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Multi-language JDI? You're Joking, Right?

Jim Laskey
Multi-language Lead
Java Language and Tools Group

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Why?

- Talk server as a discussion point for MLVM Language debugging.
- Print statements are a pain.
- Debugging infrastructure is already there.
  - JPDA works for Java.
  - IDEs already understand JPDA well.
- Server side remote debugging (Node.jar)

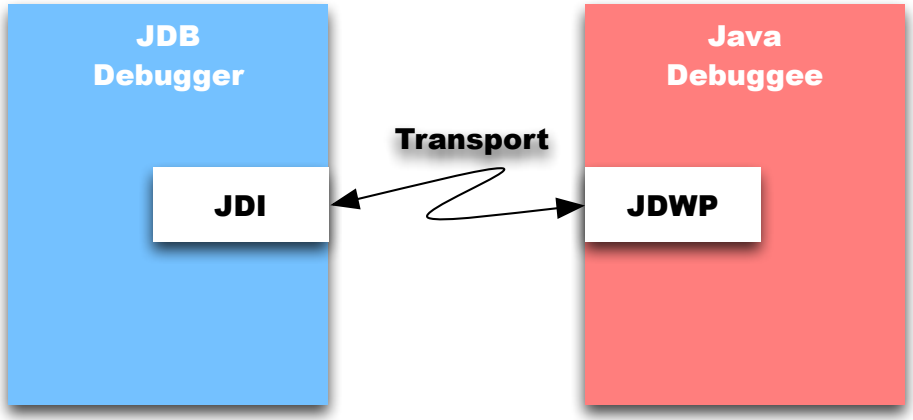
Agenda

- JPDA, JDWP and JDI
- Framework For Multi-Language Debugging
- Specific Examples In Nashorn
- Demo
- Multi-Language JDI?
- Q & A

JPDA, JDWP and JDI

JPDA, JDWP and JDI

- JPDA - Java Platform Debugger Architecture
- JDWP - Java Debug Wire Protocol
- JDI - Java Debugger Interface
  - http://docs.oracle.com/javase/7/docs/jdk/api/jpda/jdi/index.html



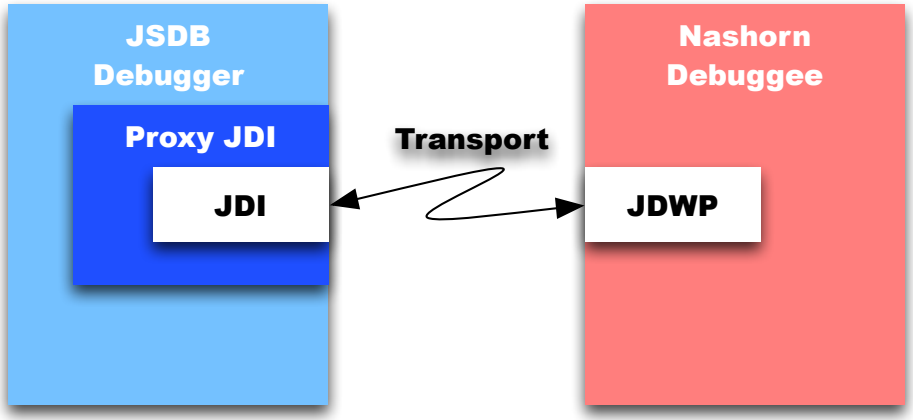
What does JDI do?

- Manage the connection to the debuggee.
  - Connection
    - Sockets
    - Shared memory (Windows)
    - Launch/Attachment
- Sends requests to debuggee.
  - Setting breakpoints
  - Stepping
  - View stacks, frames, objects
- Receives events from debuggee.
  - Class loaded
  - Breakpoint hit
  - Value of objects

Framework For Multi-Language Debugging

Virtualized View Our World Via A Proxy JDI

- Have the proxy connect to Java JDI and transform requests and events.
- Wrap JDI objects in mirroring proxy objects.



