EJB Basics – By Example

- Dave Landers
- BEA Systems, Inc.
-
- dave.landers@4dv.net
- dave.landers@bea.com

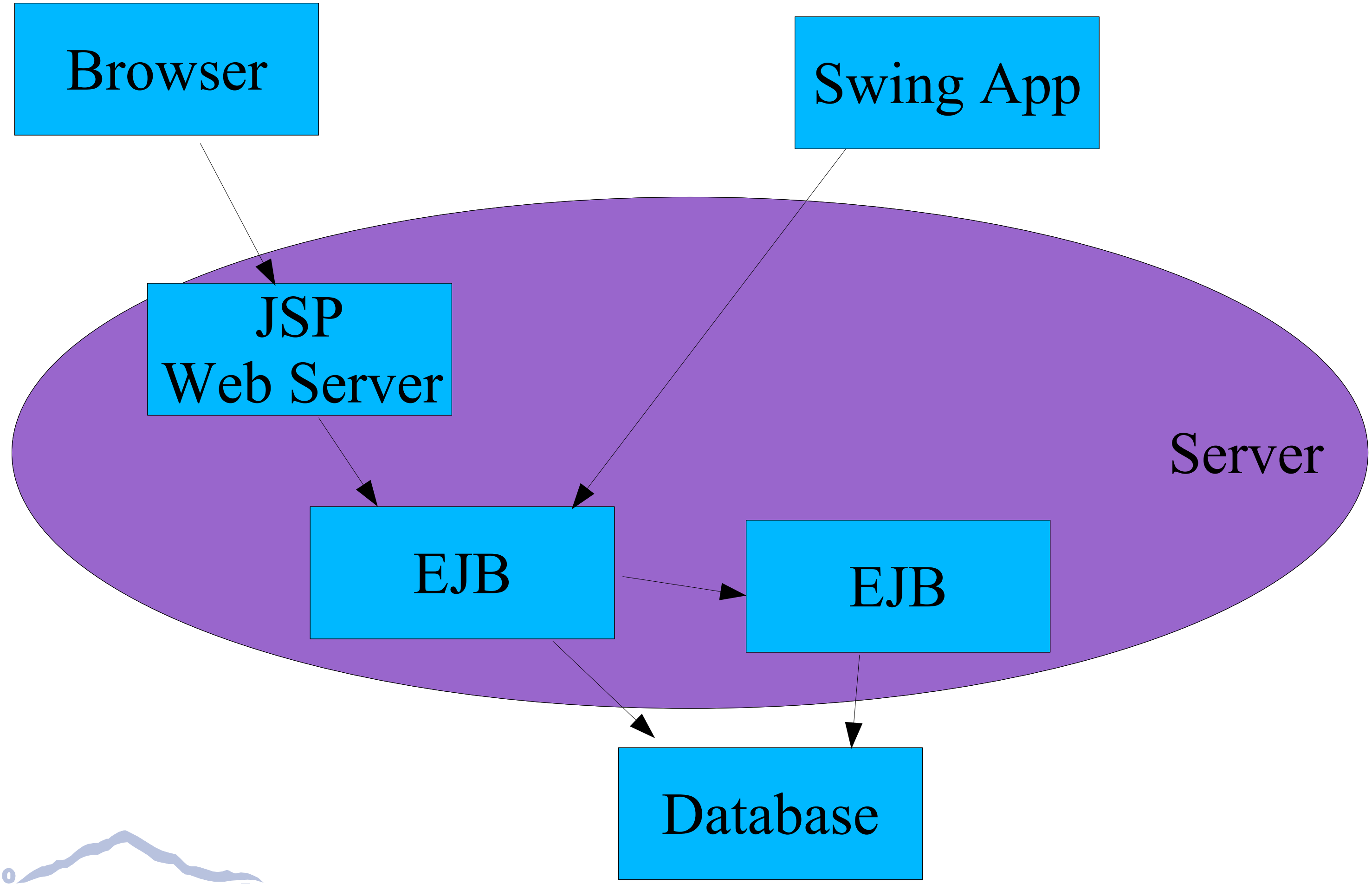
Agenda

- EJB Overview
- Parts of an EJB
  - Component Interface
  - Home Interface
  - Implementation
  - Deployment Descriptor
- Writing simple EJBs
- Limitations
- *Etc.*

What is an EJB?

