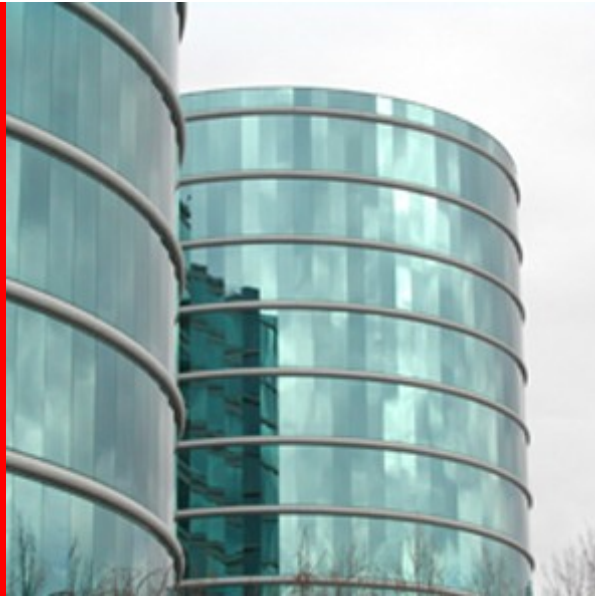


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JDK7 The Future of The Java Platform

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Technology Evangelist

JDK 7 Features

- Language
 - Annotations on Java types
 - Small language changes (Project Coin)
 - Modularity (JSR-294)
- Core
 - Modularisation (Project Jigsaw)
 - Concurrency and collections updates
 - More new IO APIs (NIO.2)
 - Additional network protocol support
 - Elliptic curve cryptography
 - Unicode 5.1

JDK 7 Features

- VM
 - Compressed 64-bit pointers
 - Garbage-First GC
 - Support for dynamic languages (Da Vinci Machine project)
- Client
 - Forward port Java SE6 u10 features
 - XRender pipeline for Java 2D



Modularity

Project Jigsaw

Size Matters

- JDK is big, really big
 - JDK 1.x – 7 top level packages, 200 classes
 - JDK 6 – 47 top level packages, over 4000 classes
 - About 12MB today
- Historical baggage
 - Build as a monolithic software system
- Problems
 - Download time, startup time, memory footprint, performance
 - Difficult to fit platform to newer mobile device
 - CPU capable, but constrained by memory
- Current solution – use JDK 6u10
 - Kernel installer, quick startup feature
 - More like a painkiller, not the antidote

New Module System for Java

- JSR-294 Improved Modularity Support in the Java Programming Language
- Requirements for JSR-294
 - Integrate with the VM
 - Integrate with the language
 - Integrate with (platform's) native packaging
 - Support multi-module packages
 - Support “friend” modules
- Open JDK's Project Jigsaw
 - Reference implementation for JSR-294
 - openjdk.java.net/projects/jigsaw
 - Can have other type of module systems based on OSGi, IPS, Debian, etc.

Modularizing Your Code

`planetjdk/src/`

`org/planetjdk/aggregator/Main.java`



Modularize

`planetjdk/src/`

`org/planetjdk/aggregator/Main.java`

`module-info.java`

module-info.java

```
module org.planetjdk.aggregator {  
    system jigsaw;  
    requires module jdom;  
    requires module tagsoup;  
    requires module rome;  
    requires module rome-fetcher;  
    requires module joda-time;  
    requires module java-xml;  
    requires module java-base;  
    class org.planetjdk.aggregator.Main;  
}
```

Module name

Module system

Dependencies

Main class

Module Versioning

```
module org.planetjtdk.aggregator @ 1.0 {  
    system jigsaw;  
    requires module jdom @ 1.*;  
    requires module tagsoup @ 1.2.*;  
    requires module rome @ =1.0;  
    requires module rome-fetcher @ =1.0;  
    requires module joda-time @ [1.6,2.0];  
    requires module java-xml @ 7.*;  
    requires module java-base @ 7.*;  
    class org.planetjtdk.aggregator.Main;  
}
```



Small (Language) Changes

Project Coin

“Why don't you add X to Java?”

