



Case Study:
Big Lots Store Inventory Management

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Information Technology

Big Lots
Columbus, Ohio

Agenda

- Introduction to Big Lots
- Project Overview
- Application Demo
- Technology Choices
- Technical Patterns
- Conclusions

Company Overview

- Fortune 500 retailer founded in 1967
- ~1350 stores across the U.S.
- Closeout deals



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



Store Homepage
Home

Welcome, KEVIN @ Store 00320 [Logout](#)

Home Applications E-mail Documentation Print

Alerts

Description	Start Date/Time	End Date/Time
Welcome to JBoss World 2008.	01/13/2008 12:00 PM	02/15/2008 03:00 PM
iPhone donations welcome :)	01/13/2008 12:00 PM	02/15/2008 03:00 PM

Open To Do Items

Status	Date	Type	Description	Last Updated	Updated By
Incoming	12/11/2007	Transfer In	Store To Store Transfer	12/11/2007 07:34 AM	
Incoming	12/11/2007	Transfer In	Store To Store Transfer	12/11/2007 07:34 AM	
Incoming	12/11/2007	Transfer In	Store To Store Transfer	12/11/2007 07:34 AM	
Incoming	12/11/2007	Transfer In	Store To Store Transfer	12/11/2007 07:34 AM	
Incoming	12/11/2007	Transfer In	Store To Store Transfer	12/11/2007 07:34 AM	
Incoming	12/11/2007	Transfer In	Store To Store Transfer	12/11/2007 07:34 AM	
Incoming	12/11/2007	Transfer In	Store To Store Transfer	12/11/2007 07:34 AM	
Incoming	12/11/2007	Transfer In	Store To Store Transfer	12/11/2007 07:34 AM	
Incoming	12/11/2007	DC Trailer Reconciliation	1970032060438	12/11/2007 07:34 AM	
Incoming	12/11/2007	DC Trailer Reconciliation	1970032060337	12/11/2007 07:34 AM	
Incoming	12/11/2007	DC Trailer Reconciliation	1970032060335	12/11/2007 07:34 AM	
Incoming	12/11/2007	DC Trailer Reconciliation	1970032060270	12/11/2007 07:34 AM	
Incoming	12/11/2007	DC Trailer Reconciliation	1970032060163	12/11/2007 07:34 AM	
Incoming	12/11/2007	DC Trailer Reconciliation	1970032060162	12/11/2007 07:34 AM	
Incoming	12/11/2007	DC Trailer Reconciliation	1970032060161	12/11/2007 07:34 AM	
Incoming	12/11/2007	DC Trailer Reconciliation	1970032051260	12/11/2007 07:34 AM	
Incoming	12/11/2007	DC Trailer Reconciliation	1970032051259	12/11/2007 07:34 AM	
Incoming	12/11/2007	Vendor Receiving	UNITED SLEEP PROD		
Incoming	12/11/2007	Vendor Receiving	SOUTHERN HOME TEXTILES		
Incoming	12/11/2007	Vendor Receiving	SERTA		