- Enterprise Java Beans
  - Not JavaBeans
- Architecture for server-side components
- Lots of services provided for you by Container
  - Transactions, security, *etc.*
  - Most are declarative – no coding
    - You still have to think about and understand these services
- You get a lot for a little work

Where is an EJB



EJB Features

- Transactions
- Security
- Database
- Distributed Components
  - RMI, CORBA
- Container Managed Persistence
- Performance and Scalability
  - Pooling, Load Balancing, *etc.*
- Descriptor-Based Features
- Deployment of new code to running server

Kinds of EJB

- Session Beans
- Entity Beans
- Message Driven Beans

- Each has its use
- Coding is similar for each

Session Beans

- Usually "business methods"
  - They do something
- Often used to provide coarse grained access
  - Interact with several other EJBs, services, *etc.*
- Two kinds
  - Stateless
    - Most common
  - Stateful
    - State maintained between method calls
    - State is "conversational" not "durable"
      - ✓ Think memory or files, not databases

Entity Beans

- Usually represent “data”
  - Often stored in database
- Durable persistence
  - Survives “crash” of container
  - Container- or Bean-Managed (CMP or BMP)
  - CRUD: Create, Read, Update, Delete
- Unique Primary Key identifies individual Entities
- Relationships to other Entities

Parts of an EJB

- Home Interface
  - Factory for creating, finding, deleting EJBs
  - Looked up from JNDI
- Component Interface
  - Client makes method call on these interfaces
- Implementation Class
  - You write this to implement the EJB
  - Only the container calls it
- Primary Key class for Entities
- Deployment Descriptor(s)
  - Instructions to the container

Local *vs.* Remote

- Remote
  - Distributed calls (RMI/CORBA)
  - Pass-by-Value (Serialized)
- Local (EJB 2.0)
  - Must be in same JVM
  - Pass-by-Reference
  - No RemoteException
- EJB can have Either or Both
- Can have the Same or Different Methods

EJB Component Interface

- Remote and/or Local
- extend EJBObject or EJBLocalObject
- Add your methods
  - Entities usually have get/set methods
  - Sessions usually have “operations”
  - If Remote, methods must throw java.rmi.RemoteException
- All arguments and return values for Remote must be Serializable

EJB Home Interface

- extends EJBHome or EJBLocalHome
  - One for each component interface
- Requirements
  - Create methods (not required, but common for Entity)
  - Entity findByPrimaryKey
- Optional
  - Several Create methods
    - Except jusr one for Stateless
  - Entity Beans
    - Other finders
    - Home Methods

The Implementation Class

- Implements SessionBean or EntityBean
  - No difference in interface for Stateful / Stateless
- Can Not implement Component or Home Interface
  - Not allowed
  - Method signatures differ slightly
  - Javac can’t help you get it right
    - Vendor “EJB Compiler” tools
    - IDE features
    - Errors when you deploy

Code Break

- Simple Stateless Session Bean
- HelloWorld
- Only one method
  - String sayHello()
- Local and Remote Interfaces
- Only one implementation class

Writing the Implementation Class

- Component Interface Methods
  - The business methods that do the work
  - Same signature
    - Do not throw RemoteException
      - ✓ Should pick a better Exception

Implementation…

- Container Callbacks – called on state changes
  - Session Beans
    - setSessionContext
    - ejbCreate
      - Matches create(…) method(s) from Home
      - Only no-args for Stateless
    - ejbActivate, ejbPassivate
      - Used in Stateful only
    - ejbRemove

