J2EE Best Practices and Design Considerations

J2EE Patterns

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A Brief Overview of Transactions

- *Transactions* guarantee determinism
- Transactions give you four virtues or ACID properties
  - Atomicity
  - Consistency
  - Isolation
  - Durability

Transaction Scope and Performance

Balance is everything

- Narrower scopes
  - Increase transaction traffic
  - Decrease transaction latency
- Broader scopes
  - Decrease transaction traffic
  - Increase transaction latency

Likely Discoveries

(Provided transactional scope does not extend to the client layer)

- Transactional traffic is much more costly than latency
  - Transactional storms cause:
    - Increased chance of rollbacks
    - Increased chance of transaction interaction: Unexpected state
- Longer-lived transactions cause
  - Isolation conflicts: Blocking and waiting
  - More manageable and consistent operations
- Examples of longer-lived transactions include:
  - Performing multiple updates within a single database transaction
  - Using a session façade to demarcate transactions for entity beans

Take-away Points

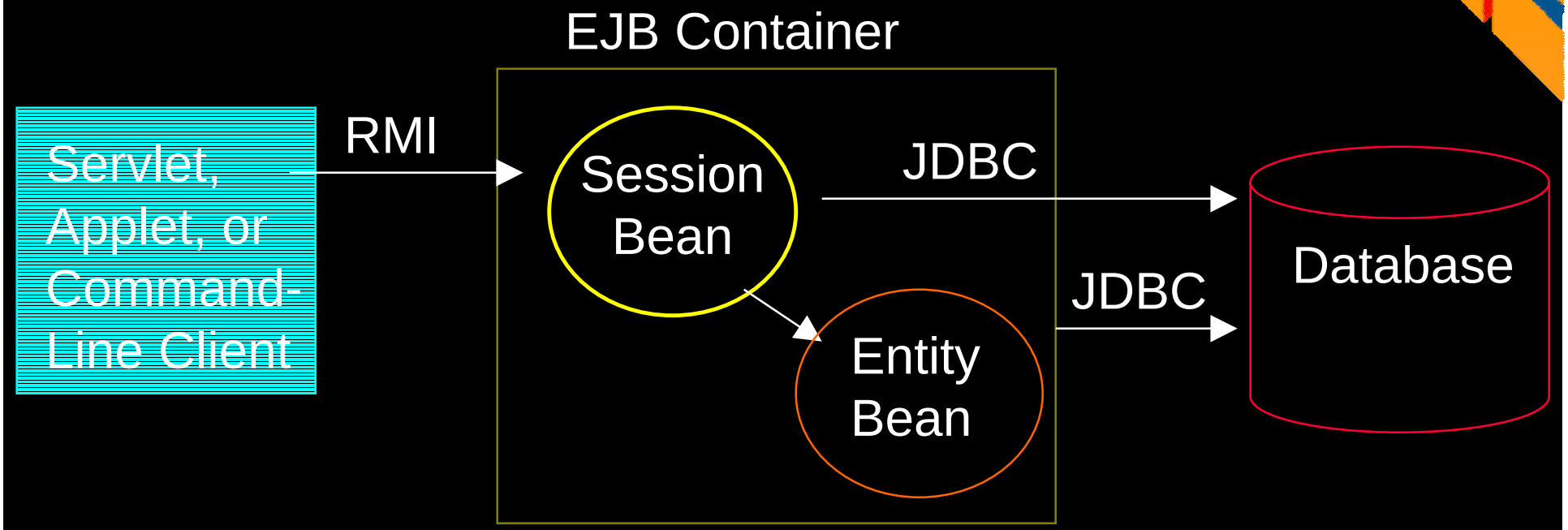
- Abstract and cache your data to:
  - Decrease client complexity
  - Decrease network latency and traffic
- Be aware of how "up to date" you really need your data
  - If an operation does not require pure data, give them latest
  - If an operation does not require latest data, give them stale
  - etc...
- Increase transactional scope to:
  - Ensure data consistency
  - Reduce traffic

Roadmap

Where are we?

- *Transactions*
- ***J2EE Design Concerns***
  - ***EJB and Data Concerns***
  - General Design Choices and Strategies
- What We Can Control

