




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

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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

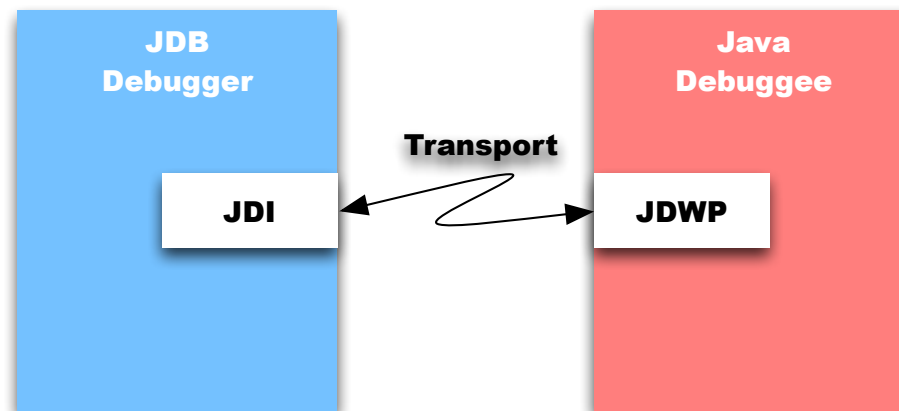
- JPDA, JDWP and JDI
- Framework For Multi-Language Debugging
- Specific Examples In Nashorn
- Demo
- Multi-Language JDI?
- Q & A



# 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

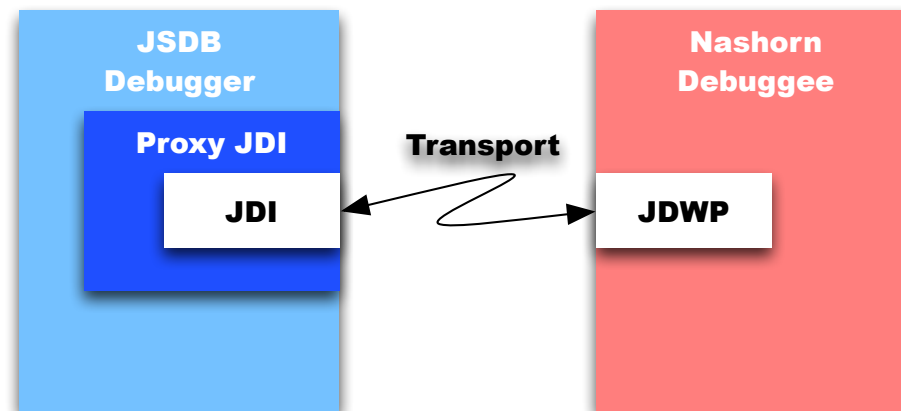


# Framework For Multi-Language Debugging



## 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???
- Contact me.
-

## 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

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# Q & A



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# Q&A