Code Break

- Simple Stateful Session Bean
- Counter
- Keeps an int as State
- One “business” method
  - int getNext()

    ```
    {
        return counter++;
    }
    ```

Special things for Entity Beans

- Primary Key Class
  - Identity for the instance – standard or custom class
- Finders to do lookups (SQL SELECT queries)
  - findByPrimaryKey (required), findXXX (optional)
  - Return Remote/Local or Collection
    - Implementation returns PK or Collection of PK
- Home Methods (EJB 2.0)
  - Not instance specific
    - Like static methods on an object
  - Prior to EJB 2.0, was usually in companion Session Bean

Entity Bean Implementation…

- Container Callbacks – called on state changes
  - setEntityContext, unsetEntityContext
  - ejbActivate, ejbPassivate
  - ejbCreate
    - ✔ Matches create(…) methos(s) from Home
    - ✔ BMP Entity – SQL INSERT, return Primary Key
  - ejbPostCreate – Entity Beans
    - ✔ Called after EJB created in Container – has identity
    - ✔ Do things that need EJB reference - establish relationships
  - ejbRemove
    - ✔ BMP Entity – SQL DELETE
  - ejbLoad, ejbStore
    - ✔ Entity Beans only – BMP SQL SELECT & UPDATE

Implementation…

- Other Entity Home Methods
  - findByPrimaryKey, findXXX, other home methods
  - Similar signature as in Home
    - Method names prefix with "ejb" and next letter upper-cased

- Return Types
  - Session ejbCreate() returns void
  - Entity ejbCreate() returns Primary Key type
    - BMP returns PK instance, CMP returns null
  - Entity ejbFindXXX() returns PK or Collection of PK

Entity Beans – Container Managed Persistence

- Abstract implementation class
- Each "attribute" has abstract get/set methods
  - Implemented by the container
  - Mapping described in deployment descriptor
- Bind finders to database using EJB-QL
  - Kind of like SQL
  - In deployment descriptor
- Select Methods allow EJB-QL to be used from home or business methods
- Can also set up relationships with other Entity Beans

Code Break

- Simple Entity Bean
- Property
- Persists Key and Value pairs in Database
- Container Managed Persistence

Entity Beans – Bean Managed Persistence

- You write the database code
- JDBC and SQL in
  - ejbCreate, ejbRemove
  - ejbLoad, ejbStore
  - Finders, select methods
- Maintain state of EJBObject *vs.* Database
- Good if:
  - Binding is too complex for CMP / EJB-QL
  - Persistence is not to database
  - You are a control freak or have extra time....