A Graphical Look



Decision Points

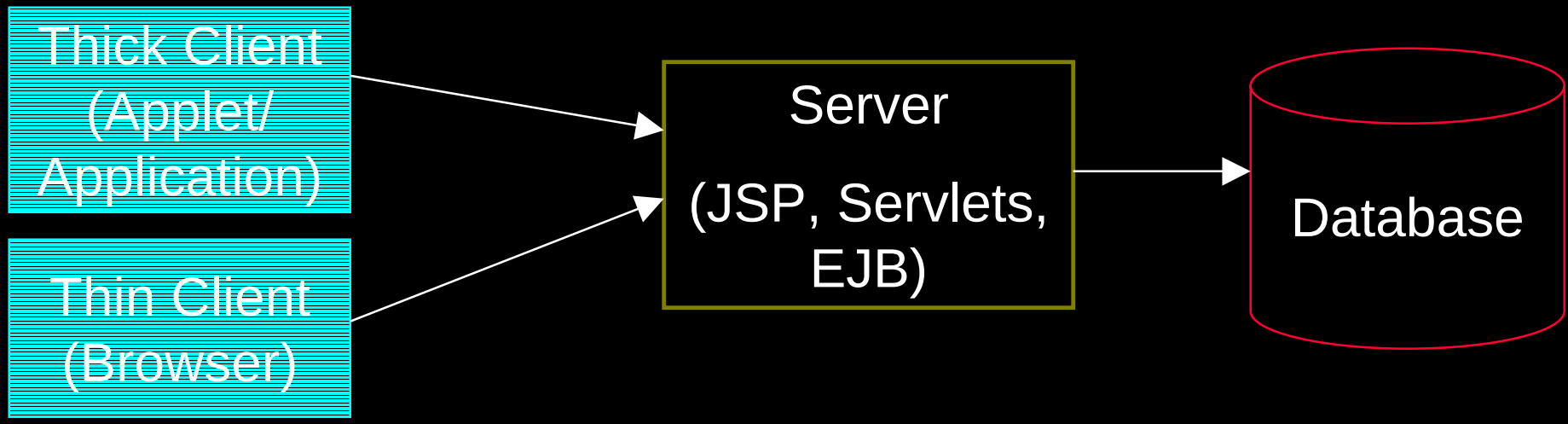
- Use session beans with Java objects when
  - Large volumes of data are retrieved in single SQL calls
  - You are working with very small bits of data
  - You have exclusive data (due to caching)
  - You have programmers who are not familiar with OO data objects
  - You have existing, (working) SQL code
- Use Entity Beans when
  - You have shared data (due to caching)
  - CMP is not prevented due to DB Optimizations
  - You can take advantage of ejb20 relationship-management
  - Data objects can be generated from UML diagrams through tools

When to Use Container-Managed Persistence

- Advantages of container-managed persistence
  - Less code
  - Faster to develop
- Advantages of bean-managed persistence
  - More control (complex mappings)
  - Can take advantage of existing tuned SQL (triggers)
  - Less new learning (reuse and extend old JDBC code/components)
- CMP is a more realistic choice now because of:
  - New EJB 2.0 relationship management
  - New EJB 2.0 local interfaces

When to Use Stateful v. Stateless?

- Say we have a stateful business process (e.g. shopping cart)
- We can keep our state in one of three places
  - In the client's memory
  - In the server's memory
  - On the database disk



Pros and Cons

- Database Pros:
  - Database is a transactional/recoverable device
- Database Cons:
  - Disk I/Os and network roundtrips are required
  - Need to write code to marshal state in and out of component
- Client Pros:
  - If client crashes we expect to lose state anyway.
  - No disk I/Os
- Client Cons:
  - Requires network overhead marshalling state back and forth
  - The client API becomes more complex due to additional state parameters
  - Need to write code to marshal state in and out of component
- Server Pros:
  - No code to marshal state in and out of component
  - No network roundtrips nor disk I/Os to marshal state
  - No single point of failure if clustering/replication is used (judiciously)

XML As a Data Transfer Mechanism

- XML is useful when communicating between disparate systems
- XML transformation and parsing is slow
- **Do not** use XML for data transfer **within** a J2EE system
  - The existing APIs work just fine
  - Remember OO?
  - J2EE applications are all Java
- **Do** transfer data between heterogeneous systems as XML when the benefits it offers can be realized

Roadmap

Where are we?

- Transactions
- ***J2EE Design Concerns***
  - EJB and Data Concerns
  - ***General Design Choices and Strategies***
- What We Can Control

Dividing up your team

- 3 basic approaches
  - Horizontal partitioning
    - Developers specialize in APIs
    - Examples: JSP team, an entity bean team, etc
  - Vertical partitioning
    - Developers focus on use cases and are generalists (use all APIs)
  - Hybrid partitioning
    - One subject matter expert per use case
    - Developers specialize in APIs and move from use case to use case
- If goal is to get project success quickly and consistently, go for horizontal or hybrid
- If goal is to educate developers, go for vertical

Reality and Reuse

- Rocky history of reusing components within an organization
  - Projects are too different, too much politics for reuse
- Rather than reuse, we recommend striving for
  - Common vocabulary between projects
    - Empowers communication
  - Common design patterns
    - Enables developers to easily transition between projects
  - Common frameworks
  - Pseudo-reuse via copy-pasting of code between projects
- Can achieve this via a "best practices task force"

