LSI's VMware vCenter Plug-In: A Study in the Use of Open Source Software

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LSI Corp
The goal for the presentation is to share our experience with open source in the hope that it will provide insight and guidance.
Bio – Brian Mason

- Staff Software Engineer at LSI
- Master in Computer Science
- 20+ years development experience
- Most of the past 11 developing Management and Control Software for hardware devices.
Bio – Erik Johannes

- Staff Software Engineer at LSI
- Master of Computer Science
- 25 years industry experience
- Variety industries including Storage, Telecommunications, and ATE.
Agenda

- **Brief Background**
  - What our group does
  - Architectural Overview of LSI vCenter plug-in
- **Options and Consideration**
  - Why Open Source?
  - Evaluation Criteria
- **Experience with Specific packages**
  - Runtime Open Source Libs
  - Development Tools
LSI’s Engenio Storage Group

- The Engenio Storage Group develops storage products:
  - Host Bus Adapters and Internal RAID controllers
  - NAS Gateways
  - External RAID systems
- Many of our products are sold through OEM partnerships.
LSI’s Application Aware Solutions

- The goal is to integrate with End User Applications
  - Management of our Storage Arrays.
  - Improve the efficient use of our Storage Arrays.
  - Provide a single pane of glass familiar to user.

- Integration examples are
  - Oracle’s Enterprise Manager.
  - Microsoft’s System Center Operations Manager.
  - VMware’s vCenter virtualization manager.
Management TLA Soup Defined

- Hyper Text Transport Protocol (HTTP/HTTPS)
- eXtensible Markup Language (XML)
- Distributed Management Task Force (DTMF)
- Common Information Model (CIM)
- Web-Based Enterprise Management (WBEM)
- Storage Management Initiative Specification (SMI-S)
- CIM Object Manager (CIMOM)
- Virtual Machine (VM)
- Virtual Infrastructure or VMWare Infrastructure (VI)
VMWare vCenter/vSphere
vSphere Plugin Integration

- The plugin is registered with the server
- Registration indicates where in the client to display plugin and the URL for the plugin
- Client display integration points include:
  - Additional Tab added to object’s display
  - Object’s right click menu items
  - An icon added to the home page
  - The entire display
- Recommend following VMWare UI guidelines
The vSphere Client
LSI’s vCenter plug-in Architecture
Agenda

- Brief Background
  - What our group does
  - Architectural overview of LSI vCenter plug-in

- Options and Considerations
  - Why open source?
  - Evaluation criteria

- Experience with specific packages
  - Runtime open source libs
  - Development tools
Why We Use Open Source

- Free as in Speech
  - Fast Bug fix turn around
  - Freedom to fix it ourselves
  - Nothing is hidden
  - Many testers
- Free as in Beer
  - Nothing is free, but often cheaper
  - Cost in Evaluation and Internal Support
- Often Best in Class
Evaluation Criteria

- Does it meet our needs?
- Can I compile it?
- **Is it an Active Community?**
  - Frequent / Current Releases
  - Active Wiki or mail group
- Is it standards based?
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- **Experience with Specific packages**
  - Runtime Open Source Libs
  - Development Tools
Runtime Open Source Libs

- Java
- Jetty
- SBLIM
- GWT And GWT Incubator
- The whole plug-in is written in Java
- The system is packaged as a Web Application
- Can be deployed on JEE Application Container
  - We shipped Jetty
- Used Java 6
- Used JMX for monitoring
- JSR 48 Compliant CIM Client (More later)
Java Development Advantages

- Familiar syntax makes for an easy transition.
- Object oriented.
- Lowers concerns about resource leaks.
- Massive library support
- Rich IDE Support
- Built in remote debugging and profiling
- Compiles very fast
Java Deployment Advantages

- Extremely stable
  - Has redefined P1 bugs
- Runs on all platforms we need
  - (AIX, HPUX, Solaris Windows, Linux, Mac)
- Single compile target for all platforms
- No DLL Issues
- Built in monitor via JMX
- Fast performance
Details System Architecture

Client

Server

HTML/CSS/ Java Script Generated Code

JSON/HTTP

JEE App Server (Jetty)

JMX MBeans

Plug-in Servlets

CIM/HTTP(s)

