

# Microkernel Architecture

*Software Architecture*

Richard Thomas

March 10, 2025

*So far...*

Simplicity – Monolith, Pipeline

Modularity – Layered, Pipeline

*Definition 0.* Extensibility

Features or extensions can be easily added to the software over its lifespan.

*Question*

How easy is it to extend *Monolith*, *Layered* or *Pipeline*?

*Question*

How easy is it to extend *Monolith*, *Layered* or *Pipeline*?

*Answer*

**Monolith** – Everything in one container 🤔

*Question*

How easy is it to extend *Monolith*, *Layered* or *Pipeline*?

*Answer*

Monolith – Everything in one container



Layered – Typically all layers



### *Question*

How easy is it to extend *Monolith*, *Layered* or *Pipeline*?

### *Answer*

Monolith – Everything in one container



Layered – Typically all layers



Pipeline – Create a new filter



*Definition 0.* Interoperability

Software can easily share information and exchange data with internal components and other systems.



*Question*

What about interoperability?

### *Question*

What about interoperability?

### *Answer*

Monolith – Everything in one container

- Internal 🤗 External 🤔

### *Question*

What about interoperability?

### *Answer*

**Monolith** – Everything in one container

- Internal 🤗 External 🤔

**Layered** – Nearest Neighbour

- Internal 🤗 External 🤔

## *Question*

What about interoperability?

## *Answer*

**Monolith** – Everything in one container

- Internal 🤗 External 🤔

**Layered** – Nearest Neighbour

- Internal 🤗 External 🤔

**Pipeline** – Standard Interface

- Internal 🤗 External 🤔

*Question*

What if I want simplicity, extensibility and interoperability?

*Question*

What if I want simplicity, extensibility and interoperability?

*Answer*

Consider *Microkernel Architecture*

# *§ Microkernel Architecture*

### *Definition 0. Microkernel Architecture*

Core system providing interfaces that allow plug-ins to extend its functionality.





*Definition 0.* Registry

Tracks which plug-ins are available to the core system and how to access them.

## Loading Plug-ins

Static Loading when application starts

Dynamic Loading as needed at run-time

Registry designed for the selected strategy

*Question*

Can you think of a *microkernel architecture*?

*Question*

Can you think of a *microkernel architecture*?

*Answer*

Web Browser?

### *Definition 0.* Independent Plug-in Principle

Plug-ins should be independent, with no dependencies on other plug-ins. The only dependency on the core system is through the plug-in interface.

*Definition 0.* Standard Interface Principle

There should be a single interface that defines how the core system uses plug-ins.

*Question*

Does a plug-in architecture equate to a microkernel architecture?

*Question*

Does a plug-in architecture equate to a microkernel architecture?

*Answer*

What about *IntelliJ*?



## Plug-ins with Separate Databases

- Plug-ins cannot access core system data
  - Core system may pass data to the plug-in
- Plug-ins may have their own persistent data



# Plug-ins as External Services

- Need communication protocol
- Registry records communication contract
  - e.g. URL of the REST endpoint & data passed to it



# Adapting Non-Conforming Interfaces



# *§ Technical & Domain Partitioning*

# Technical Partitioning



# Technical Partitioning



# Domain Partitioning



*Question*

Is the microkernel architecture suited to *technical* or *domain* partitioning?

*Question*

Is the microkernel architecture suited to *technical* or *domain* partitioning?

*Answer*

Core system can be partitioned either way.



# Domain Standard Interfaces



# Distributed Microkernel

- Partitions in the core system can be distributed
  - Technical or domain partitions
  - Plug-ins could also be distributed



# *§ Media Server Example*

*Question*

What types of systems could use a *microkernel architecture*?

*Question*

What types of systems could use a *microkernel architecture*?

*Answer*

- Social media aggregator
- IoT management & processing
- Media server

# Media Server & Renderer



# Domain Colour Key



# Media Renderer





# Core Rendering System Components



# Media Server



# Core Media Server Components



# Media Library Management Components



# Scrape Metadata Interface



# System Deployment



# $\S$ *Conclusion*

## Microkernel Pros & Cons

Simplicity Core system & Plug-in interface



Extensibility Plug-ins



Interoperability Plug-ins



Scalability



Reliability