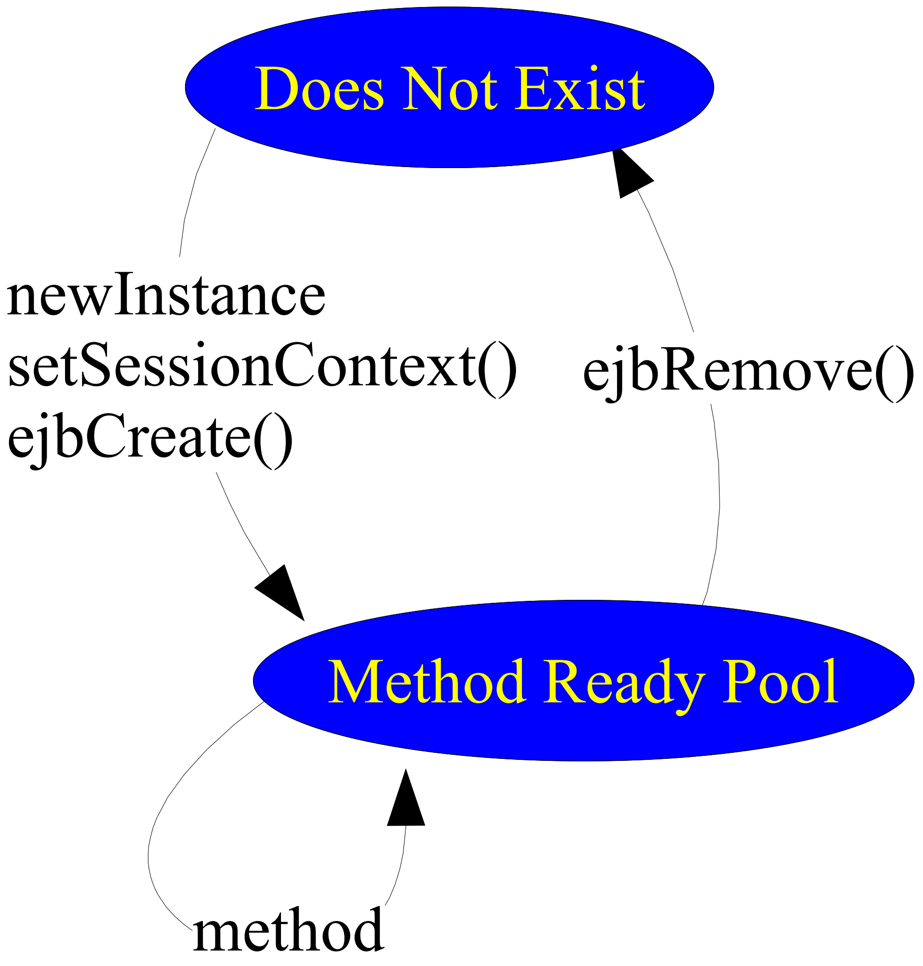
Code Break

- Property
- Bean Managed Persistence
- Extends CMP class and provides just persistence methods

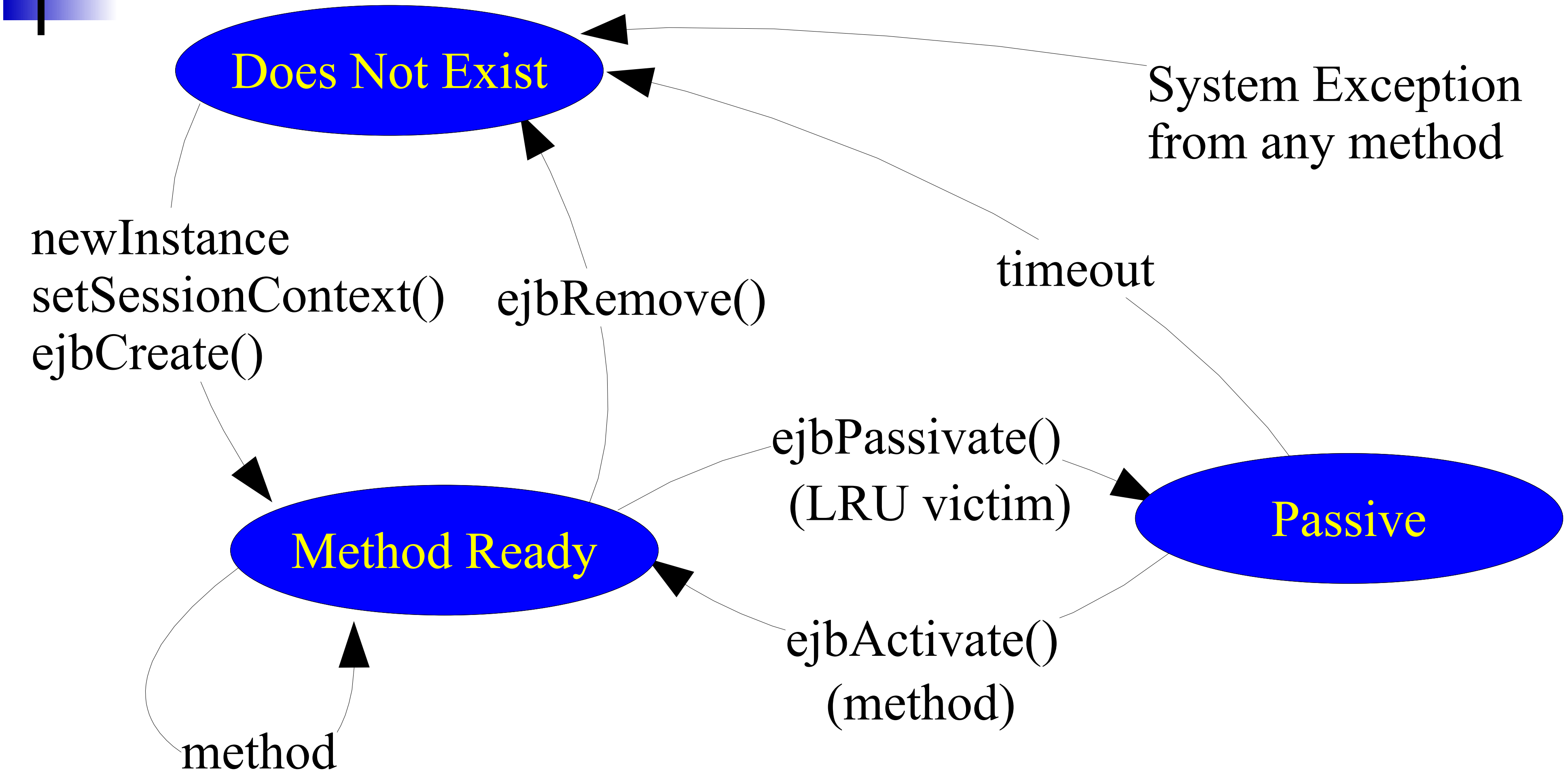
EJB Lifecycle

- For All EJB Types:
  - Lifecycle of Instances is manged by the Container
  - EJB gets callbacks at appropriate times
  - More State == More Complicated