Choosing an Application Server

- If you have no time, you could just go with market leader
  - Warning: vendor may not handle *your* needs in optimal way
- Recommended process for selection of server
  - List all features you want
  - Weight and prioritize the feature list
  - Eliminate vendors that don't meet majority of criteria
  - Download application servers from 2-3 remaining vendors
  - In a lab environment, measure features most important to you
    - Scalability
    - Usability
    - Performance

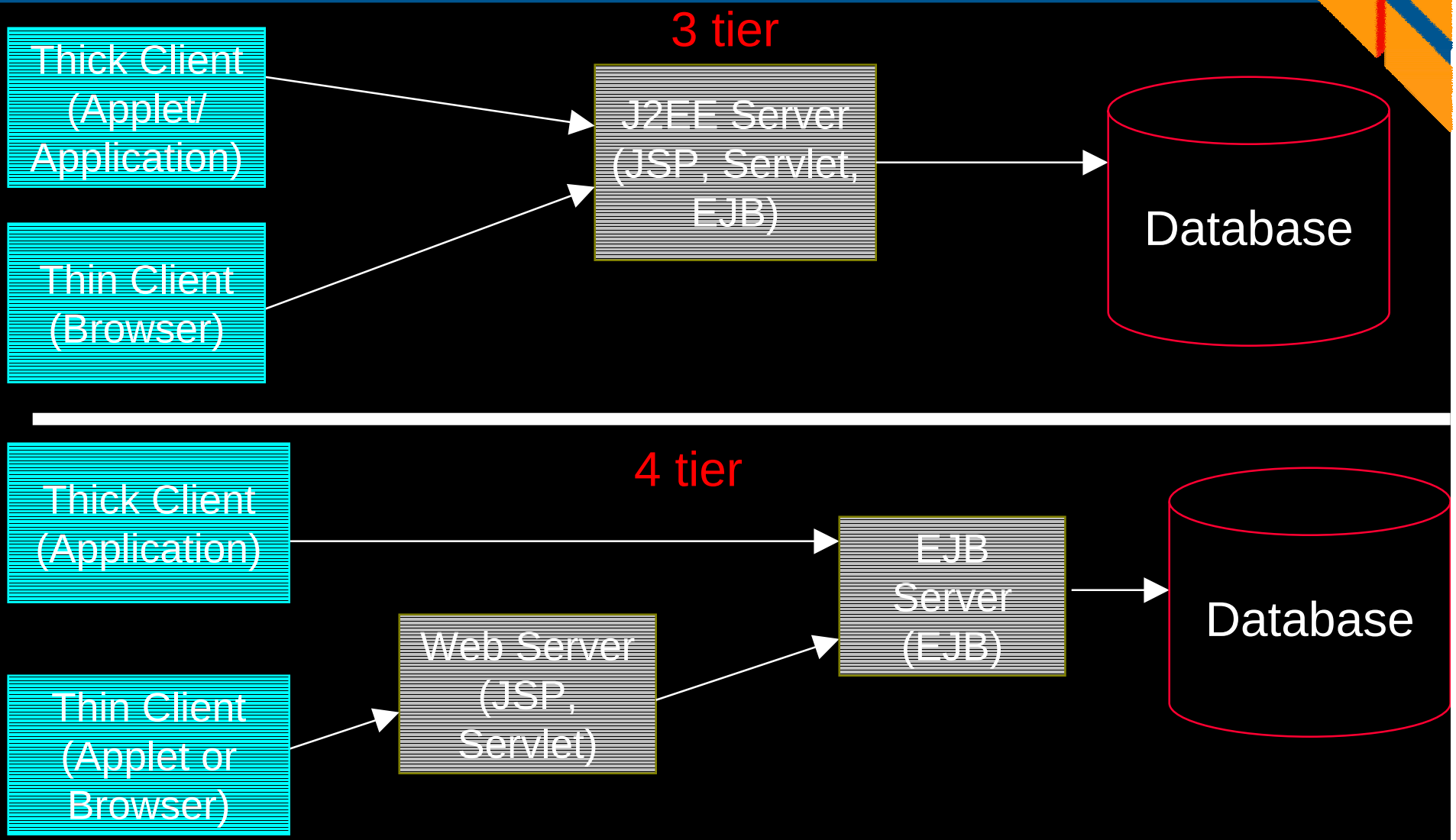
Choosing an Application Server *...continued*

- Deploy vertical slice into those application servers
  - You know how well the server handles *your* needs
  - Entire process takes 2-4 weeks
  - Can occur in parallel with development if you code portably
  - Consultants can help you through this process