CIM Server

Symbol

LSI Storage Arrays

Java VM
Runtime Open Source Libs

- Java
- Jetty
- SBLIM
- GWT And GWT Incubator
Jetty

- Open Source “light weight” Web Server
- Java Web Application Container
  - Static HTML
  - Servlets / JSP
  - SSL
  - Many more …
- Pluggable Architecture
- Used as our App Server
## Tomcat Alternative

<table>
<thead>
<tr>
<th></th>
<th>Jetty (6.1.x)</th>
<th>Tomcat (6.x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory Footprint</td>
<td>28MB</td>
<td>38MB</td>
</tr>
<tr>
<td>(With our WAR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modular</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Servlet/JSP Support</td>
<td>2.5/2.1</td>
<td>2.5/2.1</td>
</tr>
<tr>
<td>Embeddable</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Runtime Open Source Libs

- Java
- Jetty
- SBLIM
- GWT And GWT Incubator
WBEM Stack

WBEM Client

CIM/XML

HTTP Transport

CIM Server

Provider

Provider
SBLIM Java Client

- Used as CIM client
- Has a 1.x and 2.x version streams
- 2.x (2.1.5 current)
  - Requires Java 5 or higher (Generics)
  - Implements JSR 48
- 1.x and 2.x NOT COMPATIBLE
  - Source package change for JSR 48
  - No known upgrade path
Why SBLIM

- Presents a CIM logical abstraction
  - CIM Instance
  - CIM Classes
  - Typed Key / Value Properties
  - Associations
- No XML Processing!!
- Supports indications
Logical CIM Functions in SBLIM

- Navigation
  - Enumerate Classes
  - Enumerate Instances
  - Enumerate Association Classes
  - Follow Associations

- Filtering
  - Filter Properties
  - Filter Instances returned by Associations
WBEMClient client = getClient();
CIMProperty prop;
CloseableIterator<CIMInstance> poolIt;
poolIt = client.associatorInstances(storageSystem,
   "CIM_HostedStoragePool", "CIM_StoragePool",
   "GroupComponent", null, false, null);
while (poolIt.hasNext()){
    CIMInstance poolInst = poolIt.next();
    prop = poolInst.getProperty("ElementName");
    String name = prop.getValue().toString();
    System.out.println(name);
}
poolIt.close();
Runtime Open Source Libs

- Java
- Jetty
- SBLIM
- GWT and GWT Incubator
Google Web Toolkit
Used for Developing Rich Internet Applications
A set of tools and libraries
Compiles Java to Java Script
- Supports a sub section of Java Language and Packages
- Allows for “Native” Java Script
Rich Debugging Both Client and Server Side
GWT Client Side

- GWT Abstracts JavaScript Details
  - Allows Programmer to work in Java
  - Avoids cross browser JavaScript Issues
- Does not protect against CSS Issues
public void onModuleLoad() {
    Label label = new Label("Hello, GWT!!!");
    Button button = new Button("Click me!");
    button.addClickHandler(new ClickHandler() {
        public void onClick(ClickEvent event) {
            label.setVisible(!label.isVisible());
        }
    });

    RootPanel.get().add(button);
    RootPanel.get().add(label);
}
GWT Server Communication

- The client side communicates with the server side
- Uses RPC to communicate with server over HTTP
- Easy to pass Java objects back and forth
- Has both Synchronous and Asynchronous
- Project Used Asynchronous
  - Nonblocking, call returns immediately
  - Callback is called with server response
Define the Interface

```java
public interface MyService extends RemoteService {
    public String myMethod(String s);
}
```

Server implements the Interface

```java
public class MyServiceImpl extends RemoteServiceServlet implements MyService {
    public String myMethod(String s) {
        // Do something interesting with 's' on the server.
        return s;
    }
}
```
Asynchrounous interface is used to make call

```java
interface MyServiceAsync {
    public void myMethod(String s,
                             AsyncCallback<String> callback);
}
```

- AsyncCallback<T> Interface
  - onSuccess(T result)
  - onFailure(Throwable caught)
The GWT Client call

MyServiceAsync myService = (MyServiceAsync)
    GWT.create(MyService.class);
AsyncCallback callback = new AsyncCallback() {
    public void onSuccess(String result) {
        // do some UI stuff to show success
    }
    public void onFailure(Throwable caught) {
        // do some UI stuff to show failure
    }
};
myService.myMethod("Hello There", callback);
Caution Notes with GWT