- Assumption is that adding features is always good
- Application
 - Application competes on the basis of completeness
 - User cannot do X until application supports it
 - Features rarely interacts “intimately” with each other
 - Conclusion: more features are better
- Language
 - Languages (most) are Turing complete
 - Can always do X; question is how elegantly
 - Features often interact with each other
 - Conclusion: fewer, more regular features are better

Adding X To Java

- Must be compatible with existing code
 - assert and enum keywords breaks old code
- Must respect Java's abstract model
 - Should we allowing padding/aligning object sizes?
- Must leave room for future expansion
 - Syntax/semantics of new feature should not conflict with syntax/semantics of existing and/or potential features
 - Allow consistent evolution

Changing Java Is Really Hard Work

- Update the Java Language Specification
- Implement it in the compiler
- Add essential library support
- Write test
- Update the VM specs
- Update the VM and class file tools
- Update JNI
- Update reflection APIs
- Update serialization support
- Update javadoc output

Better Integer Literals

- Binary literals

```
int mask = 0b1010;
```

- With underscores

```
int bigMask = 0b1010_0101;
```

```
long big = 9_223_783_036_967_937L;
```

- Unsigned literals

```
byte b = 0xffu;
```

Better Type Inference

```
Map<String, Integer> foo =  
    new HashMap<String,  
Integer>();
```

```
Map<String, Integer> foo =  
    new HashMap<>();
```

Strings in Switch

- Strings are constants too

```
String s = ...;  
switch (s) {  
    case "foo":  
        return 1;  
  
    case "bar":  
        Return 2;  
  
    default:  
        return 0;  
}
```

Resource Management

- Manually closing resources is tricky and tedious

```
public void copy(String src, String dest) throws IOException {  
    InputStream in = new FileInputStream(src);  
    try {  
        OutputStream out = new FileOutputStream(dest);  
        try {  
            byte[] buf = new byte[8 * 1024];  
            int n;  
            while ((n = in.read(buf)) >= 0)  
                out.write(buf, 0, n);  
        } finally {  
            out.close();  
        }  
    } finally {  
        in.close();  
    }  
}}
```

Automatic Resource Management

```
static void copy(String src, String dest)
    throws IOException {
    try (InputStream in = new FileInputStream(src);
        OutputStream out = new FileOutputStream(dest)) {
        byte[] buf = new byte[8192];
        int n;
        while ((n = in.read(buf)) >= 0)
            out.write(buf, 0, n);
    }
    //in and out closes
}
```

Index Syntax for Lists and Maps

```
List<String> list =  
    Arrays.asList(new String[] {"a", "b", "c"});  
String firstElement = list[0];
```

```
Map<Integer, String> map = new HashMap<>();  
map[1] = "One";
```


Multi Catch (Maybe Back in JDK7)

```
try { ...  
} catch (InvalidClassException e) { foo(); }  
} catch (InvalidObjectException e) { foo(); }  
} catch (FileNotFoundException e) { bar(); }
```

- Longstanding request to allow catching Ex1 and Ex2 together

```
try { ...  
} catch (InvalidClassException,  
         InvalidObjectException e1)  
{ foo(); }  
} catch (FileNotFoundException e2) { bar(); }
```

- Members of e1 and e2 have direct common superclass
 - `ObjectStreamException`

A faint, sepia-toned sketch of Leonardo da Vinci's Vitruvian Man is visible in the background. The figure is inscribed within a circle and a square, with lines radiating from the center, suggesting a technical or architectural drawing.

Dynamic Languages Support

Da Vinci Machine Proejct

Virtual Machines

- A software implementation of a specific computer architecture
 - Could be a real hardware (NES) or fictitious (z-machine)
- Popular in current deployments
 - VirtualBox, VMWare, VirtualPC, Parallels, etc
- “Every problem in computer science can be solved by adding a layer of indirection” – Butler Lampson
 - VM is the indirection layer
 - Abstraction from hardware
 - Provides portability

VM Have Mostly Won the Day

- Lots of languages today are targeting VM
 - Writing native compiler is a lot of work
- Why? Language need runtime support
 - Memory management, reflection, security, concurrency controls, tools, libraries, etc
- VM based systems provides these
 - Some features are part of the VM
- Lots of VM for lots of different languages
 - JVM, CLR, Dalvik, Smalltalk, Perl, Python, YARV, Rubinius, Tamarin, Valgrind (C++!), Lua, Postscript, Flash, p-code, Zend, etc

JVM Architecture

- Stack based
 - Push operand on to the stack
 - Instructions operates by popping data off the stack
 - Pushes result back on the stack
- Data types
 - Eight primitive types, objects and arrays
- Object model – single inheritance with interfaces
- Method resolution
 - Receiver and method name
 - Statically typed for parameters and return types
 - Dynamic linking + static type checking
 - Verified at runtime

JVM Specification

“The Java virtual machine knows nothing about the Java programming language, only of a particular binary format, the class file format.”