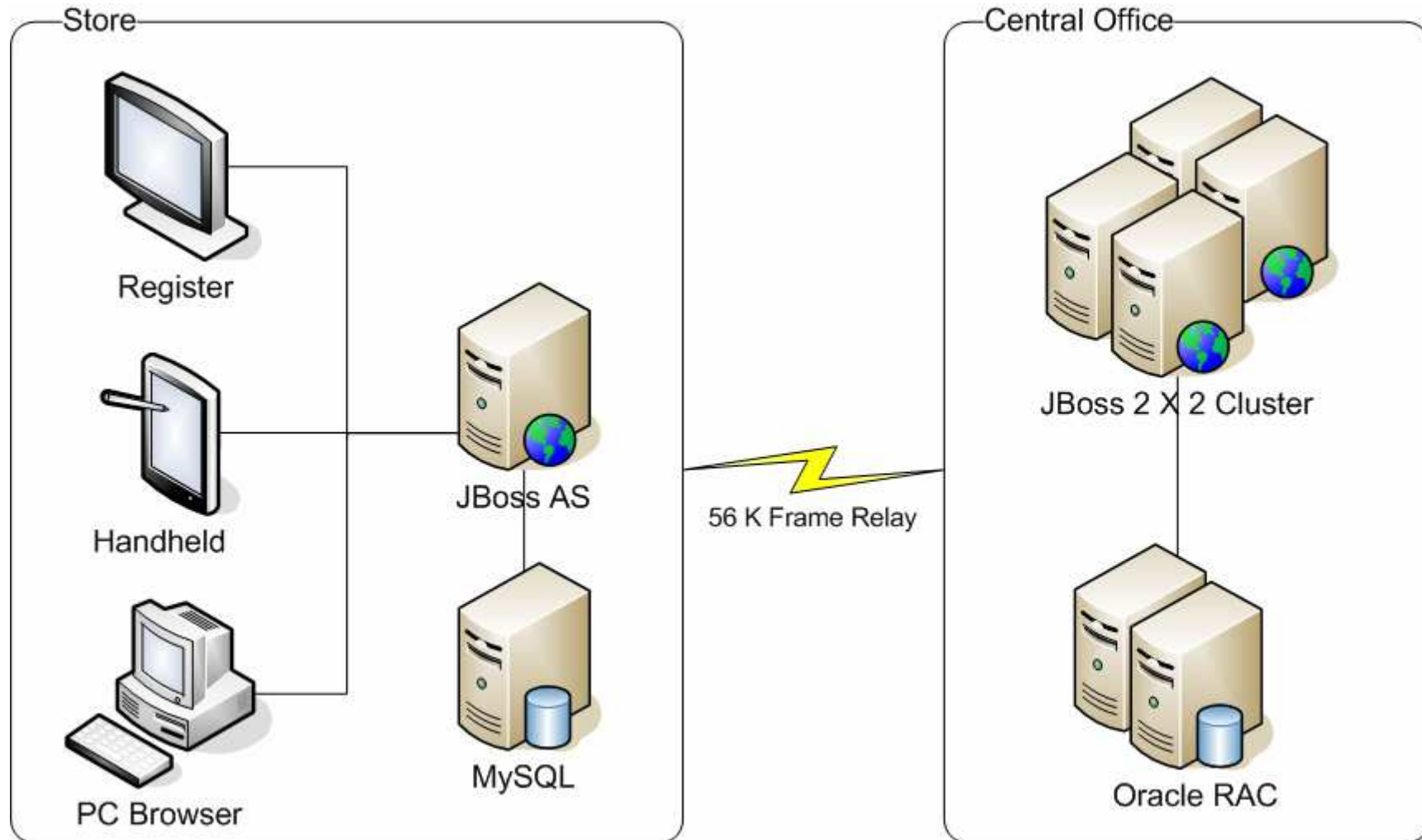
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Find a Store

