Java Applet & Netscape plug-in Integration

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Client-based WWW technologies

- Java
  - Java is an architecture-neutral programming language, not necessarily bound with WWW.
- Java applets
  - Applets are programs written in Java that are embedded in Web pages (subject to security constraints).
- JavaScript
  - JavaScript is a cross-platform scripting language to be embedded directly in HTML page and interpreted by Web browsers.
- Netscape plug-ins
  - Plug-ins are software modules that are seamlessly integrated into Navigator, appearing as supplemental capabilities of the browser.
- Netscape LiveConnect
  - LiveConnect technology encompasses plug-ins as well as facilities for integrating plug-ins with Java and JavaScript.

Inter-technology communication

native code - any language linkable with C

- Java allows one to:
  - Call native methods from Java.
  - Call Java methods from native code.

  This does not work (for security reasons) with applets.
- LiveConnect allows you to:
  - Call Java methods from plug-ins,
  - Call native methods implemented in plug-ins from Java,
  - Call Java methods from JavaScript,
  - Call JavaScript from Java methods.
- Combination of Java and LiveConnect allows:
  - Call native methods from applets,
  - Call applet methods from native code.

Applet and plug-in learn about each other via JavaScript

Inter-language capabilities

C ↔ Java ↔ J[redacted]t

Browser entities cross-aware[redacted]

Applet and plug-in learn about each other via JavaScript

Browser entities communication capabilities

Java - Native Language Communication

- The Java language uses native method modifier to declare a method implemented in another language.
- The native signature of the method as well as wrapper functions are machine generated using program javah.
- The class using native method needs to load the native library.
  - Example:
    - Create java class - file ex1.java:
      ```
      public class ex1 {
        public native int funct();
        static{ System.loadLibrary("ex1.so"); } }
      ```
    - Create java byte code ex1.class: javac ex1.java
    - Create ex1.h header file for native code: javah ex1
    - Create ex1.c stub - interface between ex1 Java class and C language: javah -stubs ex1
    - Implement native method libex1.c:
      - `#include ex1.h`
      - `funct() { ... }`
    - Compile ex1.c and libex1.c and link it into dynamic library ex1.so

Java - Plug-ins communication

- Specific for particular plug-in subclass of java.plugin.Plugin must be created and installed together with plug-in itself (NPX_PLUGIN_PATH).
- Netscape provides netscape.plugin.Plugin class which is the Java representation of the native plug-in.
- LiveConnect mechanism automatically instantiates Java class representing plug-in.
- Communication between this object and the plug-in is done the same way as in general case of Java-native code communication, except for:
  - different javah program is provided by Netscape (it must be run with additional parameter -jri)
  - one need not to explicitly load the native library - all code is in the plug-in dynamic library which is loaded automatically when necessary (Java object creation follows plug-in load).

Java - JavaScript communication

- JavaScript defines hierarchy of objects on HTML page.
- These objects are accessible from Java via LiveConnect mechanisms implemented in netscape.javascript.JSObject class.
  - For example:

    `JSObject.getWindow(this)` method returns the root of the JavaScript hierarchy;

    `JSObject.getWindow(this).getMember("document").getMember(frame_name)` returns JSObject representing Netscape frame with parameter name=frame_name
- JavaScript is aware of Java objects and can call their methods directly.
  - For example:

```
<script>package.class.method();</script>
```


Applet - plug-in communication

- Communication between applet and plug-in is done via JavaScript.
- Both `java.applet.Applet` and `netscape.plugin.Plugin` class can access JavaScript hierarchy and learn about each other.
- This way applet can call native methods against the security policy.
- Netscape Inc. vaguely defines Applet-LiveConnect interoperation: