Case Study:
Big Lots Store Inventory Management

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Big Lots
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Agenda

- Introduction to Big Lots

- Project Overview

- Application Demo

- Technology Choices

- Technical Patterns

- Conclusions

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Company Overview

- Fortune 500 retailer founded in 1967

- ~1350 stores across the U.S.

- Closeout deals

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Case Study Project

- Store technology refresh initiative – "MARS"

  – Year 1 – point-of-sale hardware/software

  – **Year 2 – inventory management software**

    - Inventory Counts

    - Transfers

    - Item Inquiry

    - Inventory Adjustments

    - Trailer Reconciliation

    - Vendor Receiving and Returns

Project Constraints

- Tight deadlines driven by business needs

- User technology maturity

- Substantial bandwidth limitations from central office to the stores

- Need for "offline" support – store must function even if disconnected from corporate headquarters ("central office")

Applications Demo
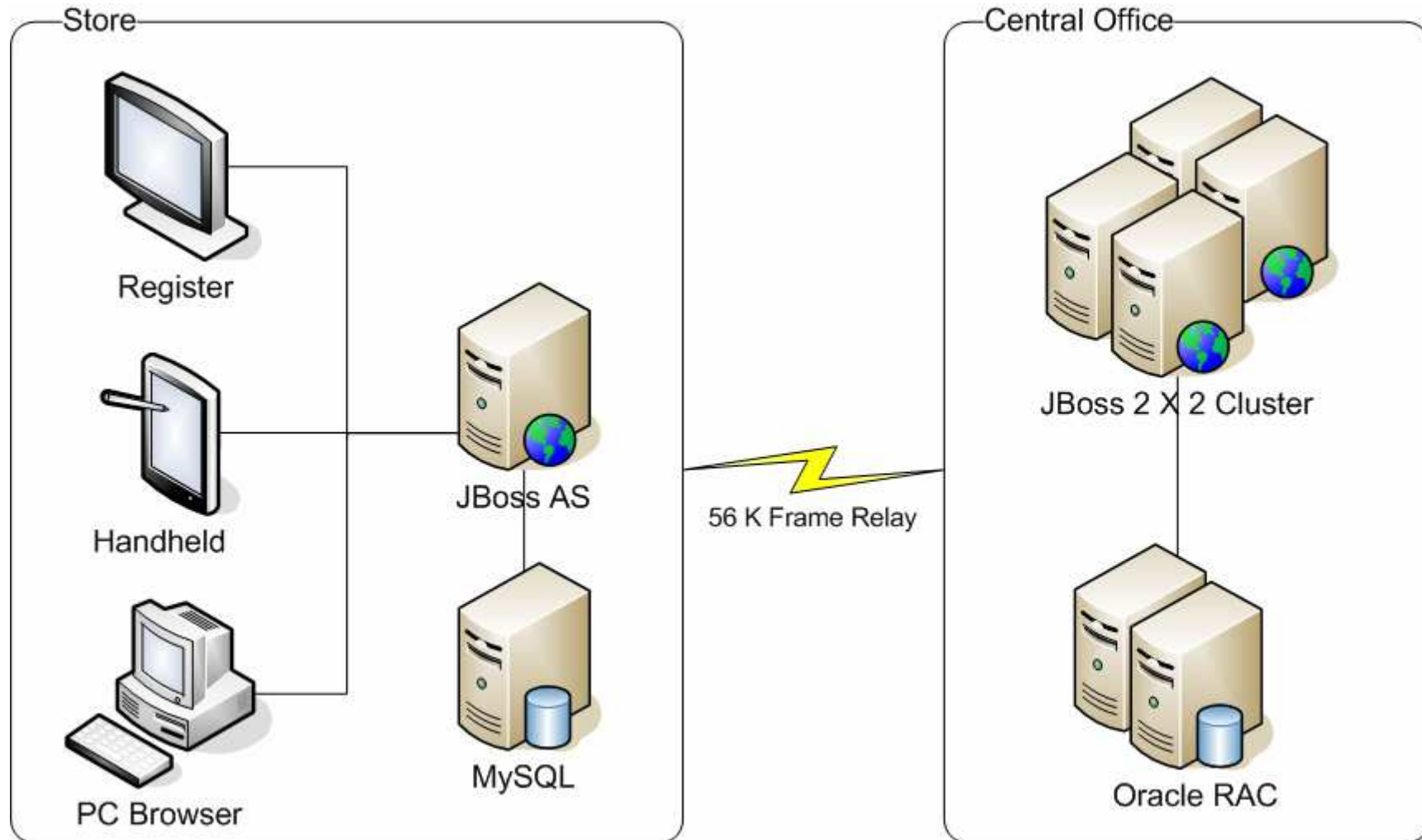
Architecture

Technical Choices

- Open Source

  - Flexibility

  - Transparency

  - Community support

  - Big Lots contribution – SymmetricDS.org

- JBoss (4.0.4)

  - Stability

  - Industry leading

  - Java5

  - Customizable stack

Technical Choices: Web Stack

- EJB3 (RC7) / JPA (1.0)
  - Industry standard
  - Java5
  - POJO
- JSF (1.2 RI)
  - Industry standard
  - Componentized
- Facelets (1.1.12)
  - !JSP
  - Easily viewable
  - Templating

- JBoss Seam (1.2)
  - Bridges gap between EJB3 and JSF
  - State management
  - Security
  - Integrates with almost everything

- Ajax4JSF (1.1.1) / RichFaces (3.0.1)
  - Rich user experience
  - Integration with Seam/JSF

Application Architecture - FASE

Facelet	**Entity**
Action **(POJO)**	**(POJO)**
Service **(EJB / JPA)**	
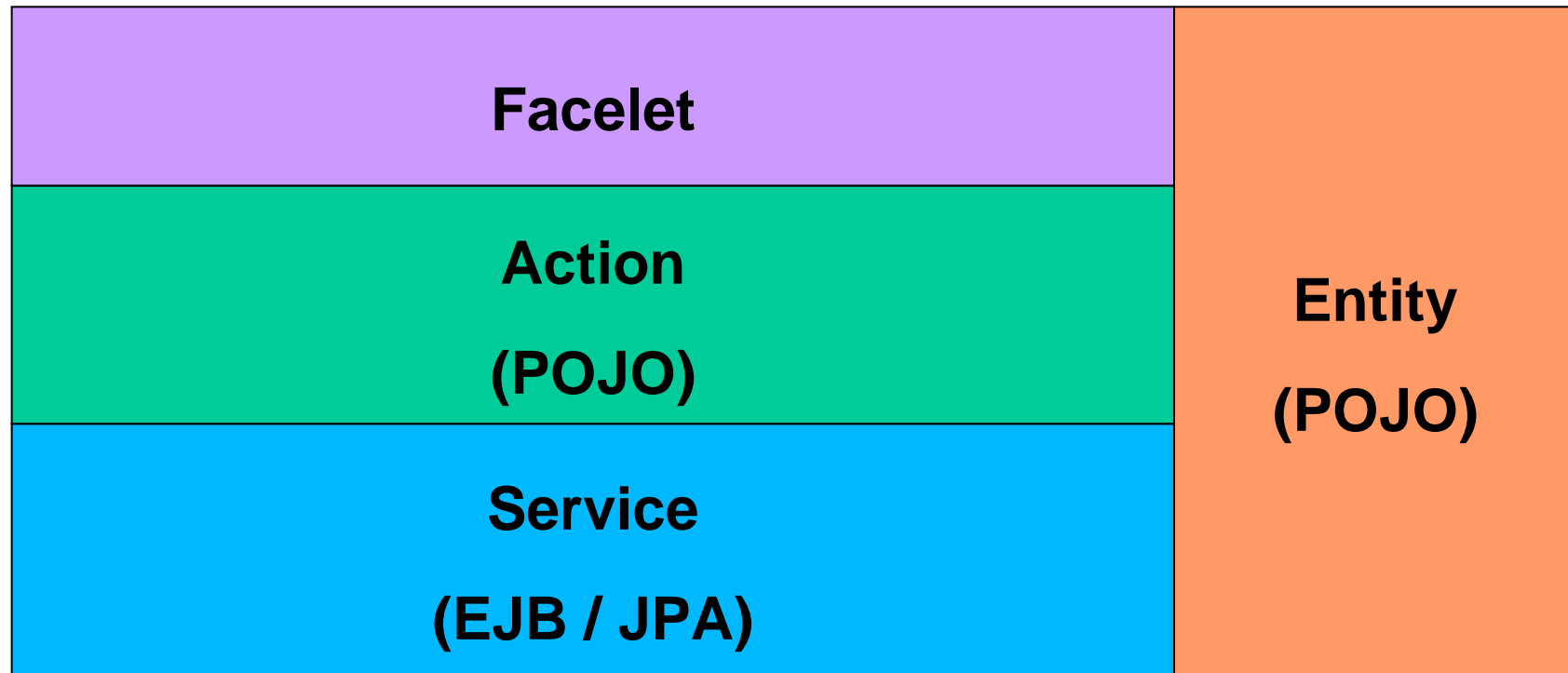
Technical Patterns Overview

- Infrastructure

- Devices

- Usability

- User Technology Maturity

Patterns: Infrastructure

How do we make authorization rules so simple even a manager can do it?

- Use JAAS
- Seam Security supports EL (`s:hasRole, s:hasPermission`)
  - Views
  - Components
  - Config files
- Content Organization
  - Split between protected/unprotected
  - Divided by domain
  - Matching `view-id` pattern simplified

Patterns: Infrastructure

How do we consistently implement Conversations?

- Transactional pages

  - `@Begin`

  - `@End`

  - `FlushModeType.MANUAL`

- Cleanup on abandonment?

  - `@Stateful` EJB3 - `@Destroy` inconsistently invoked

  - `@Destroy` needs to reinitialize `@In`'s for EJBs & POJOs

- Be aware of:

  - Lifecycle of `@In`-jected components

  - Conversation timeouts / synchronous requests

Patterns: Devices

How do we support a touch screen monitor?

- Maximize click areas

  - Links styled like buttons

  - Table cells/rows clickable with custom `dataTable` widget

- Font size and negative space reduces fat fingering

- Scrollable `modalPanel` and `dataTable`

Patterns: Devices

How do we support a handheld device with limited resources and no keyboard or mouse?

- Screen flow designed for

  - Stylus

  - Number pad

- Maximize use of JSF components, Minimize use of JavaScript

- Limit page size & number of components

- Extends .Net `WebBrowser` component

  - Maximizes screen size

  - Eliminates multiple clicks

  - Activates Barcode Scanner

Patterns: Devices

How do we deal with (very) large search results?

- Push "paging" to Service to limit resource usage
- Extend `java.util.List` and provide accessors to start index, page size and total record count.
- Use start index and page size to move the "cursor"
- Custom `dataTable` and `dataPager` implementation

Incoming	12/19/2007	DC Trailer Reconciliation	1970449770291	01/08/2008 12:31 PM
Incoming	12/19/2007	DC Trailer Reconciliation	2880449770197	01/08/2008 12:31 PM
Incoming	01/22/2008	Transfer In	Store To Store Transfer	01/22/2008 09:58 AM
Incoming	01/22/2008	Transfer In	Store To Store Transfer	01/22/2008 09:58 AM
Incoming	01/22/2008	Transfer In	Store To Store Transfer	01/22/2008 09:58 AM
Incoming	01/22/2008	Transfer In	Store To Store Transfer	01/22/2008 10:01 AM
Draft	01/22/2008	Store Counts	Store 04497 01/22/2008	01/22/2008 09:51 AM

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Patterns: Devices

How do we handle browser specific CSS or JavaScript?

- Separate files for browser specific behavior, styles

    - Dynamically loaded using JSF Function

    - `UserAgent` identifies browser

- Browser support is now modular

- Browser specific JavaScript is `@private` (e.g., `_myFunc()`)

Patterns Example: Item Inquiry Demo

Patterns: Usability

How do we provide user and developer friendly validation?

- Use Hibernate Validator annotations on Entities as well as Actions and supplement with inline business logic

- Extend Seam `UIDecorate`
    - Intercept `processDecodes(), processUpdates(), processValidators()`
    - Label attribute exposed for use in error messages

- Use Ajax4JSF to re-render
    - Labels
    - Messages
    - Styled input components
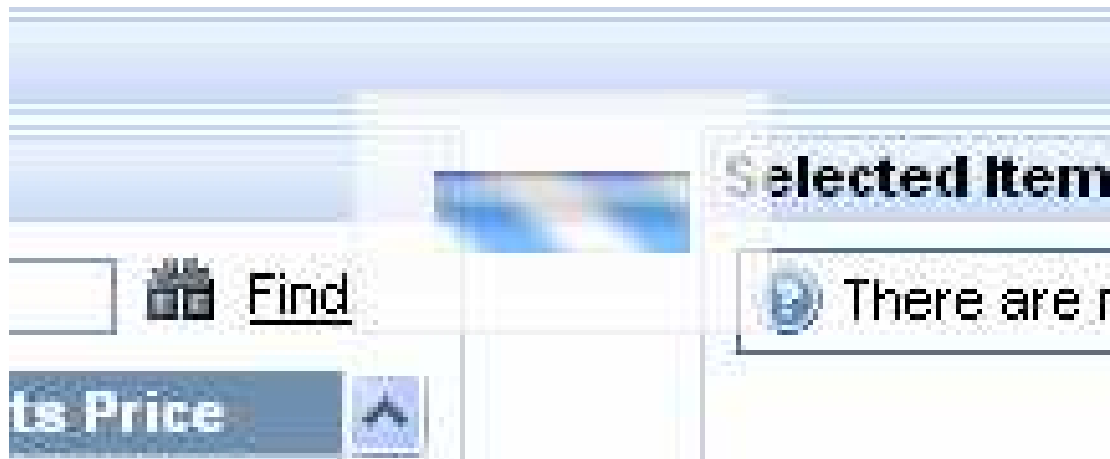
Patterns: Usability

How do we incorporate exception handling in a web application?

- Common exceptions handled in `pages.xml`

- Expected runtime exceptions handled in common Actions

- Unexpected exceptions handled in `error-page` servlet

  - JSF lifecycle invalid as soon as exception propagated from Java code

  - Captures error data

  - Redirect to JSF error page

Patterns: Usability

How do we work around time consuming operations?

- Render page quickly with available data
- Ajax4JSF `poll` kicks off time consuming operation
  - Fetched data merged by Actions and re-rendered
  - Refresh friendly

Patterns: Usability

How do we make an *Autocomplete* work like an HTML *Select*?

- Custom JSF component extends YUI `Autocomplete`

  - Accepts converters

    - Decouple the input value from the Entity key

  - Facets allow customization of `Autocomplete`

    - Headers

    - Footers

    - Labels

```
orl

Select a store name/number
00524 - ORLANDO, FL (EAST)
00954 - US COLD STORAGE
01481 - ORLANDO, FL
01678 - ORLANDO, FL.
01693 - SANFORD, FL
04175 - NEW ORLEANS, LA
04189 - NEW ORLEANS, LA
7 results
```

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Patterns Example: Item Inquiry Demo

Patterns: Users

How do we forgive a clickaholic / typeaholic?