1.2 The Java Virtual Machine Spec.

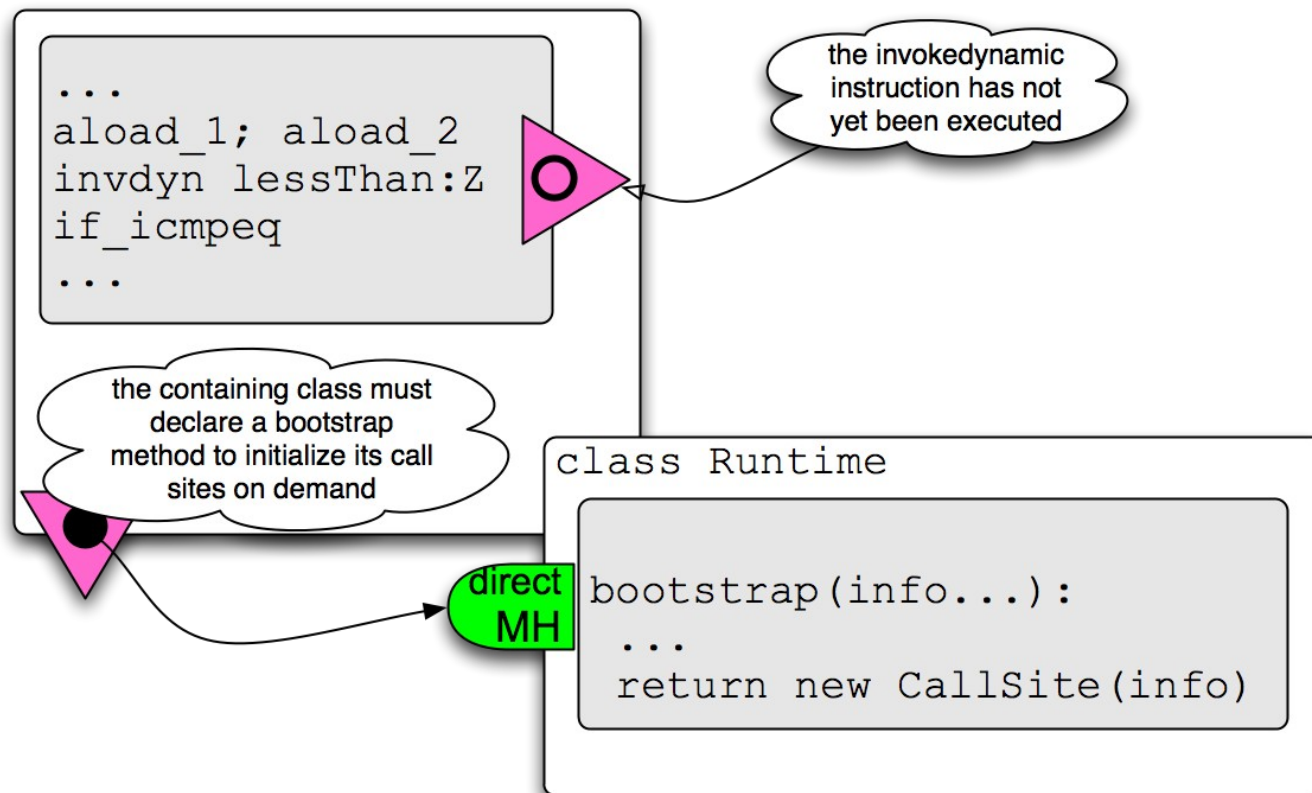
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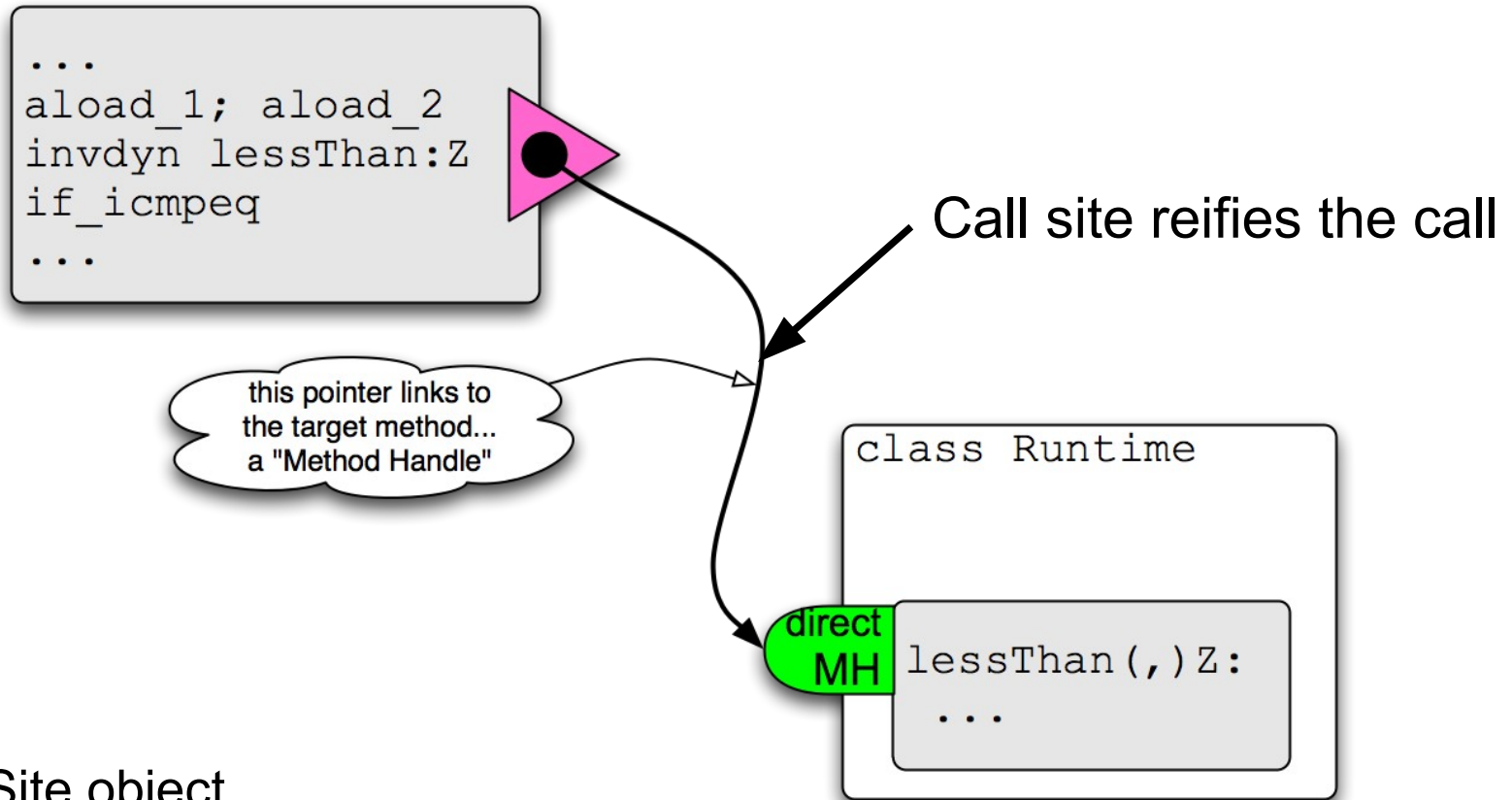
InvokeDynamic Bytecode