- CSS Issues
- 2.x has Widgets for both Quirks and Standard Mode
  - Widgets cannot be used together
  - No compile time check, just runtime weirdness
- Avoid modifying displayed tables
  - Very slow modifying displayed elements
  - Create New Elements and Replace
  - Much Worse in IE than others
GWT Incubator Project

- GWT has limited set of controls
- Incubator helps to fill out some of the gaps
- Use With Caution! It's not all cooked
- Includes
  - Tables, Panels, Status
  - Validation Library
  - Logging Library
  - Graphics Library
- We have used Tables and Logging
## GWT Incubator Paging Scroll Table

- **View only critical events**
- **Retrieve the most recent events:**
  - 2000
  - Update

<table>
<thead>
<tr>
<th>Index</th>
<th>Sequence</th>
<th>Date/Time</th>
<th>Priority</th>
<th>Component Type</th>
<th>Component Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25509</td>
<td>9/18/10 2:39:11 PM</td>
<td>1</td>
<td>Volume</td>
<td>Volume Excursion_datastore1_173-174</td>
<td>Media scan (scrub) resumed</td>
</tr>
<tr>
<td>1</td>
<td>25508</td>
<td>9/18/10 2:39:10 PM</td>
<td>1</td>
<td>Volume</td>
<td>Volume Excursion_datastore1_173-174</td>
<td>Media scan (scrub) completed</td>
</tr>
<tr>
<td>2</td>
<td>25507</td>
<td>9/18/10 2:39:10 PM</td>
<td>1</td>
<td>Controller</td>
<td>Tray 85, Slot 2</td>
<td>Alternate controller checked in late</td>
</tr>
<tr>
<td>3</td>
<td>25506</td>
<td>9/18/10 2:38:07 PM</td>
<td>1</td>
<td>Controller</td>
<td>Tray 85, Slot 1</td>
<td>Start-of-day routine completed</td>
</tr>
<tr>
<td>4</td>
<td>25505</td>
<td>9/18/10 2:37:53 PM</td>
<td>1</td>
<td>Battery Pack</td>
<td>Tray 85, Controller 1, Slot 1</td>
<td>Controller cache battery is fully charged</td>
</tr>
<tr>
<td>5</td>
<td>25504</td>
<td>9/18/10 2:37:53 PM</td>
<td>1</td>
<td>Battery Pack</td>
<td>Tray 85, Controller 1, Slot 1</td>
<td>Battery replaced</td>
</tr>
<tr>
<td>6</td>
<td>25503</td>
<td>9/18/10 2:37:53 PM</td>
<td>1</td>
<td>Controller Firmware</td>
<td>None</td>
<td>Premium feature enabled</td>
</tr>
<tr>
<td>7</td>
<td>25502</td>
<td>9/18/10 2:37:53 PM</td>
<td>1</td>
<td>Controller Firmware</td>
<td>None</td>
<td>Premium feature enabled</td>
</tr>
<tr>
<td>8</td>
<td>25501</td>
<td>9/18/10 2:37:53 PM</td>
<td>1</td>
<td>Controller Firmware</td>
<td>None</td>
<td>Premium feature enabled</td>
</tr>
<tr>
<td>9</td>
<td>25500</td>
<td>9/18/10 2:37:53 PM</td>
<td>1</td>
<td>Controller Firmware</td>
<td>None</td>
<td>Premium feature enabled</td>
</tr>
<tr>
<td>10</td>
<td>25599</td>
<td>9/18/10 2:37:53 PM</td>
<td>1</td>
<td>Controller Firmware</td>
<td>None</td>
<td>Premium feature enabled</td>
</tr>
<tr>
<td>11</td>
<td>25598</td>
<td>9/18/10 2:37:55 PM</td>
<td>1</td>
<td>Controller</td>
<td>Tray 85, Slot 1</td>
<td>Management port link up</td>
</tr>
<tr>
<td>12</td>
<td>25597</td>
<td>9/18/10 2:37:54 PM</td>
<td>1</td>
<td>Controller</td>
<td>Tray 85, Slot 1</td>
<td>Controller reset</td>
</tr>
<tr>
<td>13</td>
<td>25596</td>
<td>9/18/10 2:37:38 PM</td>
<td>1</td>
<td>Channel</td>
<td>Host-side: controller in slot A, port 4</td>
<td>Fibre channel Link up</td>
</tr>
<tr>
<td>14</td>
<td>25595</td>
<td>9/18/10 2:37:38 PM</td>
<td>1</td>
<td>Channel</td>
<td>Host-side: controller in slot A, port 3</td>
<td>Fibre channel Link up</td>
</tr>
<tr>
<td>15</td>
<td>25594</td>
<td>9/18/10 2:37:37 PM</td>
<td>1</td>
<td>Controller SFP</td>
<td>Tray 100, Slot 0</td>
<td>Host side sfp optimal</td>
</tr>
<tr>
<td>16</td>
<td>25593</td>
<td>9/18/10 2:37:37 PM</td>
<td>1</td>
<td>Channel</td>
<td>Host-side: controller in slot A, port 4</td>
<td>Fibre channel Link down</td>
</tr>
</tbody>
</table>
Open Source Tools