Find



Architecture



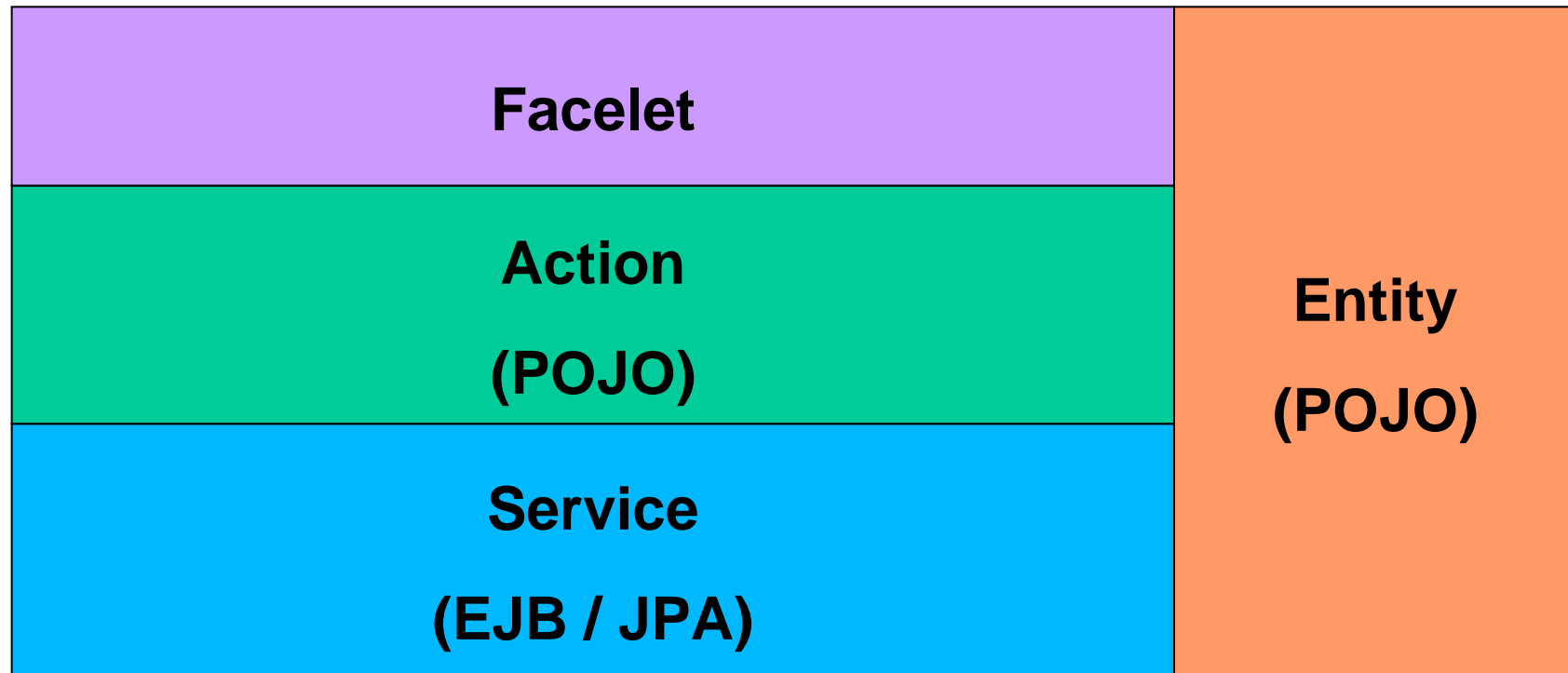
Technical Choices

- 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



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

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

BIG!LOTS Item Inquiry Find Item Logout
Welcome, KEVIN @ Store 00320

Home Applications E-mail Documentation Print

View By

Item: * mp3 Vendor: Department: Select One

Find Clear

Items


Item #	UPC/EAN	Description	Department	Mfg. Part #	Vendor	Perm Price ▼	Temp Price
550009237	N/A	MP3 156MB TUNER	550 ELECTR...	RC1090	THOMSON C...	49.99	
310004835	N/A	ESPRESS/CAPP MAKER PU...	310 APPLIA...	ECMP33	SUNBEAM CORP	39.99	
550008503	N/A	PERS CD MP3 45 SEC 2...	550 ELECTR...	MPD8400	HOPPER /...	29.99	
550008044	N/A	PORTABLE CD-MP3 PLAYE...	550 ELECTR...	C17H1343	ATICO INT...	29.99	
550008043	N/A	PORTABLE CD-MP3 PLAYE...	550 ELECTR...	C17H1311	ATICO INT...	29.99	
550007986	N/A	PORT CD AM/FM XTREME	550 ELECTR...	MP3838	HOPPER /...	29.99	
220005381	N/A	POWER INVERTER 350 WATT	220 AUTOMO...	PMP350	TEAM PROD...	29.99	
550010541	N/A	PORT CD BOOMBOX + CASS	550 ELECTR...	MP3223	HOPPER /...	25.88	