- JVM currently has four ways to invoke method
 - Invokevirtual, invokeinterface, invokestatic, invokespecial
- All require full method signature data
- InvokeDynamic will use method handle
 - Effectively an indirect pointer to the method
- When dynamic method is first called bootstrap code determines method and creates handle
- Subsequent calls simply reference defined handle
- Type changes force a re-compute of the method location and an update to the handle
 - Method call changes are invisible to calling code

Bootstrapping Method Handle



invokedynamic Byte Code



pink = CallSite object
green = MethodHandle object

Closures (Again)

- “I think it's time to add closures to Java”
Mark Reinhold, Devoxx (November, 2009)
- What closures won't have
 - Control invocation statements
 - Non-local returns
 - Access to non-final variables unlikely

Closures (What We Know So Far)

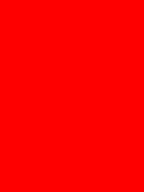
- Two key features
 - Literal syntax for writing closures
 - Function types (closures are first class types)
- Platform requires two additional features
 - Closure conversion
 - Extension methods (for existing libraries like Collections)

JDK 7 Milestone Timeline

- M5 29 Oct 2009
 - Concurrency and collections updates (jsr166y)
 - Elliptic-curve cryptography (ECC)
 - JSR TBD: Small language enhancements (Project Coin)
 - Swing updates
 - Update the XML stack
- M6 18 Feb 2010
- M7 15 Apr 2010
- M8 3 Jun 2010
- M9 22 Jul 2010
- M10 9 Sep 2010

Summary

- Lots of new things coming
 - Some not covered here
 - Includes annotations for Java type, JXLayer, date picker, etc.
- Will make Java applications smaller, more concise, easier to read and understand
- Lots of nice libraries that will exploit the hardware
 - Xrender pipeline, filesystem G1 collector, forkjoin, compressed pointer 64-bit VM, etc
- Platform will be more robust and scalable
- Coming in 2010



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