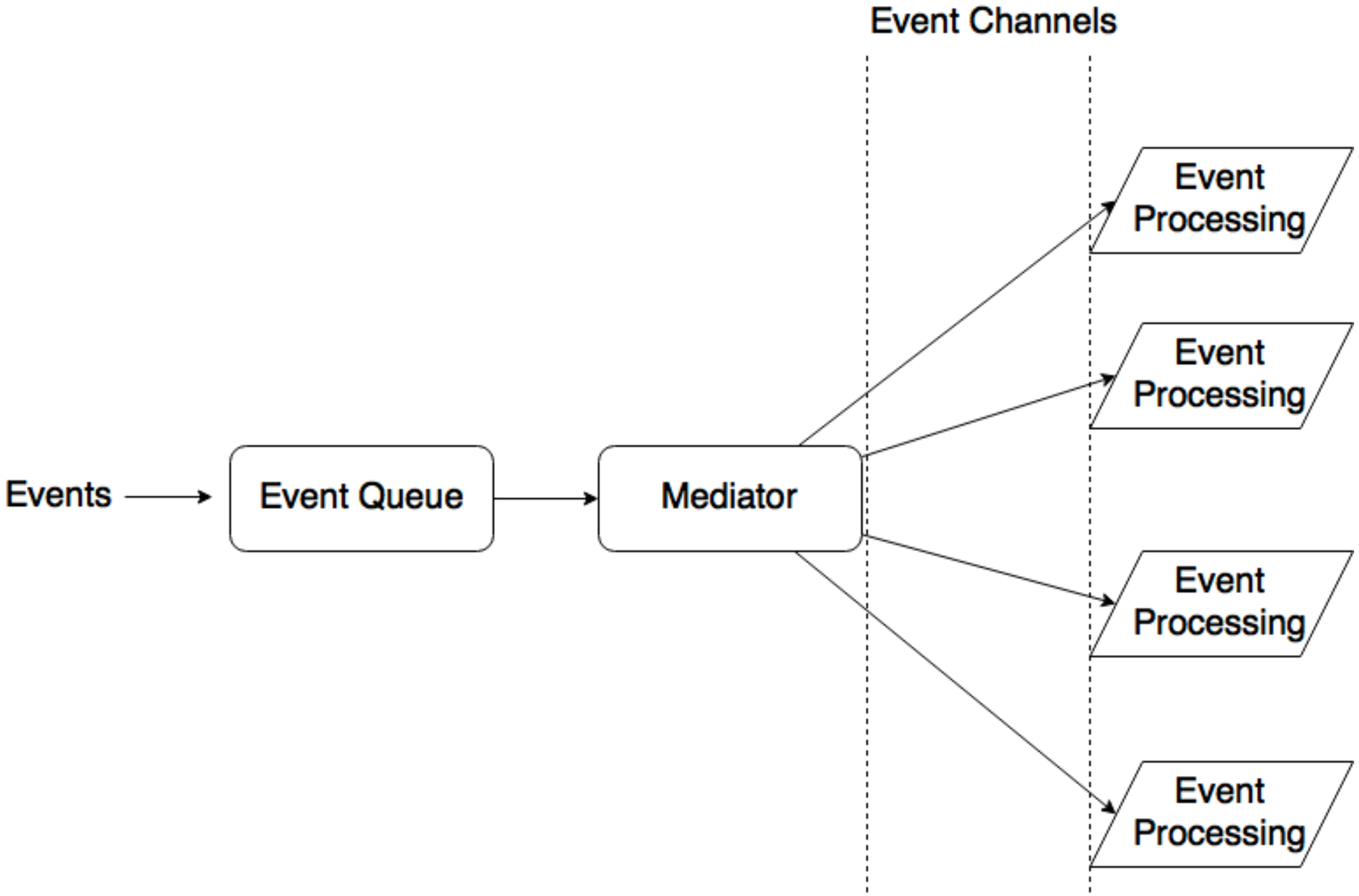
Microkernel



Microkernel

- Context:
  - The development of several applications that use similar interfaces on same core
- Problem:
  - Should cope with continuous hardware and software evolution
  - Platform should be portable, extensible and adaptable
- Solution:
  - Encapsulate fundamental services of your application platform in a microkernel
  - Other functionality provided by internal servers
- Beware:
  - Complexity of design and implementation