550010540	N/A	PORT CD BOOMBOX + CASS	550 ELECTR...	MP3207	HOPPER /...	25.88	
550010539	N/A	PORT CD BOOMBOX + CASS	550 ELECTR...	MP3225	HOPPER /...	25.88	
550010099	N/A	PORT CD/CASS	550 ELECTR...	MP3126	HOPPER /...	25.88	
550008264	N/A	PORT CD MP3 BOOMBOX	550 ELECTR...	MP3123	HOPPER /...	25.88	
550010538	N/A	PERS CD/MP3/WMA PLL	550 ELECTR...	MPD8600	HOPPER /...	24.99	
550010634	N/A	PERS CD 40/100 MP3	550 ELECTR...	HD8120	EMERSON R...	19.99	
550010576	N/A	PERS CD/MP3 SPORTS	550 ELECTR...	5CDMP455	CURTIS IN...	19.99	
550009156	N/A	PERS CD 60/80 MP3	550 ELECTR...	HD7288	EMERSON R...	19.99	
550009916	N/A	MP3 COMP/STEREO CABLE	550 ELECTR...	8000257	JASCO	7.99	
550010430	N/A	ADAPTER CABLE MP3 7	550 ELECTR...	97691	JASCO	4.99	
550010427	N/A	SILICON IPOD MP3 MINI...	550 ELECTR...	97560	JASCO	4.99	
550010426	N/A	SILICON IPOD MP3 SKIN	550 ELECTR...	97554	JASCO	4.99	

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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



Item is required.

View By

Item: * Vendor:

Item is required.

Patterns: Usability

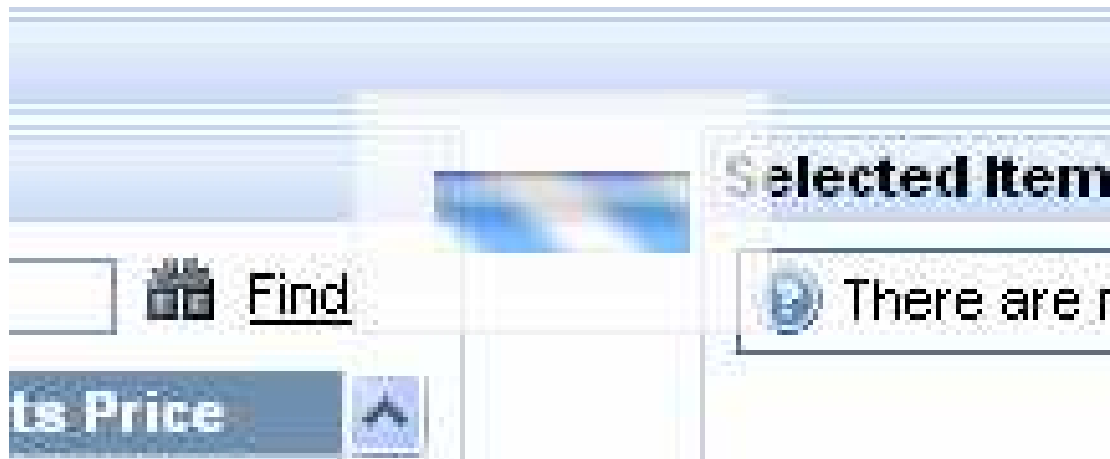
How do we incorporate exception handling in a web application?