- **IDE**
  - Eclipse
  - Netbeans
  - Both have GWT & SVN plug-ins
  - Why Use Both?

- **Build and Integration**
  - ANT
  - Junit
  - Hudson
ANT and JUnit

- ANT replacement for make
  - More Powerful
  - Extensible
- JUnit is Unit Test Framework
- Both deserve a separate presentation
Hudson

- Continuous Build Server
- Monitors VCS for changes
  - Checks out code
  - Builds code/run tests
  - Publishes results
- plug-in Architecture
  - Works with many VCS
  - Integrates with many build systems
- Is Java, but builds anything. (We do Java and C++)
Hudson Dashboard

Dashboard [Hudson] - Mozilla Firefox

Hudson

New Job
Manage Hudson
People
Build History

Build Queue
No builds in the queue.

Build Executor Status

<table>
<thead>
<tr>
<th>#</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Idle</td>
</tr>
<tr>
<td>2</td>
<td>Idle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Job</th>
<th>Last Success</th>
<th>Last Failure</th>
<th>Last Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCSF MMC</td>
<td>1 day 22 hr (#247)</td>
<td>N/A</td>
<td>15 sec</td>
</tr>
<tr>
<td>fcmaagent</td>
<td>6 mo 4 days (#306)</td>
<td>N/A</td>
<td>3 min 45 sec</td>
</tr>
<tr>
<td>fcminstaller</td>
<td>7 mo 3 days (#12)</td>
<td>7 mo 3 days (#8)</td>
<td>1 min 6 sec</td>
</tr>
<tr>
<td>fcmsim</td>
<td>7 mo 3 days (#26)</td>
<td>N/A</td>
<td>0.7 sec</td>
</tr>
<tr>
<td>KeyGenerator</td>
<td>3 mo 25 days (#102)</td>
<td>3 mo 25 days (#100)</td>
<td>5.9 sec</td>
</tr>
<tr>
<td>LsiMirroredVolume</td>
<td>1 day 21 hr (#131)</td>
<td>N/A</td>
<td>54 sec</td>
</tr>
<tr>
<td>sanmodel</td>
<td>5 mo 28 days (#15)</td>
<td>N/A</td>
<td>35 sec</td>
</tr>
<tr>
<td>vcenter2</td>
<td>2 days 3 hr (#468)</td>
<td>N/A</td>
<td>5 min 54 sec</td>
</tr>
</tbody>
</table>
Hudson Project Screen
## Would we use it Again?

<table>
<thead>
<tr>
<th>Tool</th>
<th>Use it again</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java</td>
<td>Yes</td>
</tr>
<tr>
<td>ANT</td>
<td>Yes</td>
</tr>
<tr>
<td>Junit</td>
<td>Yes</td>
</tr>
<tr>
<td>SBLIM</td>
<td>Yes</td>
</tr>
<tr>
<td>GWT</td>
<td>Maybe</td>
</tr>
<tr>
<td>Jetty</td>
<td>Yes</td>
</tr>
<tr>
<td>Hudson</td>
<td>Yes</td>
</tr>
</tbody>
</table>
QA
Reference Links

- [http://code.google.com/webtoolkit/](http://code.google.com/webtoolkit/)
- [http://code.google.com/p/google-web-toolkit-incubator/](http://code.google.com/p/google-web-toolkit-incubator/)