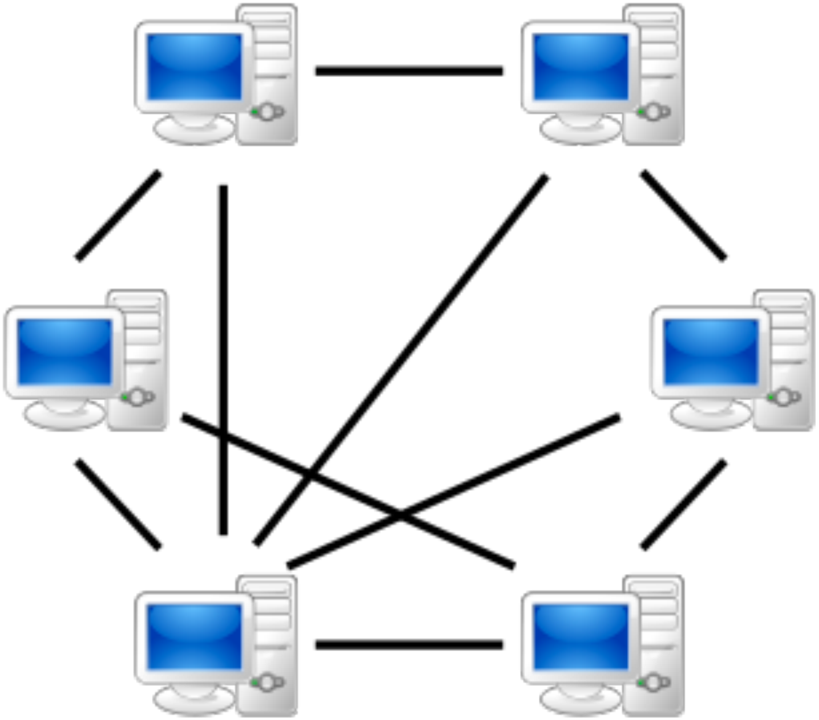
Event-driven architecture



Event-driven architecture

- Context:
  - Building a loosely coupled, more responsive system
- Problem:
  - Build a system that reacts to events in the world around it
  - Only have to decide what to do, not when to do it
- Solution:
  - Event creators, managers, and consumers
- Beware:
  - Security risks
  - Increased complexity