- Act on most recent event, ignoring all unprocessed priors
- Ajax4JSF `eventQueue` & `requestDelay` almost, but not quite
- Custom `eventQueue` widget
  - Only handles last event
  - Events before delay are discarded
- Prevents
  - Multiple clicks
  - Simultaneous events on different widgets

Patterns: Users

How do we forgive transaction abandonment?

- 1ˢᵗ JSF component attaches `window.onbeforeunload` event

- 2ⁿᵈ JSF support component ignores `window.onbeforeunload` (e.g., Save, Next buttons)

- Traps

  - Window closing

  - Cancel buttons

  - Unintended Actions

Patterns: Users

How do we deal with confusing multi-window operation?

- `window.open()` problematic on touch screen
- RichFaces `modalPanel`
  - inline PDFs
  - wizards
- Page flow designed to be deterministic
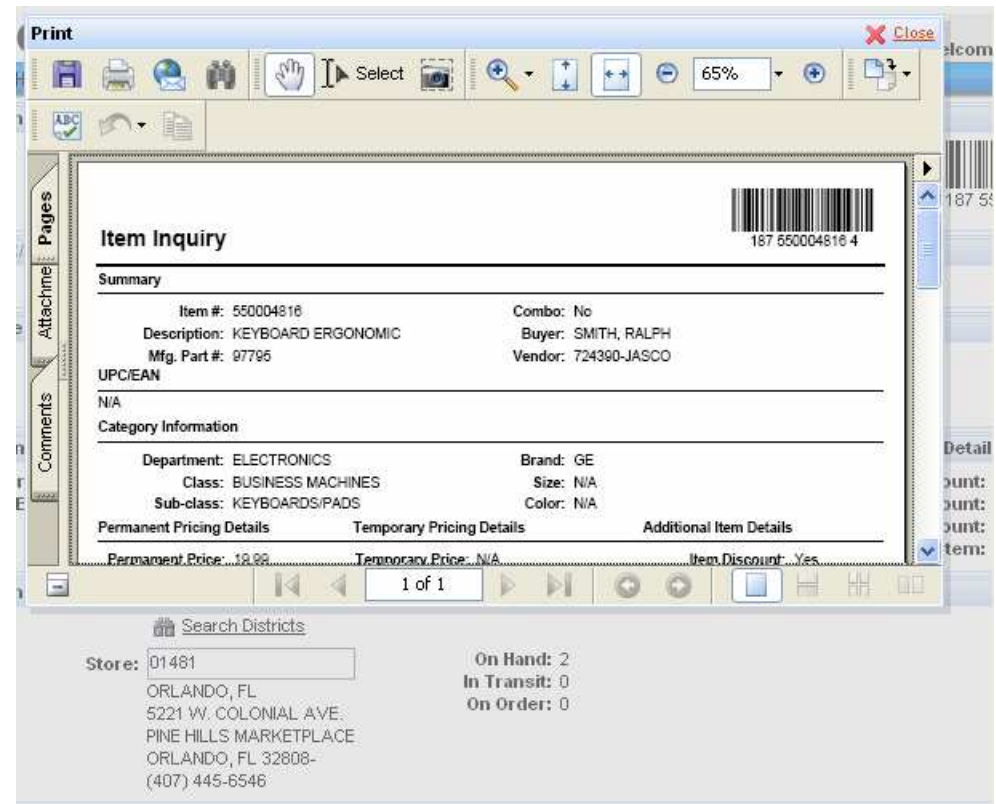
Wrap Up

- Successfully developed and deployed store inventory management applications

    - Currently used in 860+ stores nationwide

    - Full deployment expected during 2008

- Web development is challenging, but the right technology choices can ease the pain

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For further information ...

Links

- www.biglots.com

- www.symmetricds.org

- labs.jboss.com/jbossseam

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