- 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


Patterns Example: Item Inquiry

Demo

BIG!LOTS Item Inquiry / View Item
Welcome, KEVIN @ Store 00320 [Logout](#)

Home
Applications
E-mail
Documentation
Print

Summary

Item #: 110029744	Combo: No	 173 110029744 8
Description: POTTED MEAT 3 OZ	Buyer: HALASZ, KAI	
Mfg. Part #: 08594	Vendor: BIG LOTS #725930	

UPC/EAN


N/A

Category Information

Department: 110 FOOD	Brand: LIBBY'S
Class: CANNED PRODUCTS	Size: 3 OZ
Sub-class: MEAT	Color: N/A

Permanent Pricing Details	Temporary Pricing Details	Additional Item Details
Permanent Price: 0.33 Effective Date: 09/07/2000 Compare To: N/A	Temporary Price: N/A Effective Date: N/A End Date: N/A	Item Discount: Yes Employee Discount: Yes Store Count: No Inactive Item: No

Item Availability

 [Search Districts](#)

Store:

Select a store name/number

- 00524 - ORLANDO, FL (EAST)
- 00954 - US COLD STORAGE
- 01481 - ORLANDO, FL
- 01678 - ORLANDO, FL
- 01693 - SANFORD, FL

5 results

On Hand: 82

In Transit: 0

Order: 0

✖ Cancel

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

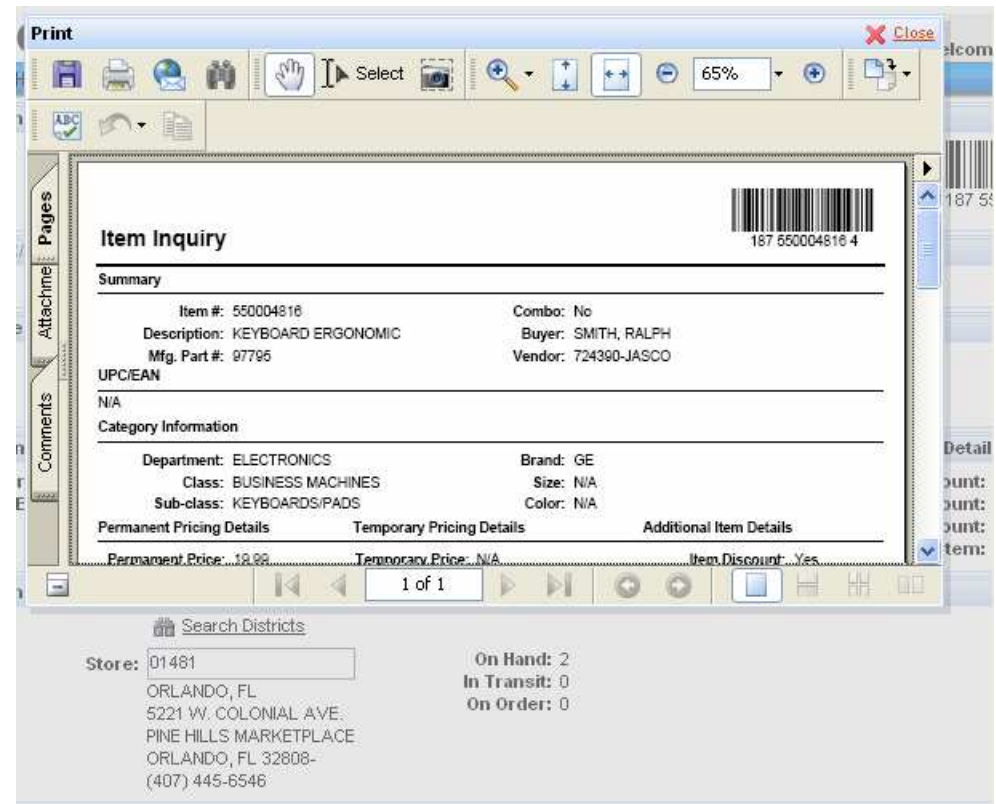
How do we forgive transaction abandonment?

- 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

For further information ...

Links

- www.biglots.com
- www.symmetricds.org
- labs.jboss.com/jbossseam

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