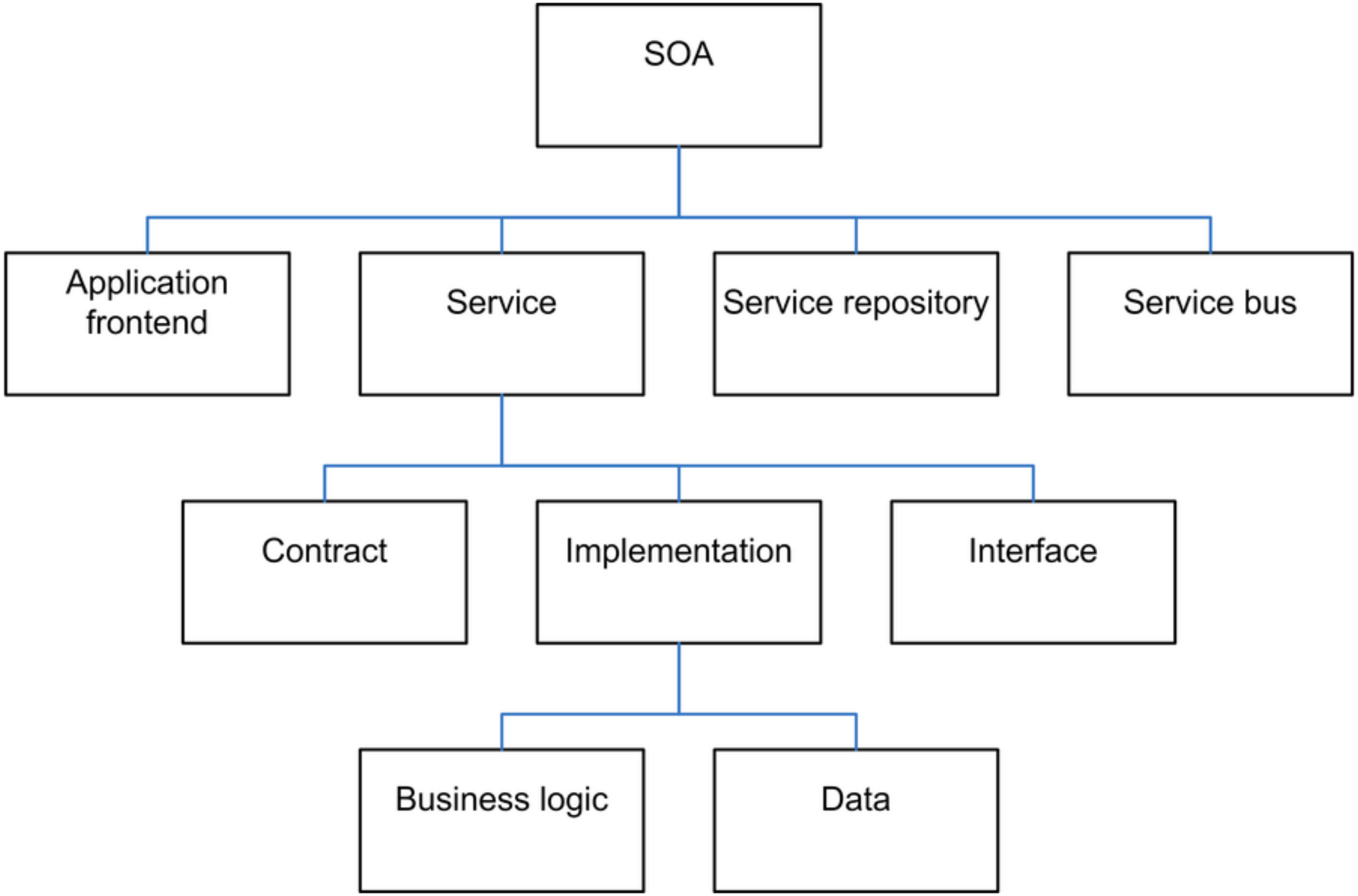
Peer-to-peer



Peer-to-peer

- Context:
  - A system where each node has the same capabilities and responsibilities
- Problem:
  - A situation where it is not feasible to know ahead of time which nodes will be servers
  - Large amounts of data need to be sent transmitted
- Solution:
  - Decentralized computing
  - Highly robust in the face of node failure
  - Highly scalable
- Beware:
  - No server to manage data
  - No always used for legal purposes

Service-oriented architecture



Service-oriented architecture

- Context:
  - Services are provided to other components over a network
- Problem:
  - Building a distributed system
  - Expose a service no objects
- Solution:
  - Each service should:
    - Represent a business activity with a specific outcome
    - Be self-contained
    - A black-box for its consumers
    - May consist of underlying services
- Beware:
  - High investment cost

Exercise:

- Styles:
  - Monolith
  - Layers
  - Pipe and Filter
  - Blackboard
  - MVC
  - Broker
  - Peer-to-peer
  - Microkernel
  - Event-driven
  - Service-oriented

- Application
  - Online banking application
  - API for third party tools to get banking information
  - Compiler
  - Optical Character recognition
  - VR content delivery system
  - VR game
  - Insurance claim processing system