VirtualMachine Object

- Abstraction of the (remote) VM.
  - Handles “reflection”-like requests to the debuggee VM.
- Object factory.
  - interns objects.

```
public class NashornJDIVirtualMachine extends NashornJDIMirror
                                       implements VirtualMachine {
```

Mirroring of JDI objects

```
public class NashornJDIMirror implements Mirror {
    private final NashornJDIVirtualMachine nashornvm;
    private final Mirror underlying;

    public NashornJDIMirror(NashornJDIVirtualMachine nashornvm,
                            Mirror underlying)...

    protected NashornJDIVirtualMachine virtualMachine() ...
    protected Mirror underlying()...
}
public class NashornJDIObject extends NashornJDIMirror
                              implements JDIObject {
  ...
  public Object request(Object args...) {
      return underlying().request(virtualMachine(), args);
  }
}
```

Example StackFrame

```
public class NashornJDIStackFrame extends NashornJDIMirror
                                   implements StackFrame {

    public NashornJDIStackFrame(NashornJDIVirtualMachine nashornvm,
                                StackFrame underlying) {
        super(nashornvm, underlying);
    }
...
    public void setValue(LocalVariable local, Value value)
                throws InvalidTypeException, ClassNotLoadedException {
        underlying().setValue(NashornJDIWrapper.unwrap(local),
                              NashornJDIWrapper.unwrap(value));
    }
...
}
```

JDI Object Wrapping/Unwrapping

```
public class NashornJDIWrapper {
...
    public static NashornJDIField wrap(
                NashornJDIVirtualMachine nashornvm,
                Field field) {
        return (field == null)? null : nashornvm.field(field);
    }
...
}
public class NashornJDIVirtualMachine extends NashornJDIMirror
implements VirtualMachine {
...
    protected NashornJDIField field(Field field) {
        return new NashornJDIField(this, field);
    }
...
}
```

Specific Examples In Nashorn

Nashorn Needs

- Debug JavaScript
  - Make JavaScript objects look like classes
  - Make properties look like Java fields
  - Map source code (not always from a file)
  - Make functions look like Java methods
  - Make internal types look like Java values
  - Ignore runtime support when stepping and stack crawls
- Flavours (consideration)
  - JavaScript only
  - JavaScript into Java code
  - Java with JavaScript objects

Make Nashorn objects look like Java objects

```
public static NashornJDIObjectReference
    wrap(NashornJDIVirtualMachine nashornvm, ObjectReference ref) {
        ...
        if (nashornvm.isScriptObjectType(classType)) {
            return new NashornJDINashornObjectReference(nashornvm,
                                                        ref);
        ...
 }
```

...Make Nashorn objects look like Java objects

```
public boolean isScriptObjectType(NashornJDIClassType subClass) {
    return subclassOf(subClass, nashornScriptObjectType());
}
... //NashornJDIVirtualMachine
public static final String NASHORNJDI_SCRIPTOBJECT_TYPE_NAME =
                           "com.oracle.nashorn.runtime.ScriptObject";
private NashornJDIClassType nashornScriptObjectType;
public synchronized NashornJDIClassType nashornScriptObjectType() {
    if (nashornScriptObjectType == null) {
        List<ReferenceType> refTypes =
                    classesByName(NASHORNJDI_SCRIPTOBJECT_TYPE_NAME);
        nashornScriptObjectType = refTypes.isEmpty() ? null :
                                  (NashornJDIClassType) refTypes.get(0);
    }
    return nashornScriptObjectType;
}
```

Make Nashorn properties look like Java fields

```
    } else if (nashornvm.isPropertyMapType(classType)) {
        return new NashornJDINashornPropertyMap(nashornvm, ref);
    } else if (nashornvm.isPropertyType(classType)) {
        return new NashornJDINashornProperty(nashornvm, ref);
...

public class NashornJDINashornObjectReference extends
             NashornJDIObjectReference implements ObjectReference {
    ...
    public NashornJDINashornPropertyMap getMap() {
        return (NashornJDINashornPropertyMap)getFieldValue("map");
    }
    ...
    public List<NashornJDINashornProperty> getMapProperties() {
        return getMap().getProperties();
    }
```