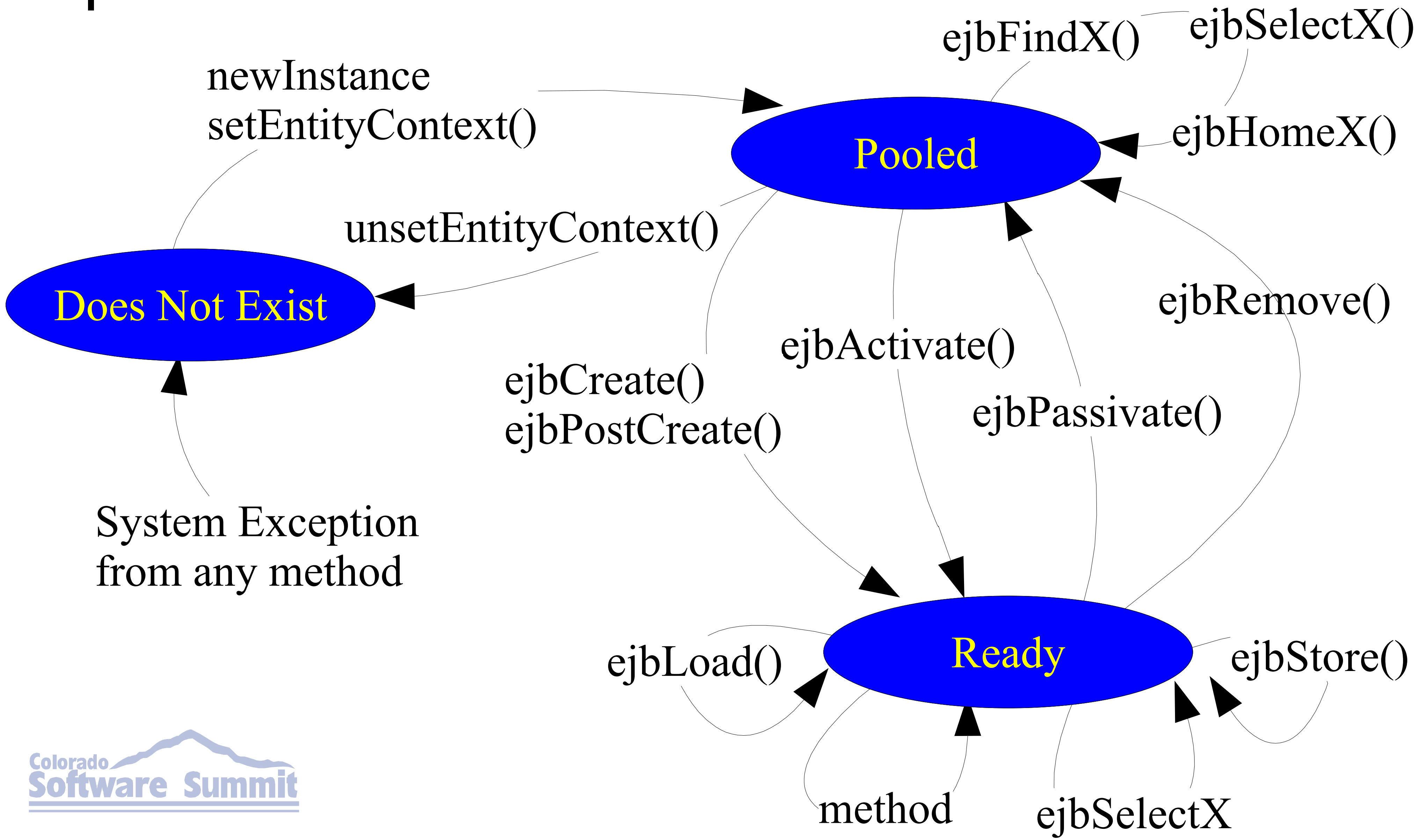
Stateless Session



Stateful Session Lifecycle



Entity Lifecycle



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About Exceptions

- Throw any exception that makes sense

- Application Exceptions
  - These are non-RuntimeExceptions
  - In your throws clause
  - You must handle things like rollback
- System Exceptions
  - RuntimeException, Error (and subclasses)
  - Container must
    - ✔ Log it
    - ✔ Rollback transaction
    - ✔ Destroy bean instance

Deployment Descriptor

- In EJB jar file: META-INF/ejb-jar.xml
- Declares each EJB and
  - References to other EJBs (ejb-ref)
  - Environment Properties (env-entry)
  - Database and other resources (resource-ref)
  - Security restrictions
  - Transaction settings
- CMP Definitions
  - Fields and Queries
- Vendor specific Descriptor
  - Server specific configurations, tunings, *etc.*

Code Break

- Deployment Descriptor for other examples

Client view of EJB

- Lookup Home with JNDI
- Create or find bean
- Make method calls

Client EJB calls

- Context jndiCtx = new InitialContext();
  - Might need JNDI properties for server connection

- Object o = jndiCtx.lookup(“beanJndiName”);
- MyLocalHome = (MyLocalHome)
  jndiCtx.lookup(“localBeanJndiName”);

- MyRemoteHome home = (MyRemoteHome)
  PortableRemoteObject.narrow(o,
  MyRemoteHome.class);
  - Narrow needed only if Remote

Use EJBHome to get EJBObject

- MyEJB ejbObj = home.create();
- MyEJB ejbObj = home.create(args);
- MyEntity ejbObj = home.findByPrimaryKey(pk);
- MyEntity ejbObj = home.findTheOne(...);
- Collection c = home.findTopTen(...);
  - If Remote, objects retrieved from collection must be Narrowed

Client *etc.*

- ejbObject.remove()
  - When done with Stateful Session “conversation”
  - Not necessary for Stateless Session
  - Removes Entity from database
- Don’t use equals()
  - ejbObject.isIdentical(EJBObject other)
  - For Entity or Stateful Session
- ejbObject.getPrimaryKey()
  - Returns Entity PK