A Vertical Slice

- What is a vertical slice?
  - One or two use-cases in your system
  - Example: search engine, or product catalog – but not complete site
  - You build this slice, using all the relevant J2EE APIs:
    - JSPs, servlets, EJBs, etc
- Benefits of implementing a vertical slice
  - Gain experience with J2EE
  - Reduce risk of 'unsound architecture'
  - Prove project works to stakeholders –show them working use-case
  - Answers question: "Will it scale?" – can performance tune slice early
  - Helps you refine design patterns
  - Not throwaway code: Slice is real piece of working system

When to Use 3-Tier v. 4-Tier



When to Use 3-Tier v. 4-Tier *...continued*

- Load-balancing
  - Required and only possible in 3 tier
- Efficiency
  - No RPCs in 3-tier –possibly no IPCs (inter-process calls)
- Adaptability
  - 3-tier is more self-adapting than 4-tier
  - Resources are used for whatever purpose is needed currently
    - Either web server or application server
- Security
  - Firewall may be deployed in-between boxes in 4-tier
- Fail-over
  - 4-tier has no fail-over capability in this limited scenario

Increase Responsiveness

- When Programming EJBs
  - Use Local Interfaces
  - Use Session or Message-driven façade
- Cache Data
  - Read-only Entity Beans
  - Data Transfer Objects
- Cache JNDI Resources
  - EJB Home Objects
  - Data Sources
  - JMS Connection Factories

Increase Responsiveness *...continued*

- Serialization
  - Use the transient keyword for fields that you don't want serialized
  - Use smaller transport objects to send the subset of info you need
- Reduce network traffic
  - Make coarse-grained network calls ("chunk" your remote requests)
  - Always be aware of your remote boundaries
- Key to designing correctly: *perceived* performance
  - Be smart about how you optimize
  - E.g. don't optimize a Swing GUI if the app sits idle most of the time
  - Don't put long-running tasks on the UI thread
  - Put them on a new thread to give your GUIs snappier performance

Increase Responsiveness *...continued*

- Garbage collection
  - Null out references that are no longer needed
  - They are more likely to be GC'ed
- Use lazy initialization, this is a powerful technique

```
MySingleton singleton = null;
...
if (singleton == null)
  singleton = new MySingleton();
return singleton;
```

Increase Productivity

- Use/build frameworks
- What is a framework?
  - Set of related classes which you specialize and/or instantiate to implement an application or subsystem
  - Why are they useful?
    - The framework is not just a collection of classes – it also defines a generic design
    - Bi-directional flow of control means the framework can contain much more functionality than a traditional library
  - Obstacle: learning curve

Roadmap

Where are we?

- The Good of the Many: Data Tiers and Transaction Concepts
- J2EE Design Concerns
- ***What We Can Control***
  - Handling Java Threads
  - Memory Management
  - Accurate Benchmarks

Handling Java Threads

- With EJB thread management is handled for us
- Vendors allow us to tune the # of threads in the App Server
  - Too many threads cause increased competition for resources
  - Too few threads cause under-utilization of CPU
- We can choose to deploy to multiple instances
  - Each VM has its own thread pool limit
  - Each tier has its own thread behavior
    - Web-tier uses greater number of threads of a shorter duration
    - EJB-tier uses fewer threads of a greater duration
  - Deploying to multiple CPUs decreases CPU exhaustion

Memory Management

- More is Better
- Do not starve your OS
  - If you have 2GB ram available save 256mb for the OS
- Use –Xms<x-Amount>m -Xmx<x-Amount>m arguments to VM
  - Ensure the minimum and maximum are identical
    - You are certain to get what you need at startup
    - You can easily partition your ram among multiple instances
- Remember: Actual RAM use can be twice that declared

Obtaining Accurate Benchmarks

- System-centric
  - System.currentTimeMillis()
    - Invasive, inaccurate by as much as tens of milliseconds
    - May be all you have
  - CPU utilization
  - Memory use
- Test... Test... Test...
  - Every application is different
  - Fix what you can – it's the least you can do
    - Use StringBuffers in place of Strings if doing much concatenation
    - Reuse objects where possible since object creation is costly
  - Development-time performance measurement
    - Sitraka PerformaSure
    - Borland OptimizeIt

Obtaining Accurate Benchmarks *...continued*

- User-centric
  - What really counts
  - Difficult to determine
    - Network issues
    - User error/unexpected behavior
    - Real-world load
- Requires the right tools
  - Deployed/Live performance measurement and advice
    - Precise Indepth for J2EE

Summary

In this presentation we discussed:

- The Good of the Many: Transactions
- J2EE Design Concerns
  - When to Use Messaging
  - EJB and Data Concerns
  - General Design Choices and Strategies
- What We Can Control
  - Handling Java Threads
  - Memory Management
  - Accurate Benchmarks