...Make Nashorn properties look like Java fields

```
public class NashornJDINashornObjectReference extends
...
    public NashornJDIValue get(NashornJDINashornProperty property) {
        return invokeMethod("get", property.invokeMethod("getKey"));
    }
...
    public void set(NashornJDINashornProperty property,
                    NashornJDIValue value) {
        invokeMethod("set", property.invokeMethod("getKey"),
                             value);
    }
...
}
```

Map source code

- Source can come from an url or an eval.
- Can’t just read from class name or source
- Need to invoke a request to runtime to get the source.

```
String filename = loc.sourceName();
if (filename.endsWith(".js") || filename.endsWith("<eval>")) {
    ReferenceType scriptType = loc.declaringType();
    Field sourceField = scriptType.fieldByName("source");
    ObjectReference source =
                  (ObjectReference)scriptType.getValue(sourceField);
    ClassType sourceType = (ClassType)source.type();
    Method getStringMethod =
                   sourceType.methodsByName("getString").get(0);
    StringReference sourceStringReference =
    (StringReference)source.invokeMethod(currentThread.getThread(),
                          getStringMethod, new ArrayList<Value>(),
                          ClassType.INVOKE_SINGLE_THREADED);
    String sourceString = sourceStringReference.value();
```

Make Nashorn functions look like Java methods

- Nothing required since source maps through line number tables.
  - Nashorn's tokens track source position.
- Frame values can be access thru LocalVariables.
  - Another form of property in Nashorn.

```
public NashornJDIValue getValue(LocalVariable local) {
    if (local instanceof NashornJDINashornLocalProperty) {
        NashornJDINashornLocalProperty localProperty =
                                (NashornJDINashornLocalProperty)local;
        return localProperty.getScope().get(localProperty);
    }
    return NashornJDIWrapper.wrap(virtualMachine(),
            underlying().getValue(NashornJDIWrapper.unwrap(local)));
}
```

Ignore runtime support

```
public class NashornJDIEventRequestManager extends NashornJDIMirror
                                        implements EventRequestManager {
...
// same for createMethodExitRequest and createStepRequest
public NashornJDIMethodEntryRequest createMethodEntryRequest() {
    NashornJDIMethodEntryRequest request =
                        NashornJDIEventRequest.wrap(virtualMachine(),
                            underlying().createMethodEntryRequest());
    if (virtualMachine().nashornCodeOnly) {
        request.addClassFilter("com.oracle.nashorn.scripts.*");
    }
    return request;
}
```

Ignore runtime support

```
request.addClassExclusionFilter("com.oracle.nashorn.api.*");
request.addClassExclusionFilter("com.oracle.nashorn.codegen.*");
request.addClassExclusionFilter("com.oracle.nashorn.ir.*");
request.addClassExclusionFilter("com.oracle.nashorn.objects.*");
request.addClassExclusionFilter("com.oracle.nashorn.parser.*");
request.addClassExclusionFilter("com.oracle.nashorn.runtime.*");
request.addClassExclusionFilter("com.oracle.nashorn.tools.*");
```

DEMO

Multi-Language JDI?

Multi-Language JDI?

- Is there a demand for it?
- Boiler plate
- MOP(Dynalink)-like based JDWP?

- Debugging MethodHandles/Lambdas?

Boiler Plate

- Providing a stripped down boiler plate.
  - s/xyzzyx/myStuff/
  - s/Xyzzyx/MyStuff/
  - mv XyzzyxJDI??? MyStuffJDI???

http://wiki.jvmlangsummit.com/Multi-language_JDI%3F_You%27re_Joking,_Right%3F

Hooking Up An IDE

- Adding a layer on top of your version of the JDI.
- http://bits.netbeans.org/dev/javadoc/org-netbeans-api-debugger/index.html
- http://confluence.jetbrains.net/display/IDEADEV/PluginDevelopment

Contact

Jim Laskey

james.laskey@oracle.com

Q & A

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Q&A