Code Break

- Client code for examples
- JSP

Message Driven Beans

- No client interfaces (component or home)
- Implement
  - MessageDrivenBean
  - javax.jms.MessageListener
- One method:
  - onMessage(javax.jms.Message m)
- Tied to JMS Destination when deployed
- EJB 2.1 will let MDB receive non-JMS messages

EJB Limitations

- No Read/write static fields
  - Might not be accessible by all EJBs
  - Container might spread across multiple JVMs
- No Thread synchronization or thread management
  - Might not work like you think
    - ✔ Container spread across multiple JVMs
  - Mess up the container pooling, load balancing, *etc.*
- No File I/O
  - Database is better
- No Server sockets or multicast
- No ClassLoader games or Native Library Loading

EJB Limitations

- Usually OK for EJB to use objects that do these things
- But:
  - Read the rationale in the EJB spec
    - Chapter 24.1.2 – Programming Restrictions
  - Make sure you are aware of the <u>reasons</u> *for the restrictions*
  - *Food for Thought:*
    - *What is a Singleton?*
      - ✓ *Consider distributed system, multiple ClassLoaders, multiple JVMs, multiple computers....*

EJB Limitations

- Never give away “this”
  - Object reference to implementation
  - It “belongs” to the container
  - Get interfaces from SessionContext or EntityContext and pass these around instead
    - context.getEJBObject()
    - context.getEJBLocalObject()

Design hints

- Use locals where possible
  - Intra-server calls
  - Hide some things from Remote clients
    - Only deployed code has access
- Use “queries” rather than “bulk” finders
  - If finder would return a lot
  - Finder returns EJBObject, might swamp container pool
  - Query as Home method returning PKs
  - Can use as needed
  - Or set up finder to return “reasonable sized” sets
    - Like cursor

Design hints

- Entity Value Object
  - Serializable object representing state of Entity
  - Client can work with this rather than lots of remote calls (individual get/set methods)
  - Entity has getValue / setValue
- Consider where state is kept
  - Client (memory or HttpSession) *vs.* Stateful Session
- Session Bean methods to access groups of EJBs
  - Rather than all on the client
  - Allows control of logic, transactions, security, *etc.*

What’s New – EJB 2.1

- Expanded EJB-QL
  - Adds useful things SQL users are used to like ORDER BY, MIN, MAX, SUM, COUNT,*etc.*
- Timer Service
  - EJBs can get timed callbacks from container
- Web Services
  - Stateless Session Beans as Web Services endpoints
  - JAX-RPC

Summary

- Component Interface
  - Contract for the Component
  - Local and/or Remote
- Home Interface
  - Factory
  - Create, Find, etc.
- Implementation
  - Container Required Stuff
  - Your Code for Component and Home
- Deployment Descriptor

Book Recommendations

- Enterprise JavaBeans
  - Richard Monson-Haefel
- Mastering Enterprise JavaBeans
  - Ed Rowman, et. al.
  - www.theserverside.com
- Practical Java Programming Language Guide
  - Peter Haggar
- Effective Java Programming Language Guide
  - Joshua Bloch
- Mr. Bunny's Big Cup o' Java
  - Carlton Egremont III

Web References

- EJB Spec
  - http://java.sun.com/products/ejb/docs.html
  - Go ahead, it's only 572 pages
- J2EE API Docs
  - http://java.sun.com/j2ee/sdk_1.3/techdocs/api
- The Server Side
  - http://www.theserverside.com
  - News, Patterns, Discussion, Downloads, etc.

The End – Thank You

- Please fill out evaluations

- Example Code
  - On the conference CDROM
  - http://www.avitek.com/landers

dave.landers@4dv.net
dave.landers@bea.com

More Implementation…

- Container Callbacks – called on state changes
  - setSessionContext, setEntityContext, unsetEntityContext
  - ejbActivate, ejbPassivate
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